Appendix E. Eight Point Drilling Program

Bull Mountain Unit
Federal Unit #: COC-067120X
Gunnison County, CO

Drilling plans in the Bull Mountain Unit at this time cover vertical coalbed methane wells and horizontal shale wells. Due to specific constraints at certain locations, directional wells may be drilled, but this is the exception. A brief description of the drilling program will be included in this section touching on cementing plans, drilling fluid to be used, and log offsets for the specific well.

1. Estimated formation tops:

Table E-1. Estimated Depth, Formation Tops[1]

Formation/Group	Depth of Top (feet)
Mesaverde Group	
• Coal Ridge Coal	2600-4600
• South Canyon	3100-4700
• Cameo Coal	3500-5300
• Rollins Sandstone	3580-5400
• Cozette	4600-6300
• Corcoran	4600-6300
• Mancos Shale	4200-4850
Dakota Group	8500-9670

[1] General range for measured depth to formation tops in the Bull Mountain Unit. Specific measurements included on APDs will differ.

2. Estimated depth and thickness of formations:

Table E-2. Estimated Depth and Thickness of Gas Formations [1]

Name	Depth (feet)	Thickness (feet)
Cameo	2800-3660	100
Cozzette-Corcoran	3900-5150	300
Mancos	5500	3,000

[1] Estimates for depth and thickness of formations with gas that have been targeted to date.

3. Minimum Specifications for Pressure Control Equipment:

Blowout preventer (BOP) equipment and accessories will meet or exceed BLM requirements outlined in 43 CFR Part 3160. A 3,000 or a 5,000 psig double ram hydraulic BOP will be used (a diagram of the specific device will be attached) for the intermediate portion of the well (400 – 5400 feet). Maximum anticipated surface pressure is 2,300 – 2,500 pound-force per square inch gauge (psig). Accessories to the BOP will meet BLM requirements for the system used. The accumulator system capacity will be sufficient to close all BOP events with a 50% safety factor. Fill line, kill line, and line to choke manifold will be 2 inches in diameter. BOPs will be function-tested every 24 hours and will be recorded on the log. Surface casing will be tested to 1,500 psig for 30 minutes.

Accessories to BOPE will include upper and lower Kelly cocks with handles, stabbing valve to fit drill pipe on floor at all times, string float at bit, 3,000 or 5,000 psig choke manifold with 3" adjustable and 3" positive chokes, and pressure gauge.

4. Casing and Cementing Program:

Table E-3 provides an example of a typical casing and cementing program for a horizontal shale well:

Table E-3. Typical Casing and Cementing Program, Horizontal Shale Well

String	Size of Hole (inches)	Size of Casing (inches)	Weight Per Foot (lbs)	Grade	Setting Depth (MD, feet)	Sacks Cement	Cement Bottom (feet)	Cement Top (feet)
Conductor	26	20	106.5	X-42/A-53	80	100	80	Surface (0')
Surface	16	13.375	54.5	J-55	400	260	400	Surface (0')
1st Inter.	12.125	9.625	40.0	J-55	5,500	1,280	5,500	Surface (0')
2nd Inter.	8.5	7	29.0	P-110	9,074	355	9,074	5,300
Prod. Lnr.	6.125	4.50	13.5	P-110	12,727 – 8,110	235	12,727	8,100

Table E-4 provides an example of a casing and cementing program for a vertical coalbed methane well in the Bull Mountain Unit.

Table E-4. Typical Casing and Cementing Program, Vertical Coalbed Methane Well

String	Size of Hole (inches)	Size of Casing (inches)	Weight per Foot (lbs)	Grade	Setting Depth (feet)	Sacks Cement	Cement Bottom (feet)	Cement Top (feet)
Surface	12.25	9.625	24	J-55	300	210	300	Surface
Production	8.5	5.5	17	J-55	3,600	1st stage: 220 2nd stage: 300 + 100	3,600	Surface

5. Mud Program:

In general, the mud program is as follows:

A native water-based spud mud system (FW) will be used for the surface hole. The primary product used will be gel for viscosity control. A low-solids, non-dispersed gel system (LSND) will be used throughout the intermediate hole as well as the production hole. Products used may include but not be limited to: Barite for weighting material, gel for viscosity control, lime for alkalinity control, Pac LV for fluid loss, Desco for rheological control and to reduce gel strengths, and lost circulation materials (LCM) such as fibers, sawdust or walnut shells. Solids control equipment will include shakers and a centrifuge. Fluid densities will be maintained as low as possible to drill with minimal over-balance to reduce the possibility of losing returns and/or of differentially sticking the drill sting. Hole conditions and drilling parameters will be monitored closely for indications of increases in formation pressures. Fluid densities will be adjusted accordingly. Optimum hydraulics will be maintained to provide maximum hole cleaning and minimize washout of the wellbore. Rheological properties will be adjusted for optimum bit hydraulics, penetration rates and minimize drag forces on the wellbore. Holes conditions and mud properties will be optimized prior to running logs, running casing and cementing. Adequate amounts of lost circulation and weighting material will be on location if needed as well as sorbitive agents to handle potential spills of

fuel or lubricants. The maximum mud weight (12.2 parts per gallon, or ppg) was experienced at intermediate casing point (+/-5,400 feet).

Table E-5. Drilling Mud Program

Depth (feet)	Type	Weight (parts per gallon)	Viscosity (seconds per quart)	Water loss (cubic centimeters)	Solids
0 – 400	FW	± 8.5 – 8.70	30 – 40	26 up to no control[1]	<7%
400 – 5,400	LSND	± 8.7 – 12.2	40 – 70	6 – 8	<7%
5,400 – Total depth	LSND	± 9.0 – 10.0	40 – 70	6 – 8	<7%

[1] Due to the rapid speed of drilling through the first 400 feet, combined with short turnaround time to setting of surface casing, the amount of water loss in this segment cannot be controlled.

6. Testing, Coring, and Logging Program:

Generally, no drill stem tests or cores are planned. Open-hole logs to include:

- gamma ray, induction, caliper, and density logs from 5,400 to 400 feet; and
- gamma ray, induction, caliper, density, and formation micro-imaging logs from total depth to 5,400 feet.

7. Anticipated Drilling Conditions (pressures, tempera tures, l ost circulati on, hydroge n sulfide, etc.):

Abnormal temperatures or pressures that SG expects to encounter during drilling will be discussed in this section. Lost circulation is possible. If encountered, lost circulation material will be maintained on location. Intermediate casing will be set at approximately 5,400 feet to isolate potential shallower lost circulation zones. Both the intermediate and long strings will have two stage cementing jobs performed. No hydrogen sulfide (H_2S) is expected in new wells in the unit. H_2S been not been encountered in the drilling of any previous wells.

8. Operations:

Anticipated spud date will be included in this section, along with the estimated drilling timeframe. Completion details will also be included in this section, such as whether hydraulic fracturing will be used and an approximate timeframe for completion.

Figure E-1. 5-M Choke Manifold Diagram

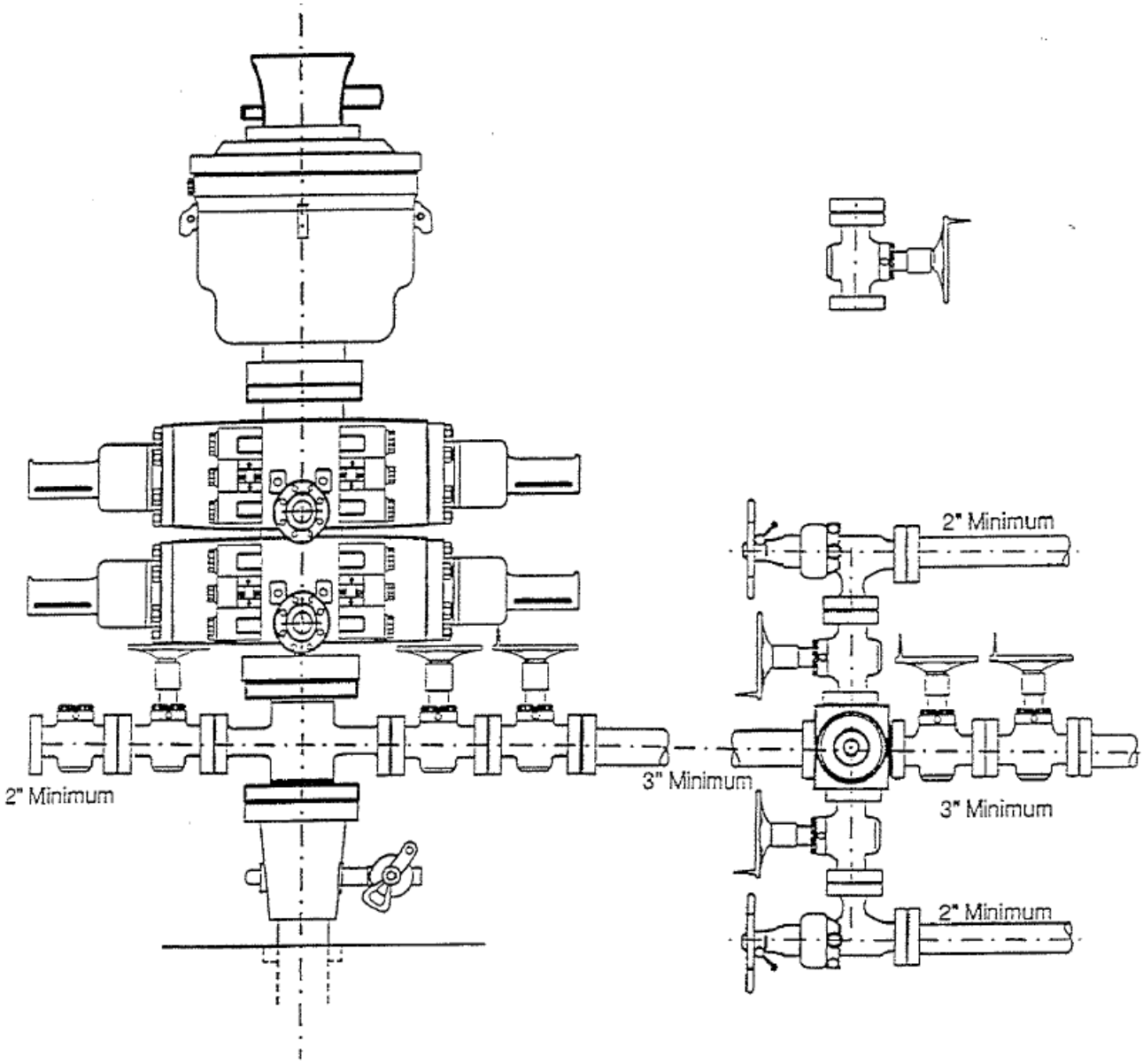
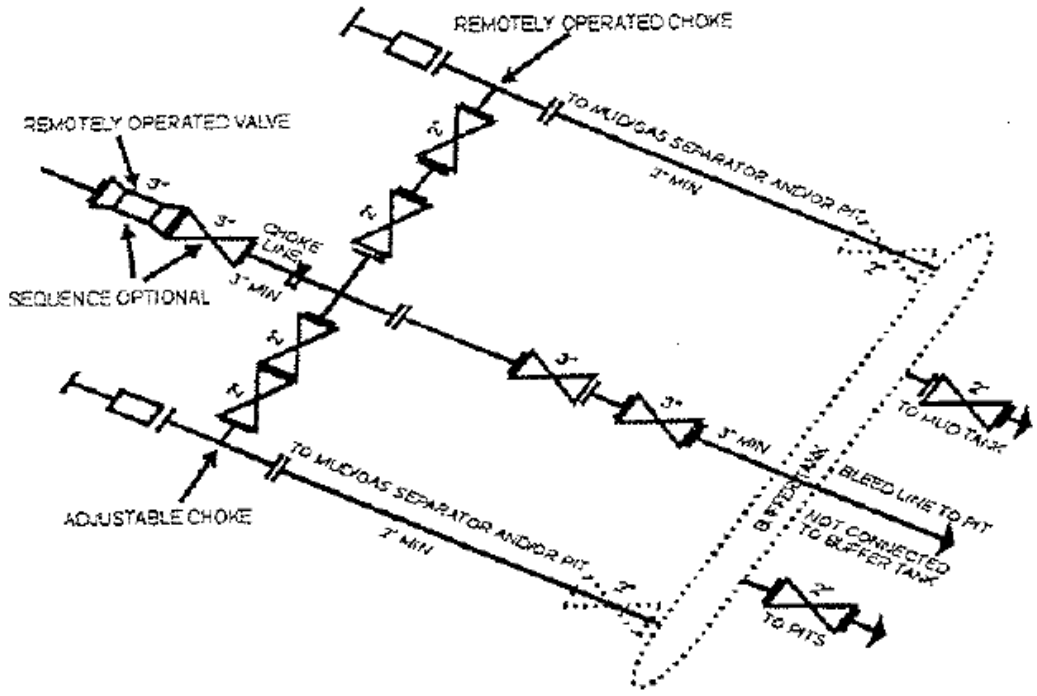


Figure E-2. 5-M Choke Manifold Diagram

(Configuration of chokes may vary)



Although not required for any of the choke manifold systems, buffer tanks are sometimes installed downstream of the choke assemblies for the purpose of manifolding the bleed lines together. When buffers are employed, valves shall be installed upstream to isolate a failure or malfunction without interrupting flow control. Though not shown on 2M, 3M, 10M, or 15M drawings, it would also be applicable to those situations [54 FR 39528, Sept. 27, 1989].