

The Office of Oil and Gas; Oil and Gas Wells
West Virginia Department of Environmental Protection
Chapter §22 Article 1, Article 6 and Article 6A Office of Oil and Gas
Chapter §22C Article 9 Oil and Gas Conservation

WELL SITE SAFETY PLANS *and Collision Avoidance Protocol*

- **Deep Well Policy Statement**
- **Natural Gas Horizontal Well Control Act §22-6A**

West Virginia
Oct 7th, 2015





Site Safety Plans

- Prevention measures
- Protection procedures
- Action protocols necessary

Well Site Safety Plans

✓ Authority requirements by:

- Deep Well Policy Statement
- Natural Gas Horizontal Well Control Act
§22-6A

• Deep Well Policy Statement by the

❑ Office of Oil and Gas

❑ Oil and Gas Conservation Commission

Agreement Policy REVISED - October 22nd, 2012 [[doc1](#)]

Requires Site Safety Plans -

ALL - DEEP PERMITTED WELLS

✓ Site specific Safety Plan must be submitted with each deep well application...

which cover and include -

✓ Deep Well Drilling Procedures and the Site Safety Plan Requirements

OIL AND GAS CONSERVATION COMMISSION
AND
OFFICE OF OIL AND GAS

Policy Statement
Deep Well Drilling Procedures
And Site Safety Plan Requirements

The drilling of wells to new and untapped producing horizons has increased significantly in the past year. The recent trend involves the drilling of wells depths of 10,000-14,000 feet with the potential for encountering very high

The Oil and Gas Conservation Commission and the Office of Oil and Gas have the required authority and believe that it is necessary to issue this Policy setting forth minimum requirements for necessary equipment and procedures that must be addressed in a Safety Plan ("Plan") which shall be approved prior to drilling a deep well. A deep well shall be defined as any well to be drilled as provided for in Chapter 22C, Article 7 of the West Virginia Code.

A site specific Safety Plan must be submitted with each deep well application and shall be maintained and available at the drilling site. The minimum address the following items:

Site Requirements:

1. The Plan shall provide a map indicating the location, access road, and nearby dwellings, and take into consideration the direction.
2. Topographic map of well location.

Site Safety Plan

A Safety Plan shall be filed prior to beginning drilling operations. A person shall be employed and involved in the drilling operations and including the district oil and gas inspector or

- **§22-6A Well Site Safety Plans**

Submit with each well permit application

- ✓ Applies to any natural gas well drilled using a horizontal drilling method *provided . . .*
 - Well site disturbance of three acres or more of surface
 - Utilizes more than two hundred ten thousand gallons of water in any thirty day period
- ✓ Address measures to be employed by the operator
- ✓ Protection of persons on the site, as well as the general public and the environment.

- **§22-6A Well Site Safety Plans**

Site Safety Plans are promulgated by . . .

§35-8- Rules Governing Horizontal Well Development (Legislative Rule)

sec. 1.1. Scope. -- This rule shall govern and apply to proceedings under W. Va. Code §22-6A-1, et seq., related to horizontal wells. Certain portions of this rule also govern and apply to W. Va. Code § 22-12-1, et seq., related to groundwater protection.

1.2. Authority. -- W. Va. Code §§ 22-1-3 and 22-6A-6(a)(4).

1.3. Filing Date. -- April 21, 2014

1.4. Effective Date. -- June 1, 2014

- **§35-8-5.7 Well Site Safety Plan**
Emphasis and Scope necessities . . .
 - ✓ Encompass all aspects of the operations
 - **actual well work during drilling, completion , and production activities**
 - ✓ Provide emergency point of contact
 - ✓ Provide copy to the *LEPC at least 7 days prior to well work or site construction

**WV HSEM Information
1(304)558-5380*

Well Site Safety Plan Standards

General Summary of Criteria Needs

- Siting: site descriptions, topographic view
- LEPC emergency planning and ER familiarizations
- Safety meetings, contacts, evacuations
- MSDS availability and where
- Well bore program, casing/cementing
- Strata incl. abnormal expectations
- Well control & BOP equipment
- Testing measures and schedules, training
- Well flaring operations & kill procedures
- H2S operations and handling
- Wellbore collision avoidance protocols
- Notification method and protection zones

Preamble to Site Safety Plans

§35-8-5.7.a. Rules Governing Horizontal Development

- All well applications shall be accompanied by a well site safety plan (SSP)
- SSP shall address proper safety measures employed to protect:
 - ✓ The Persons on the well site, and
 - ✓ The General Public in the area surrounding the well site
- Each SSP shall be specific to the well site and the surrounding area as described in the well permit application
- SSP shall encompass all aspects of the operation including:
 - ✓ Actual well work for which the permit is sought
 - ✓ Anticipated MSDS Sheets, and
 - ✓ Drilling, completion, production, and work-over activities
- SSP shall be made available on the well site during all phases of the operation
- SSP provides an emergency point of contact and twenty-four (24) hour contact information for the well operator
- SSP copy shall be provided to the County LEPC at least seven (7) days prior to well work or site/land disturbance
- SSP shall be provided to the surface owner and any water purveyor or surface owner subject to notice and water testing as provided in section 15 of this rule
- **The Operator should work closely with the local responders to familiarize them with potential incidents that are related to oil and gas development, so that the local first responders have the information they need to provide the support necessary for the operator to implement the well site safety plan.**

Site Safety Plan - OUTLINE

Descriptive Availability On-line [[doc2](#)]

- **Site Safety Plan Table of Contents . . .**
 1. Contacts, Schedules, ER coordination, and Meetings
 2. Maps and Diagrams
 3. Well Work Descriptions
 4. Chemical Inventory & MSDS
 5. BOP and Well Control
 6. Hydrogen Sulfide (H₂S)
 7. Flaring
 - 8. Collision Avoidance Safeguards, Practices and Standards**
 9. Deep Well Additional Requirements (Deep Well Distinction)
 10. Deep Vertical Well Requirements per Policy Statement*

**selections are needed from the above contents*

Collision Avoidance Protocol Plans and Outline*

Descriptive Availability On-line [[doc3](#)]

Established minimums are in pursuance to:

§35-8-5.7.c.7. Rules Horizontal Development

A protocol and established safeguards designed to prevent underground collisions during any drilling on multi-well pads.

* **Table of Contents . . .**

Introduction - Purpose and Scope

A. Established definitions

B. Established descriptions of risk

C. Plan components

Preamble to Collision Avoidance Safeguards, Practices and Standards Plan

Introduction and Recognition - Purpose and Scope

- ✓ *Measures keeping wellbores separated and HSE restrained*
- ✓ *Recognizes survey accuracy and the survey maintenance*
- ✓ *Shall be well specific to the proposed wellbore*
- ✓ *Shall address all items within the contents outlined*
- ✓ *Shall provide survey designs throughout the proposed wellbore including the QC / QA activities and the counter-actions necessary*
- ✓ *Minimum separation factors and standards apply*
- ✓ *Shall include proposed counter-actions necessary if a collision occurs **or** if surveys observe an imminent risk for a collision*
- ✓ *All wellbore collisions shall be treated as high-risk events*
- ✓ *Approved plans are conditions and terms of the well permit and any modifications are subject to approval*

Collision Avoidance Safeguards, Practices and Standards Plans

A. Established definitions:

- ✓ Proposed Wellbore - vertical top-hole, the curve, and the lateral.
- ✓ Nudging - intentional well path diverted (generally in vertical section)
- ✓ KOP - kick off Point. Diverting a well path one trajectory to another
- ✓ MWD - Measurement While Drilling.
- ✓ LWD - Logging While Drilling.
- ✓ SF - Separation Factor or Clearance Factor:
- ✓ $SF^* = CC \div [UR_{ref} + UR_{off}]$ Collision Avoidance Calculation
***R Type Rule Common Practice - Recognized by ISCWSA**
The Industry Steering Committee on Wellbore Survey Accuracy
- ✓ CC - well separation distance (center to center of wellbores)
 - ☐ UR_{ref} - radius ellipse of uncertainty on reference well
 - ☐ UR_{off} - radius ellipse of uncertainty on offset well
 - ❖ Calculation options may be considered
- ✓ TMD - Total Measured Depth.
- ✓ Gyro - High accuracy well bore survey instrument unaffected by magnetic interference.
- ✓ QC / QA - Quality Control and Quality Assurance.
- ✓ HSE - Health Safety and the Environment.

Collision Avoidance Safeguards, Practices and Standards Plans

B. Established collision risks:

✓ $SF \leq 1.0$	Level 1	Extreme risk
✓ $SF = 1.0$ to 1.5	Level 2	High risk
✓ $SF = 1.5$ to 2.0	Level 3	Moderate risk
✓ $SF > 2.0$	Level 4	Low to no risk

Collision Avoidance Safeguards, Practices and Standards Plans

C. Plan components:

- 1) Describe the scope of work and the type of survey techniques by use of gyros, MWD, LWD, or others and include the following:
 - a) The survey intervals or frequencies proposed as adjustments to address each level of risk covering the vertical top-hole section of the proposed wellbore.
 - b) Provide TOOL ALIGNMENT and MULESHOE procedures** when drilling in critical areas covering the vertical top-hole section of the proposed wellbore. **These procedures are visual verification for alignment and orientation QC/QA purposes.** Provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities. ****Provide other orientations or survey methods and procedures if utilized.**

Collision Avoidance Safeguards, Practices and Standards Plans

C. Plan components: (cont.)

- 1) (Cont.) Describe the scope of work and the type of survey techniques by use of gyros, MWD, LWD, or others and include the following:
 - c) Description of any nudge activity proposed in the vertical top-hole section.
 - d) The survey tools to be utilized from the KOP to the lateral landing and the lateral section to the TMD.
 - e) Description of any software utilized for the directional and anti-collision planning proposed. (Rule Type Policy utilized)

Collision Avoidance Safeguards, Practices and Standards Plans

C. Plan components: (cont.)

2) The following shall be addressed in the plan for the proposed wellbore:

- a) Vertical top-hole section beginning at the surface and to the lateral landing –
 - i. **Minimum SF standards (thresholds) required - $SF \geq 1.5$ shall be obtained early as practical and maintained.**
(Indicate the frequency of survey intervals proposed)
 - ii. Minimum SF standards (thresholds) required - $SF \geq 2.0$ *** applies when in proximity to any fractured or any producing well that exists on the well pad. (Indicate the frequency of survey intervals proposed) *****Risk management and technological mitigations, i.e. downhole plugs, are critical and should be considered along with other safety measures necessary.** The OOG may require additional safety measures of a specific well application for permitting as deemed necessary.

Collision Avoidance Safeguards, Practices and Standards Plans

C. Plan components: (cont.)

2) (Cont.) The following shall be addressed in the plan for the proposed wellbore:

b) Lateral section beginning at the lateral landing and to the TMD -

- i. Provide a general protocol to declination, grid correction, and magnetic interference correction during the drilling of the proposed lateral. Also provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities.
- ii. For any existing horizontal or vertical wells found adjacent to this lateral section, provide the protocols for separation safeguards and the spacing planned during the drilling of this section. A reconnaissance review is required for each proposed lateral; OOG may establish a minimum footage for review as deemed necessary.

Collision Avoidance Safeguards, Practices and Standards Plans

C. Plan components: (cont.)

- 3) Provide a well pad surface diagram depicting the wellhead arrangement (API labeled) of all existing wells adjacent to the proposed wellbore. Indicate the surface footage separation between wellheads and each wellbore status.
- 4) Describe the gyro surveying or other type surveying conducted within each existing wellbore located on the pad.
- 5) Provide descriptive actions if a collision should occur or if surveys should observe imminent risk for a collision.
- 6) Provide method to notify the OOG Oil and Gas Inspector immediately of any underground collision or if the SF Level 1 is determined within the extreme collision risk zone (ellipses of uncertainty overlap).
- 7) Provide other supportive resources or proposed safety measures as needed.

Flaring Operations

Please contact the
Division of Air Quality* WVDAQ
WVDEP

***New Source Review Permitting**
Phone: 304 926 0475 · Fax: 304 926 0479

• In Conclusion

- ❑ Recently incidents are reduced and isolated, and nothing is reported with downhole collisions.
- ❑ Continue Planning and Implementations -
 - ✓ Site Safety Plans – Complete and Indexed Content
 - ✓ Maintain Trainings and Certifications
 - ✓ Continue Safety Meetings and Practice Drills
 - ✓ Communications, Contacts and Notifications
 - ✓ Personnel - Public Protections
 - ✓ Environmental Protections - Waste Conservation.
- ❑ Continue QC/QA efforts Designs / Activities -
 - ✓ Wellbore and Well Controls
 - ✓ Surface Managements and Controls.
- ❑ Explore Areas: Training/Certification/Conservation.

David J. Belcher

Office of Oil and Gas
Department of Environmental Protection
601 57th Street, SE
Charleston, WV 25304
304-926-0450

david.j.belcher@wv.gov
www.dep.wv.gov



west virginia department of environmental protection

**OIL AND GAS CONSERVATION COMMISSION
AND
OFFICE OF OIL AND GAS**

Policy Statement

**Deep Well Drilling Procedures
And Site Safety Plan Requirements**

The drilling of wells to new and untapped producing horizons has increased significantly in the past year. The recent trend involves the drilling of wells to depths of 10,000-14,000 feet with the potential for encountering very high pressures and volumes.

The Oil and Gas Conservation Commission and the Office of Oil and Gas have the required authority and believe that it is necessary to issue this Policy setting forth minimum requirements for necessary equipment and procedures that must be addressed in a Safety Plan ("Plan") which shall be submitted and approved prior to drilling a deep well. A deep well shall be any well which meets the definition as provided for in Chapter 22C, Article 9 of the West Virginia Code.

A site specific Safety Plan must be submitted with each deep well application. Approved Plans shall be maintained and available at the drilling rig at all times. The Plan shall, at a minimum, address the following items:

Siting Requirements

1. The Plan shall provide a map indicating the location, access road, pit, flare line and nearby dwellings, and take into consideration the prevailing wind direction.
2. Topographic map of well location.

Site Safety Plan

1. A pre-spud meeting shall be held prior to beginning drilling operations and include personnel to be employed and involved in the drilling operations and including the district oil and gas inspector or

other designated Office of Oil and Gas representative. The Plan shall list all persons involved in the pre-spud meeting.

2. The Plan shall provide a system for the check in of personnel and visitors to the drilling location to allow for an accurate headcount of personnel at any time.
3. The Plan shall include an evacuation plan for the removal of personnel from the drilling location and residents in the surrounding area should the need arise.
4. The Plan shall include a schedule for conducting safety meetings on a regular basis.
5. The Plan shall include a list of the nearest emergency response personnel and phone numbers for each.

Casing Requirements

1. The Plan shall provide details on the location of all freshwater, saltwater, oil and gas producing, hydrogen sulfide producing, "thief", and high pressure and volume zones known to the operator.
2. The Plan shall include a detailed casing and cementing program that employs a minimum of three strings of casing which are sufficient weight and quality for the anticipated conditions to be encountered. The casing setting depths shall be sufficient to cover and seal off those zones as identified above.

BOP Requirements

1. The Plan shall provide a listing of all BOP equipment with types, sizes and ratings to be utilized and available during the drilling of the deep well.
2. The Plan shall provide a procedure and schedule for testing of BOP equipment.
3. The Plan shall provide a schedule of when BOP equipment is to be installed and operational. BOP equipment shall be installed on the innermost string of casing after the surface casing.
4. The Plan shall include a listing of all approved BOP trained and actively certified personnel that will be involved in the drilling operation to assure that a trained person is present during the drilling operations.

5. The Plan shall include a system of maintaining a detailed record of significant drilling events such as lost circulation, hydrogen sulfide gas, fluid entry, abnormal pressures, etc. The district oil and gas inspector or the designated Office of Oil and Gas representative shall be notified as soon as possible of any unusual drilling events such as hydrogen sulfide gas or large kicks that occur during drilling operations. Any encounter of hydrogen sulfide gas shall require mandatory immediate notification to the Office of Oil and Gas.
6. The Plan shall include a schematic and description of the wellhead assembly to be placed on the well upon completion.

Well Flaring Operations

1. The Plan shall specify the size, construction and length of the flare line and the method that will be used to anchor the flare line along with a description of the choke assembly.
2. The Plan shall specify the system to be used for lighting the flare and what will serve as back-up igniters. All gas diverted through the manifold shall be burned. Notification shall be given to the local fire department prior to lighting of the flare if possible, otherwise as soon as possible.
3. The plan shall specify the minimum distance of clearing of flammable material beyond the end of the flare line.

Well Killing Operations

1. The Plan shall include an inventory of all materials that will be on-site for the mixing of mud. Inventory shall include the amount of mixed mud, mixed mud weight, amount of additional weighting material such as barite or bentonite and the volume of water for mixing.
2. The Plan shall specify the number and type of mixing units that will be utilized for the mixing of mud.

Hydrogen Sulfide Operations

1. The Plan shall specify the equipment and methods to be utilized for the monitoring, detection and warning of hydrogen sulfide gas during drilling operations and shall specify the location of the monitoring and detection equipment.

2. The plan shall provide a statement of the training to be provided or that has been provided for all personnel that will be involved in the drilling operations.
3. The plan shall specify the personal protection equipment that will be maintained on location.
4. The Plan shall specify the method of notification of hydrogen sulfide presence and how access will be controlled.

Notification

1. The Plan shall provide a list of names, addresses and telephones number of all residents, businesses, churches, schools and emergency personnel within a one mile radius, that may be affected by specific events during the drilling process. Such events may include the presence of hydrogen sulfide, flaring, etc.

Plan Modifications

1. The Office of Oil and Gas must approve all changes and modification to previously approved plans.

Approved: Barry K Lay Date: 10/18/12
Barry K. Lay, Chairman & Commissioner

Approved: James A. Martin Date: 10-22-12
James A. Martin, Chief - Office of Oil and Gas

Site Safety Plan Table of Contents

For H6A Well Work Permits and Deep Well Work Permits

Please prepare a Site Safety Plan to accompany each applicable H6A and/or Deep well work permit, adhering to the following organizational and informational structure. Plans submitted must contain an index of the content entirety including page-number references.

1. Contacts, Schedules, and Meetings

- A. Emergency point of contact for the well operator covering all phases of activities and including 24 hour contact information (35-8 5.7.b.4)
- B. List of telephone numbers for (35-8 5.6.4):
 - 1) Operator
 - 2) Contractors
 - 3) DEP office and oil/gas inspector
 - 4) Local emergency response units
 - 5) Local ER personnel
 - 6) All schools and public facilities within a one mile radius of proposed well site (35-8 5.7.b.5)
- C. Method of notification of public of H₂S gas presence and how access will be controlled. (applicable horizontal wells include all residents and emergency response personnel who may be affected by an event. Such events may include the presence of H₂S, blow-outs, and flaring) (35-8 5.7.f.1)
- D. Pre-spud meeting held prior to drilling operations, including (35-8 5.7.h):
 - 1) Attendance log, including personnel to be employed and involved in drilling operations
 - 2) Notification of County oil and gas inspector or other designated Office of Oil and Gas representative
- E. Describe schedule for conducting regular well site safety meetings. Log attendance at all meetings and also initiate check in check out during drilling, completion, and workover phases. (35-8 5.7.h)

2. Maps and Diagrams

- A. Plan view map of location, access road, pit(s), flare lines, nearby dwellings, note the north direction and the prevailing wind direction (35-8 5.7.b.1)
- B. Topographic map of well location, including
 - 1) 1 mile radius of well location
 - 2) UTM NAD 83 coordinates of well site entrance (35-8 5.7.b.2)
 - 3) UTM NAD 83 coordinates of the point the access road intersects the public route (35-8 5.7.b.2)
 - 4) Identify public route number and/or route name (35-8 5.7.b.2)
- C. Evacuation plan for the removal of personnel from the drilling location and residents in the surrounding area who have the potential to be affected by an emergency. (35-8 5.7.b.3)

3. Well Work

- A. Detailed written descriptions of well work and procedure to be used during the drilling, completion, and production phases, including schematic plan views of each (35-8 5.7.a)
- B. Statement detailing how a copy of the plan will be provided to the local emergency planning committee or county emergency services office within at least 7 days from land disturbance or well work. (35-8 5.7.a)

4. Chemical Inventory & MSDS

- A. Material Safety Data Sheets for all chemicals anticipated to be used in all aspects of the operation (can be provided on CD or USB drive) (35-8 5.7.a)
- B. Statement that all MSDS are to be readily available at the well site and their location indicated in the site safety plan including contact information for person(s) responsible maintaining them on site. (35-8 5.7.g)
- C. Inventory of all materials on site for mixing of mud including numbers and type of mixing units - mixed mud amount and weight, amount of weighting material and volume of mixing fluid. (35-8 5.7.d.1 & 5.7.d.2)

5. BOP and Well Control

- A. BOP equipment and casing heads with types, sizes and ratings to be utilized and available during the drilling for both intermediate and lateral drilling phases (35-8 5.7.c.1 & 5.7.c.8)
- B. Procedure and schedule for testing the BOP stack for intermediate drilling phase the BOP tested upon initial set up and the annular tested to 70% of capacity and the ram preventers tested to 80%. Same testing % for bottom and horizontal phase except testing to be done upon initial installation, weekly and after each bit trip (35-8 5.7.c.2)
- C. BOP equipment and assembly installation schedule (35-8 5.7.c.3)
- D. List and names of all personnel with well control training (35-8 5.7.c.4)
- E. Description of system of maintaining detailed records of and for immediate notification to OOG inspector for all significant drilling issues, including but not limited to (35-8 5.7.c.5):
 - 1) Lost circulation
 - 2) Hydrogen sulfide gas
 - 3) Fluid entry
 - 4) Abnormal pressures
- F. Notification of the oil and gas inspector or designated representative as soon as possible of any unusual drilling events, hydrogen sulfide gas* or large kicks that occur during drilling operations).
*(Mandatory immediate notification is required of any encounter of hydrogen sulfide gas - 22-6A wells >10ppm H₂S Gasses!) (35-8 5.7.c.5)
- G. Schematic and detailed written description of the wellhead assembly to be placed on the well upon completion (35-8 5.7.c.6)
- H. Method and type of kill procedures as recognized by the IADC – Wild Well Control Kill Sheet. (35-8 5.7.d.3)

6. Hydrogen Sulfide (H₂S)

- A. Detection, monitoring and warning equipment including location of the monitoring detection equipment on the site (35-8 5.7.e.1)
- B. Statement of H₂S personnel training provided (35-8 5.7.e.2)
- C. Method to notify the OOG of H₂S presence (35-8 5.7.e.4)
- D. Establish and maintain Protection Zones. Describe detailed written general procedures proposed in drilling phases. (application horizontal wells must include the completion, work-over, and production phases) (35-8 5.7.f.2)
- E. List of personal protective equipment (PPE) and the amount of each piece of PPE that will be maintained and available on site. (35-8 5.7.e.3)

7. Flaring

- A. Proposed written description and plan including schematic of installation for duration of flaring activities. (35-8 5.7.f.1)

8. Collision Avoidance Safeguards, Practices and Standards Plans

Protocol and established safeguards designed to prevent underground collisions during any drilling on multi-well pads (35-8 5.7). Collision avoidance plans are measures in keeping wellbores separated and in preventing HSE risk. Such plans describe the survey accuracy and the survey maintenance by systematic management efforts throughout the drilling of the proposed wellbore. These plans submitted shall be well specific to the proposed wellbore and shall address all items within the components section as outlined below. The scope of these plans shall provide survey designs throughout the proposed wellbore including the QC / QA activities and the counter-actions necessary; minimum separation factors (SF), standards and thresholds apply as specified in the components section. These plans shall include proposed counter-actions necessary if a collision occurs or if surveys observe an imminent risk for a collision; all wellbore collisions shall be treated as high-risk events. Approved plans are conditions and terms of the well permit and any modifications are subject to approval by the Office of Oil and Gas (OOG).

A. Established definitions:

- 1) Proposed Wellbore – Involves sections of the vertical top-hole, the KOP, the lateral landing, and the lateral drilling to the total measured depth TMD.
- 2) Nudge – Technique generally used in the vertical top-hole section. The well path is nudged from vertical to pass areas of possible magnetic interferences and to reduce the risk of collision by maintaining separation with other wellbores.
- 3) KOP – Kick off Point. Diverting a well path from one trajectory to another.
- 4) MWD – Measurement While Drilling.
- 5) LWD – Logging While Drilling.
- 6) SF – Separation Factor or Clearance Factor:

$$SF^* = CC \div [UR_{ref} + UR_{off}]$$

CC - well separation distance (center to center of wellbores)

UR_{ref} - radius ellipse of uncertainty on reference well

UR_{off} - radius ellipse of uncertainty on offset well

Note: ellipses are half-axes or radii.

*Calculation options may be considered

- 7) TMD – Total Measured Depth.
- 8) Gyro – High accuracy well bore survey instrument unaffected by magnetic interference.
- 9) QC / QA – Quality Control and Quality Assurance.
- 10) HSE – Health Safety and the Environment.

B. Established descriptions of risk:

- | | | |
|--------------------|---------|--------------------------|
| 1) SF ≤ 1.0 | Level 1 | Extreme collision risk |
| 2) SF = 1.0 to 1.5 | Level 2 | High collision risk |
| 3) SF = 1.5 to 2.0 | Level 3 | Moderate collision risk |
| 4) SF > 2.0 | Level 4 | Low to no collision risk |

C. Plan components:

- 1) Describe the scope of work and the type of survey techniques by use of gyros, MWD, LWD, or others and include the following:
 - a) The survey intervals or frequencies proposed as adjustments to address each level of risk covering the vertical top-hole section of the proposed wellbore.

- b) Provide TOOL ALIGNMENT and MULESHOE procedures** when drilling in critical areas covering the vertical top-hole section of the proposed wellbore. These procedures are visual verification for alignment and orientation QC/QA purposes. Provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities.
 - **Provide other orientations or survey methods and procedures if utilized.
 - c) Description of any nudge activity proposed in the vertical top-hole section.
 - d) The survey tools to be utilized from the KOP to the lateral landing and the lateral section to the TMD.
 - e) Description of any software utilized for the directional and anti-collision planning proposed.
- 2) The following shall be addressed in the plan for the proposed wellbore:
- a) Vertical top-hole section beginning at the surface and to the lateral landing -
 - i) Minimum SF standards (thresholds) required -
SF \geq 1.5 shall be obtained early as practical and maintained.
(Indicate the frequency of survey intervals proposed)
 - ii) Minimum SF standards (thresholds) required -
SF \geq 2.0*** applies when in proximity to any fractured or any producing well that exists on the well pad.
(Indicate the frequency of survey intervals proposed)
***Risk management and technological mitigations, i.e. downhole plugs, are critical and should be considered along with other safety measures necessary. The OOG may require additional safety measures of a specific well application for permitting as deemed necessary.
 - b) Lateral section beginning at the lateral landing and to the TMD -
 - i) Provide a general protocol to declination, grid correction, and magnetic interference correction during the drilling of the proposed lateral. Also provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities.
 - ii) For any existing horizontal or vertical wells found adjacent to this lateral section, provide the protocols for separation safeguards and the spacing planned during the drilling of this section. A reconnaissance review is required for each proposed lateral; OOG may establish a minimum footage for review as deemed necessary.
- 3) Provide a well pad surface diagram depicting the wellhead arrangement (API labeled) of all existing wells adjacent to the proposed wellbore. Indicate the surface footage separation between wellheads and each wellbore status.
 - 4) Describe the gyro surveying or other type surveying conducted within each existing wellbore located on the pad.
 - 5) Provide descriptive actions if a collision should occur or if surveys should observe imminent risk for a collision.
 - 6) Provide method to notify the OOG Oil and Gas Inspector immediately of any underground collision or if the SF Level 1 is determined within the extreme collision risk zone (ellipses of uncertainty overlap).
 - 7) Provide other supportive resources or proposed safety measures as needed.

9. Deep Well Additional Requirements

- A. List of anticipated freshwater, saltwater, oil and gas, hydrogen sulfide, thief zones, high pressure and volume zones and their expected depths.

- B. Detailed casing and cementing program that employs a minimum of three strings of casing which are sufficient weight and quality for the anticipated conditions.
- C. Flaring activities: Size, construction and length of flare line-anchor method and choke assembly description, Flare lighting system and back up igniters, Notify local fire department (if possible) prior to igniting flares, Minimum clearing distance beyond end of flare.
- D. List of names, addresses, and telephone numbers of all residents, businesses, churches, schools and emergency facilities within 1 mile radius that may be affected by specific events during the drilling process. Such events may include presence of hydrogen sulfide, and flaring, etc.

10. Deep Vertical Well Requirements per Policy Statement (Deep Well Drilling Procedures and Site Safety Plan Requirements)

The following selections are needed from the above contents:

- 1.** A - E (E. drilling phase only)
- 2.** A - C
- 3.** A (drilling phase only)
- 4.** B - C
- 5.** A - H
- 6.** A - E
- 9.** A - D.

8. Collision Avoidance Safeguards, Practices and Standards Plans

Protocol and established safeguards designed to prevent underground collisions during any drilling on multi-well pads (35-8 5.7). Collision avoidance plans are measures in keeping wellbores separated and in preventing HSE risk. Such plans describe the survey accuracy and the survey maintenance by systematic management efforts throughout the drilling of the proposed wellbore. These plans submitted shall be well specific to the proposed wellbore and shall address all items within the components section as outlined below. The scope of these plans shall provide survey designs throughout the proposed wellbore including the QC / QA activities and the counter-actions necessary; minimum separation factors (SF), standards and thresholds apply as specified in the components section. These plans shall include proposed counter-actions necessary if a collision occurs or if surveys observe an imminent risk for a collision; all wellbore collisions shall be treated as high-risk events. Approved plans are conditions and terms of the well permit and any modifications are subject to approval by the Office of Oil and Gas (OOG).

A. Established definitions:

1. Proposed Wellbore – Involves sections of the vertical top-hole, the KOP, the lateral landing, and the lateral drilling to the total measured depth TMD.
2. Nudge – Technique generally used in the vertical top-hole section. The well path is nudged from vertical to pass areas of possible magnetic interferences and to reduce the risk of collision by maintaining separation with other wellbores.
3. KOP – Kick off Point. Diverting a well path from one trajectory to another.
4. MWD – Measurement While Drilling.
5. LWD – Logging While Drilling.
6. SF – Separation Factor or Clearance Factor:

$$SF^* = CC \div [UR_{ref} + UR_{off}]$$

CC - well separation distance (center to center of wellbores)

UR_{ref} - radius ellipse of uncertainty on reference well

UR_{off} - radius ellipse of uncertainty on offset well

Note: ellipses are half-axes or radii.

*Calculation options may be considered

7. TMD – Total Measured Depth.
8. Gyro – High accuracy well bore survey instrument unaffected by magnetic interference.
9. QC / QA – Quality Control and Quality Assurance.
10. HSE – Health Safety and the Environment.

B. Established descriptions of risk:

- | | | |
|--------------------|---------|--------------------------|
| 1. SF ≤ 1.0 | Level 1 | Extreme collision risk |
| 2. SF = 1.0 to 1.5 | Level 2 | High collision risk |
| 3. SF = 1.5 to 2.0 | Level 3 | Moderate collision risk |
| 4. SF > 2.0 | Level 4 | Low to no collision risk |

C. Plan components:

1. Describe the scope of work and the type of survey techniques by use of gyros, MWD, LWD, or others and include the following:

- a) The survey intervals or frequencies proposed as adjustments to address each level of risk covering the vertical top-hole section of the proposed wellbore.
 - b) Provide TOOL ALIGNMENT and MULESHOE procedures** when drilling in critical areas covering the vertical top-hole section of the proposed wellbore. These procedures are visual verification for alignment and orientation QC/QA purposes. Provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities.
**Provide other orientations or survey methods and procedures if utilized.
 - c) Description of any nudge activity proposed in the vertical top-hole section.
 - d) The survey tools to be utilized from the KOP to the lateral landing and the lateral section to the TMD.
 - e) Description of any software utilized for the directional and anti-collision planning proposed.
2. The following shall be addressed in the plan for the proposed wellbore:
- a) Vertical top-hole section beginning at the surface and to the lateral landing -
 - 1) Minimum SF standards (thresholds) required -
SF \geq 1.5 shall be obtained early as practical and maintained.
(Indicate the frequency of survey intervals proposed)
 - 2) Minimum SF standards (thresholds) required -
SF \geq 2.0*** applies when in proximity to any fractured or any producing well that exists on the well pad.
(Indicate the frequency of survey intervals proposed)
***Risk management and technological mitigations, i.e. downhole plugs, are critical and should be considered along with other safety measures necessary. The OOG may require additional safety measures of a specific well application for permitting as deemed necessary.
 - b) Lateral section beginning at the lateral landing and to the TMD -
 - 1) Provide a general protocol to declination, grid correction, and magnetic interference correction during the drilling of the proposed lateral. Also provide the responsible personnel (minimum two representatives) and their titles of those involved for QC/QA purposes during the drilling activities.
 - 2) For any existing horizontal or vertical wells found adjacent to this lateral section, provide the protocols for separation safeguards and the spacing planned during the drilling of this section. A reconnaissance review is required for each proposed lateral; OOG may establish a minimum footage for review as deemed necessary.
3. Provide a well pad surface diagram depicting the wellhead arrangement (API labeled) of all existing wells adjacent to the proposed wellbore. Indicate the surface footage separation between wellheads and each wellbore status.
 4. Describe the gyro surveying or other type surveying conducted within each existing wellbore located on the pad.
 5. Provide descriptive actions if a collision should occur or if surveys should observe imminent risk for a collision.
 6. Provide method to notify the OOG Oil and Gas Inspector immediately of any underground collision or if the SF Level 1 is determined within the extreme collision risk zone (ellipses of uncertainty overlap).
 7. Provide other supportive resources or proposed safety measures as needed.