

District I  
1625 N. French Dr., Hobbs, NM 88240  
District II  
1301 W. Grand Avenue, Artesia, NM 88210  
District III  
1000 Rio Brazos Road, Aztec, NM 87410  
District IV  
1220 S. St. Francis Dr., Santa Fe, NM 87505

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DEC 16 2010

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State of New Mexico  
Energy Minerals and Natural Resources

Oil Conservation Division  
1220 South St. Francis Dr.  
Santa Fe, NM 87505

Form C-101  
June 16, 2008

Submit to appropriate District Office

☐ AMENDED REPORT

**APPLICATION FOR PERMIT TO DRILL, RE-ENTER, DEEPEN, PLUGBACK, OR ADD A ZONE**

<sup>1</sup> Operator Name and Address Enstor Grama Ridge Storage and Transportation, LLC		<sup>2</sup> OGRID Number 234255
<sup>3</sup> Property Code 005927 301452		<sup>4</sup> API Number 40003
<sup>5</sup> Property Name GRM	<sup>6</sup> Property Name Grama Ridge Morrow Unit	<sup>7</sup> Well No. 10
<sup>9</sup> Proposed Pool 1 Grama Ridge Morrow		<sup>10</sup> Proposed Pool 2

**7 Surface Location**

UL or lot no. m	Section 3	Township 22-S	Range 34-E	Lot Idn	Feet from the 200	North/South line South	Feet from the 300	East/West line West	County LEA
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**8 Proposed Bottom Hole Location If Different From Surface**

UL or lot no.	Section	Township	Range	Lot Idn	Feet from the	North/South line	Feet from the	East/West line	County
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**Additional Well Information**

<sup>11</sup> Work Type Code N	<sup>12</sup> Well Type Code S	<sup>13</sup> Cable/Rotary R	<sup>14</sup> Lease Type Code S	<sup>15</sup> Ground Level Elevation 3,599 feet
<sup>16</sup> Multiple N	<sup>17</sup> Proposed Depth 13,500	<sup>18</sup> Formation MORROW	<sup>19</sup> Contractor Not known	<sup>20</sup> Spud Date 1/1/2011

**21 Proposed Casing and Cement Program**

Hole Size	Casing Size	Casing weight/foot	Setting Depth	Sacks of Cement	Estimated TOC
17-1/2"	13-3/8"	54.5 npf	1,850'	1,175	Surface
12-1/4"	9-5/8"	40.0 npf	5,460'	630	Surface
8-3/4"	7-0"	29.0 npf	11,500'	1,020	5,300'
6-1/8"	4-1/2"	13.5 npf	13,500'	170	11,300'

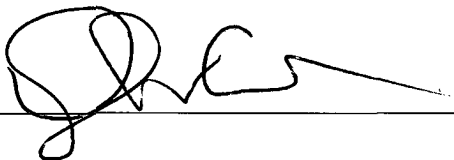
<sup>22</sup> Describe the proposed program. If this application is to DEEPEN or PLUG BACK, give the data on the present productive zone and proposed new productive zone. Describe the blowout prevention program, if any. Use additional sheets if necessary.

Drill new natural gas storage well per attached prognosis and well bore diagram.

**Permit Expires 2 Years From Approval  
Date Unless Drilling Underway**

<sup>23</sup> I hereby certify that the information given above is true and complete to the best of my knowledge and belief.

Signature:



Printed name:

Daryl W. Gee

Title:

Director, Regulatory Affairs and Land  
Management

E-mail Address:

daryl.gee@enstorinc.com

Date:

December 15, 2010

Phone:

281-374-3050

OIL CONSERVATION DIVISION

Approved by:



Title:

PETROLEUM ENGINEER

Approval Date:

JAN 05 2011

Expiration Date:

Conditions of Approval Attached ☐



## DRILLING PROGNOSIS

12/15/10

WELL: GRAMA RIDGE MORROW UNIT NO. 10  
FIELD: GRAMA RIDGE  
TYPE COMP: SINGLE CONVENTIONAL - NATURAL GAS STORAGE

EST. TD = 13,500 FT.  
MORROW A & C COMPLETION

### A. DRILLING PROGNOSIS:

1. **LOCATION:** 200' FSL AND 300' FWL OF SECTION 3, TOWNSHIP 22 SOUTH, RANGE 34 EAST, LEA COUNTY, NEW MEXICO.

<b>GEOLOGY:</b>	<b>PROJECTED FORMATION TOPS:</b>
RUSTLER	1,791'
YATES	3,941'
CAPITAN REEF	4,487'
CAPITAN REEF BASE/DELAWARE MTN TOP	5,524'
DELAWARE LS	5,460'
BONE SPRING	8,360'
WOLFCAMP	11,205'
STRAWN	11,615'
ATOKA	11,904'
MORROW LS	12,448'
MORROW CLASTICS	12,706'
MORROW A	12,789'
MORROW C	12,949'
MORROW BASE	13,220'

3. **CASING PROGRAM:**

<u>DEPTH</u>	<u>HOLE SIZE</u>	<u>CASING SIZE</u>	<u>TYPE</u>	<u>COMMENTS</u>
0' - 1,850'	17-1/2"	13-3/8"	SURFACE	CASES OFF FRESH WATER, RED BEDS, AND GRAVEL SECTIONS. SET 50' INTO RUSLTER.
0' - 5,460'	12-1/4"	9-5/8"	INTERM. I	CASES OFF SALT & CAPITAN REEF TO PREVENT LOST RETURNS & EROSION OF SALT STRINGERS. SET 100' BELOW BASE OF CAPITAN REEF.
0' - 11,500'	8-3/4"	7"	INTERM. II	CASES OFF NORMALLY PRESSURED FORMATIONS FROM ABNORMALLY PRESSURED STRAWN (POSSIBLE) AND ATOKA (PROBABLE) FORMATIONS.
11,300' - 13,500'	6-1/8"	4-1/2"	PROD	CASES OFF ABNORMALLY PRESSURED FORMATIONS AND MORROW SANDS, AND GIVES 200' OF CASED CELLAR BELOW MORROW INTERVAL

#### CASING SPECIFICATIONS AND DESIGN FACTORS:

TYPE	INTERVAL	LENGTH	SIZE- OD	WT/GRADE/THREAD	SF COLLAPSE	SF BURST	CONN SF TENSION
Surface	0-1,850'	1,850'	13-3/8"	54.5 ppf/J-55/BTC	1.125	1.250	1.50
INTERMED I	0-5,460'	5,460'	9-5/8"	40.0 ppf/N-80/LTC	1.125	1.250	1.50
INTERMED II	0-11,500'	11,500'	7-0"	29.0 ppf/P-110/LTC	1.230	1.375	1.50
LINER	11,300'-13,500'	2,200'	4-1/2"	13.5 ppf/P-110/Ultra FJ	1.125	1.250	1.50

- Notes:
- Centralizers will be run on all casing strings, including surface casing.
  - 7-0" casing and 4-1/2" liner are designed for fracturing down the casing.
  - All casing will be new and manufactured to API specifications.

#### **4. MUD PROGRAM:**

<u>DEPTH</u>	<u>TYPE</u>	<u>WEIGHT (PPG)</u>	<u>WATER LOSS (CC)</u>	<u>Ph</u>
0-1850'	FRESH WATER	9.0	NC	9.5-10.0
1,850'-5,460'	BRINE WATER	10.0	NC	9.0-9.5
5,460'-11,500'	FRESH WATER	8.6	NC	10.0-10.5
11,500'-13,500'	BRINE WATER	10.0-12.8	6-12	10.0-10.5

#### MUD PROGRAM CONSIDERATIONS:

<u>DEPTH INTERVAL</u>	<u>CONSIDERATIONS</u>	<u>COMMENTS</u>
0-1,850'	LOST CIRCULATION	TREAT W/ LOST CIRCULATION MATERIAL
1,850'-5,460'	LOST CIRCULATION	TREAT W/ LOST CIRCULATION MATERIAL. IF CIRCULATION IS LOST AND CANNOT BE REGAINED BELOW BASE OF SALT, A FRESH WATER MUD WILL BE USED TO 5,460'
5,460'-11,500'	NO KNOWN PROBLEMS	MAINTAIN MINIMAL MUD WEIGHT
11,500'-13,500'	ABNORMAL & SUBNORMAL	MAINTAIN MINIMAL MUD WEIGHT, TREAT WITH LOST CIRCULATION MATERIAL, INCREASE WEIGHT AS NEEDED

#### ANTICIPATED HIGH PRESSURES BELOW 11,500':

- POSSIBLE STRAWN PRESSURE 7,500 PSI (~12.4 ppg). STRAWN HAS BEEN PRODUCED IN A SECTION 3 WELL AND SECTION 10 WELL.
- PROBABLE ATOKA PRESSURE 8000 PSI (~12.8 ppg). NO PRODUCTION FROM THE ATOKA. 1980 DST IN LLANO 3 (SECTION 3) ~8,000 PSI.
- VIRGIN PRESSURE IN THE MORROW IN THE GRMU WELLS DRILLED IN 1965 (GRMU #1 AND #4) WAS ~8000 PSI (~12 ppg) AND WAS ~6,500 PSI (~9.8 ppg) IN GRMU #7 DRILLED IN 1989.

#### ANTICIPATED DEPLETED PRESSURES IN MORROW:

- MORROW LS @ 12,448' ~650 PSI. PUMP IN PRESSURE IN LS PERFS IN GRMU #7 PRIOR TO SZQ JOB 11/2009 WAS 7.5 GPM @ 7,200 PSI BHP (10.9 PPG)
- MORROW A @ 12,789' ~4,500 PSI -GAS STORAGE (GRMU #4);
- MORROW C @ 12,949' +/-1,000-2,000 PSI-GAS STORAGE (GRMU #7).
- FRAC PRESSURE IN MORROW C WAS 13.3 ppg IN GRMU #7, NOVEMBER 2010. BHP ESTIMATED TO BE ~500 PSI AT THE TIME.
- NEGLIGIBLE H2S HAS BEEN REPORTED IN AREA AND MONITORING EQUIPMENT WILL BE ONSITE FOR DETECTION.

## 5. CEMENTING PROGRAM:

<u>CASING</u>	<u>PROPOSED CEMENT DESIGN</u>
1,850' 13-3/8"	CEMENT TO SURFACE WITH 875 SACKS OF CLASS 'C' CEMENT W/4% GEL + 2% CACL <sub>2</sub> (ACCELERATOR) MIXED AT 13.5 PPG (YIELD=1.75 FT <sup>3</sup> /SK). TAIL IN W/300 SACKS CLASS 'C' CEMENT + 2% CALCIUM CHLORIDE (ACCELERATOR) MIXED AT 14.8 PPG (YIELD=1.35 FT <sup>3</sup> /SK.) THIS VOLUME GIVES A 60% EXCESS OVER A GAUGE HOLE. PLACE CENTRALIZERS AT 5' & 15' ABOVE THE SHOE AND OVER EVERY 4TH COLLAR TO SURFACE. PUMP A FLUID CALIPER PRIOR TO COMING OUT OF THE HOLE TO RUN CASING, TO CHECK THE HOLE VOLUME. ADJUST CEMENT VOLUMES, IF NECESSARY. IF CEMENT DOES NOT REACH SURFACE, A TEMPERATURE LOG WILL BE RUN TO VERIFY TOP OF CEMENT.
5,460' 9-5/8"	CEMENT TO SURFACE USING A MULTI-STAGE CEMENTER (DV TOOL) AT ~4,000': <b><u>PUMP STAG 1</u></b> -WITH 380 SACKS OF CLASS 'C' LIGHT CEMENT (65:35) WITH 3% SALT, MIXED AT 12.9 PPG (YIELD=1.84 FT <sup>3</sup> /SK.), FOLLOWED BY 250 SACKS OF CLASS 'C' NEAT CEMENT MIXED AT 14.8 PPG (YIELD=1.33 FT <sup>3</sup> /SK.). A CALIPER LOG WILL BE RUN TO DETERMINE FINAL CEMENT VOLUMES.  <b><u>PUMP STAGE 2</u></b> - WITH 990 SACKS OF CLASS 'C' LIGHT CEMENT (65:35) WITH 3% SALT, MIXED AT 12.9 PPG (YIELD=1.84 FT <sup>3</sup> /SK.), FOLLOWED BY 250 SACKS OF CLASS 'C' NEAT CEMENT MIXED AT 14.8 PPG (YIELD=1.33 FT <sup>3</sup> /SK.) THIS GIVES 100% EXCESS OVER A GAUGE HOLE, PLUS 10% EXCESS INSIDE THE 13-3/8" CASING. PLACE CENTRALIZERS AT 5' & 15' ABOVE THE SHOE, AND OVER THE FIRST 10 COLLARS, AND 10' ABOVE AND BELOW THE DV TOOL. FINAL CEMENT VOLUMES WILL BE DETERMINED FROM A CALIPER LOG.
11,500' 7-0"	CEMENT UP ANNULUS INSIDE THE 9-5/8" CASING TO 160' ABOVE THE CASING SEAT, PUMP 820 SACKS OF LIGHT CLASS 'H' LEAD CEMENT WITH 3% SALT, MIXED TO 12.9 PPG (YIELD= 1.85 FT <sup>3</sup> /SK.), FOLLOWED BY 200 SACKS OF CLASS 'H' NEAT WITH 0.2% HR-601 RETARDER, MIXED TO 15.6 PPG (YIELD= 1.19 FT <sup>3</sup> /SK.). THIS GIVES 100% EXCESS IN THE OPEN HOLE AND 10% EXCESS INSIDE THE 9-5/8" CASING. PLACE CENTRALIZERS AT 5' & 15' ABOVE THE SHOE, AND THEN EVERY 2 <sup>ND</sup> JOINT FOR THE NEXT 600'. FINAL CEMENT VOLUMES WILL BE DETERMINED FROM A CALIPER LOG, AND CEMENT WILL EXTEND TO AT LEAST 150 FT INSIDE 9-5/8" CASING.
13,500' 4-1/2"	CEMENT ENTIRE ANNULUS BACK UP TO LINER HANGER INSIDE 7" CASING USING 170 SACKS OF CLASS 'H' (SUPER 'H' BLEND) CEMENT W/ 1.0 LBM./SX. SALT + 0.4% HALAD R-344 LOW FLUID LOSS CONTROL (SIMILAR TO GAS STOP) + 0.3% CFR-3 DISPERSANT + 0.2% HR-601 RETARDER, MIXED AT 13.0 PPG (TO PREVENT FRACTURE OR LOST RETURNS IN THE OBJECTIVE INTERVAL) YIELD= 1.68 FT <sup>3</sup> /SK. IF EXCESSIVE GAS IS ENCOUNTERED, ADD ADDITIONAL R-344. USE ROTATING LINER HANGER AND ROTATE THE CASING IF POSSIBLE TO OBTAIN A GOOD CEMENT JOB.

CEMENT VOLUMES WILL BE ADJUSTED FOR ANY BOREHOLE CALIPERS RUN. WAITING TIME ON CEMENT WILL BE ADEQUATE TO ACHIEVE A MINIMUM 500 PSI COMPRESSIVE STRENGTH, AND NO LESS THAN 18 HOURS.

## 6. BIT PROGRAM:

<u>RUN NO.</u>	<u>BIT SIZE</u>	<u>BIT TYPE</u> <u>OR EQUIV. DEPTH OUT</u>	<u>EST. DRILL</u> <u>TIME (HRS.)</u>	<u>ROP</u>	<u>BIT WT.</u>	<u>RPM</u>	<u>ALTERNATIVE</u> <u>PDC BITS</u>
1	17-1/2"	GT-C1	1,750'	44	40	25-45	70-80
2	12-1/4"	GX-28C	4,800'	102	30	40-70	50-70
3	12-1/4"	GX-38C	5,460'	22	30	40-70	50-70
4	8-3/4"	VG-E28CH	9,300'	96	40	40-50	50-70
5	8-3/4"	VG-E44C	11,500'	88	25	40-50	50-70
6	6-1/8"	STX-40	12,000'	50	10	15-30	50-70 FMHX543ZZ
7	6-1/8"	STX-50	12,700'	70	10	15-30	50-70
8	6-1/8"	XR40Y	13,500'	80	7	15-30	50-70 FMHX543ZZ

**7. DRILLING MECHANICS:**

- a. USE AVAILABLE HORSEPOWER OF MUD PUMPS TO MAXIMIZE HYDRAULIC HORSEPOWER TO BIT AND FOR HOLE CLEANING.
- b. USE 4-1/2" DRILL PIPE TO 11,500' AND CHANGE TO 3-1/2" DRILL PIPE TO TD.
- c. HAVE LOST CIRCULATION MATERIAL AND PILLS READY ON HAND TO COMBAT LOST CIRCULATION IN ALL PORTIONS OF THE HOLE.
- d. USE CLOSED LOOP MUD SYSTEM & STEEL MUD TANKS. OPTIMIZE SOLIDS CONTROL EQUIPMENT WITH RIG FURNISHED AND RENTAL EQUIPMENT.

**8. WELL CONTROL EQUIPMENT:**

- a. BLOWOUT PREVENTER (BOP) EQUIPMENT (SCHEMATICS OF THE BOP CONFIGURATIONS ARE ATTACHED):

<u>DEPTH</u>		
1,850' – 5,460'	5,000 PSI	BOP STACK – PIPE AND BLIND RAMS & ANNULAR BOP
5,460' – 11,500'	5,000 PSI	BOP STACK – PIPE AND BLIND RAMS & ANNULAR BOP
11,500' – TD	10,000 PSI	BOP STACK – 2 PIPE AND BLIND RAMS & ANNULAR BOP
- b. BOPS AND RELATED PRESSURE ACCUMULATOR SYSTEMS WILL BE CONFIGURED ACCORDING TO BLM DRILLING OPERATIONS ONSHORE ORDER NUMBER 2.
- c. FLOOR CONTROLS FOR BOP'S WILL BE OPERABLE FOR 3K PSI AND GREATER BOP SYSTEMS.
- d. PRIOR TO DRILLING OUT OF EACH CASING STRING, THE BOPS AND CASING SEATS WILL BE TESTED BY AN INDEPENDENT TESTING COMPANY USING A TEST PLUG AND TESTED ACCORDING TO BLM DRILLING OPERATIONS ONSHORE ORDER NUMBER 2. TEST RESULTS WILL BE RECORDED ON PASON AND WILL INCLUDE A LOW PRESSURE 250-300 PSI TEST AND HIGH PRESSURE TEST.
- e. BOPS WILL BE FUNCTIONALLY OPERATED AT A FREQUENCY PRESCRIBED IN BLM DRILLING OPERATIONS ONSHORE ORDER NUMBER 2.
- f. ADDITIONAL WELL CONTROL EQUIPMENT WILL CONSIST OF A DRILLING SPOOL, WITH 2 SIDE OUTLETS FOR THE CHOKE MANIFOLD & KILL LINE.
- g. 5K PSI AND 10K PSI SYSTEMS WILL HAVE AN HCR VALVE, REMOTE KILL LINE AND ANNULAR TO MATCH. THE REMOTE KILL LINE WILL BE INSTALLED PRIOR TO TESTING THE SYSTEM AND TESTED TO STACK PRESSURE.
- h. A 5K PSI CHOKE MANIFOLD WILL BE USED WITH THE 5K PSI BOP STACK, AND A 10K PSI MANIFOLD WILL BE USED WITH THE 10K PSI BOP STACK. THE MANIFOLDS WILL BE CONFIGURED ACCORDING TO BLM DRILLING OPERATIONS ONSHORE ORDER NUMBER 2.
- i. UPPER AND LOWER KELLY COCKS WILL BE IN THE DRILL STRING AT ALL TIMES.
- j. A FULL OPENING DRILL PIPE STABBING VALVE WITH APPROPRIATE CONNECTIONS WILL BE ON THE RIG FLOOR AT ALL TIMES.
- k. A ROTATING HEAD WILL BE INSTALLED ON BOTH THE 9-5/8" AND 7" CASINGS.
- l. A MUD-GAS SEPARATOR AND FLARE LINE WILL BE USED TO DRILL THE 8-3/4" AND 6-1/8" HOLES.

- m. MUD SYSTEM MONITORING EQUIPMENT WITH AUDIO AND VISUAL ALARMS WILL BE OPERATING PRIOR TO DRILLING INTO THE WOLFCAMP FORMATION AND SHALL BE USED UNTIL PRODUCTION CASING IS RUN AND CEMENTED.

**9. FORMATION EVALUATION:**

- a. OPEN HOLE ELECTRIC LOGS:

SURFACE – 5,460’ 5,460’ – 11,500’ 11,500’ – TD	GAMMA RAY-NEUTRON LOG + CALIPER LOG FROM 5,450’ TO 1,750’. SONIC LOG (Simple Compression Wave), GAMMA RAY-NEUTRON LOG PLATFORM EXPRESS (RESISTIVITY, NEUTRON POROSITY, BULK DENSITY), GAMMA RAY NEUTRON AND SONIC (Simple Compression Wave) LOG.
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- b. XPT IN MORROW, DEPTHS TBD.
- c. SAMPLE PROGRAM. MUD LOGGER PLACED ON WELL AT 10,000’ TO TD.
- d. DRILL STEM TEST - NONE PLANNED.

**10. OTHER:**

EVEN THOUGH H2S IS NOT ANTICIPATED, AS A SAFETY PRECAUTION, H2S SENSORS WILL BE KEPT ON THE RIG FLOOR, AROUND BOPS AND ON SHALE SHAKER THROUGHOUT THE DRILLING OPERATION.

**11. WELLHEAD EQUIPMENT:**

A-SECTION	13-3/8” SOW 3 KPSI WP CASING HEAD, W/ LANDING BASE
B-SECTION	13-3/8”, 3 KPSI WP X 11”, 5 KPSI WP CASING SPOOL.
C-SECTION	11”, 5 KPSI WP X 7-1/16”, 10 KPSI WP TBG. HD. SPOOL.
TREE ASSY.	7-1/16”, 10 KPSI WP TREE WITH 2 MV’S, CROSS, ADAPTER FLANGE W/TREE CAP, 2 WINGS WITH EACH HAVING A 4-1/16”, 10 KPSI WP MANUAL VALVE & A 4-1/16”, 10KPSI OPERATED VALVE.

**12. ANTICIPATED SCHEDULE:**

- a. LOCATION CONSTRUCTION WILL BEGIN AFTER THE OCD HAS APPROVED THE DRILLING PERMIT.
- b. THE WELL WILL BE SPUDDED AS SOON AS THE ROAD AND LOCATION HAVE BEEN CONSTRUCTED, DEPENDING ON RIG AVAILABILITY.
- c. IT IS ESTIMATED THE DRILLING OPERATION WILL TAKE 60 DAYS.

## **B. COMPLETION PROGNOSIS:**

### **1. CASED HOLE LOGGING & PERFORATING**

#### **a. LOGGING:**

4,000' – TD	CEMENT BOND LOG
SURFACE – 13,500'	GAMMA RAY-NEUTRON LOG
SURFACE – 13,500'	CASING INSPECTION LOGS

#### **b. PERFORATING:**

THE MORROW C WILL BE PERFORATED AND FRACTURE TREATED THEN THE MORROW A WILL BE PERFORATED AND FRACTURED.

### **2. STIMULATION**

- a. MORROW C: AFTER PERFORATING, THE MORROW C WILL BE STIMULATED WITH A CO2 FRAC TREATMENT.
- b. MORROW A: AFTER TREATING AND FLOWING BACK THE MORROW C, A PLUG WILL BE SET ABOVE THE MORROW C AND THE MORROW A WILL BE CO2 FRAC STIMULATED. FOLLOWING FLOWBACK, THE PLUG WILL BE DRILLED OUT AND TUBING RUN.

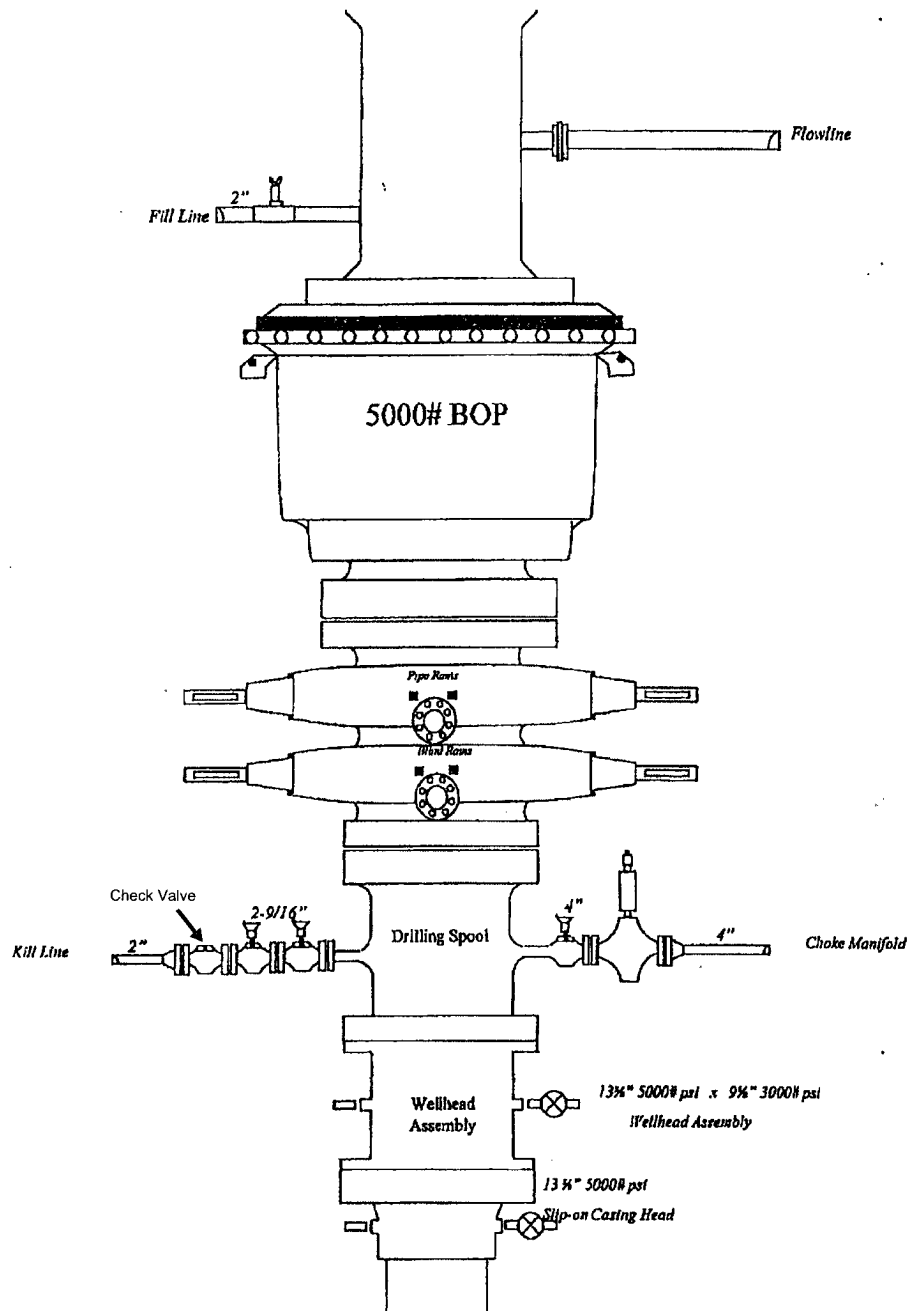
### **3. TUBING**

<u>DEPTH</u>	<u>TUBING</u>
0 - 11,150'	4-1/2" OD, 15.5 PPF, L-80, RTS-6 OR EQUIVALENT CONNECTION
11,150'-12,700'	2-7/8" OD, 6.4 PPF, L-80, FJ SET ON PACKER =<100' ABOVE MORROW A PERFS

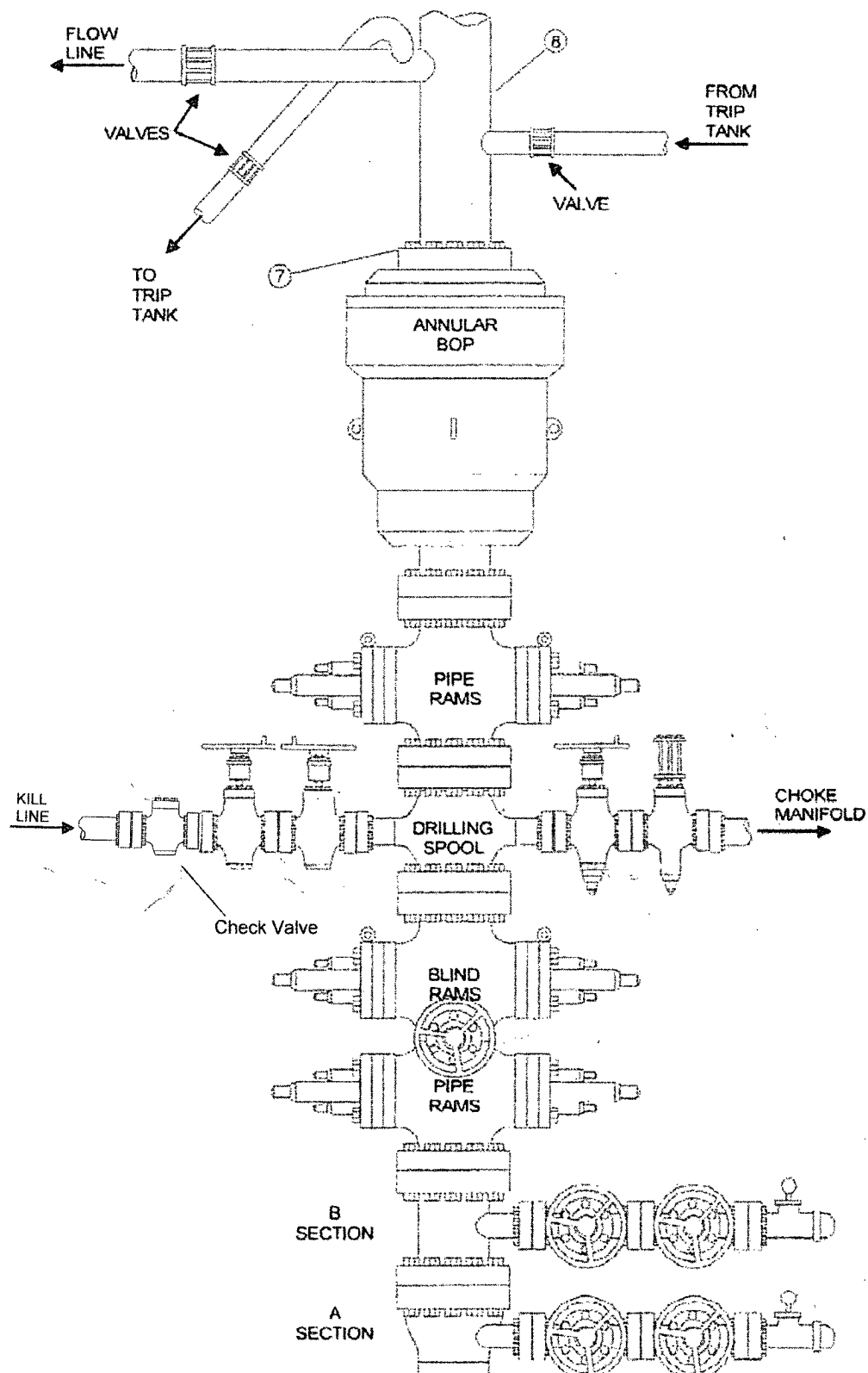
### **4. ANTICIPATED SCHEDULE: IT IS ESTIMATED IT WILL TAKE 60 DAYS TO COMPLETE THE WELL**

### **5. SCHEMATIC: SEE ATTACHED WELLBORE SCHEMATIC.**





5000# BOP Stack



10,000 psi BOP Stack

**4-1/16" 15M  
Centerline Manifold**

