2004 West Divide Gas Seep and Current Engineering Practices

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Colorado Oil and Gas Conservation Commission Hearing
Glenwood Springs, Colorado

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Complaint of Gas Release

- On April 1, 2004, COGCC Staff received a complaint alleging a natural gas release to West Divide Creek, approximately one-half mile to three-quarters of one mile from the Schwartz 2-15B (O2) Well.

Schwartz 2-15B (O2) Well General Characteristics

- Location: SWSE Section 2, Township 7 South, Range 92 West, 6th P.M.
- Field: Mamm Creek
- Spud Date: January 16, 2004
- Objective Formations: Williams Fork and Rollins (Rollins was not completed)
- Formation Tops: Wasatch at surface, Williams Fork at 3,217 feet, and Rollins at 6,299 feet
- Vertical well with total measured depth of 6,535 feet

Schwartz 2-15B (O2) Well Surface Casing

- 9-5/8 inch Surface Casing set at a depth of 706 feet and cemented to surface.
- For comparison, water well depths within a one-mile search radius range from 150 feet to 450 feet.
- COGCC statewide policy requires surface casing to be set a minimum of 50 feet below the total depth of offset water wells within one mile.
- Current Mamm Creek policies for surface casing setting depths are more stringent than the statewide policy.

2017-002976-0000670

Schwartz 2-15B (O2) Well
Wasatch Lost Circulation and Gas Kick

- During drilling on January 20, 2004, EnCana lost mud circulation and encountered a gas kick in the Wasatch Formation at a depth of 1,589 feet.
- EnCana shut the well in for approximately one hour in order to control the kick.
- While Wasatch gas is produced in gas fields located west of Rifle, it is not considered an objective formation in the Mamm Creek field.
- Wasatch gas kicks are uncommon in the Mamm Creek field. However, intermittent zones of Wasatch gas appear to result in nuisance bradenhead pressure.

2017-002976-0000671

Schwartz 2-15B (O2) Well
Williams Fork Lost Circulation and Gas Kick

- During drilling on January 27, 2004, EnCana lost mud circulation and encountered a gas kick in the Williams Fork Formation at a depth of 4,328 feet.
- EnCana shut the well in for approximately eight hours in order to control the kick.
- EnCana also lost circulation on or about February 6, 2004 while running production casing. Operations were shut down for approximately seven hours to re-establish mud circulation.

Schwartz 2-15B (O2) Well Production Casing Primary Cement Job

- Cement was initially circulated to surface with 25 bbl excess cement observed at the surface.
- Subsequently, a February 16, 2004 cement bond log showed that the apparent top of competent cement had fallen to a depth of 4,050 feet. Top of gas in the Williams Fork Formation was reportedly at a depth of 4,132 feet.
- EnCana also ran a temperature survey on February 16, 2004, which showed cooling beginning at a depth of 4,328 feet. The temperature survey demonstrated that upward gas migration was occurring under shut-in conditions.

Schwartz 2-15B (O2) Well Completion and Post-Completion Bradenhead Pressure Measurements

- EnCana proceeded with fracture stimulation during the month of March 2004.
- During fracture stimulation of the final stage (Stage 5) at a depth of 4,458 feet to 4,633 feet, EnCana observed bradenhead pressures ranging from 575 psi to 661 psi.
- EnCana observed bradenhead pressures of 515 psi and 650 psi on April 4, 2004 (following completion activities immediately prior to remedial cement operations).

Schwartz 2-15B (O2) Well
Notification to COGCC and Remedial Cement

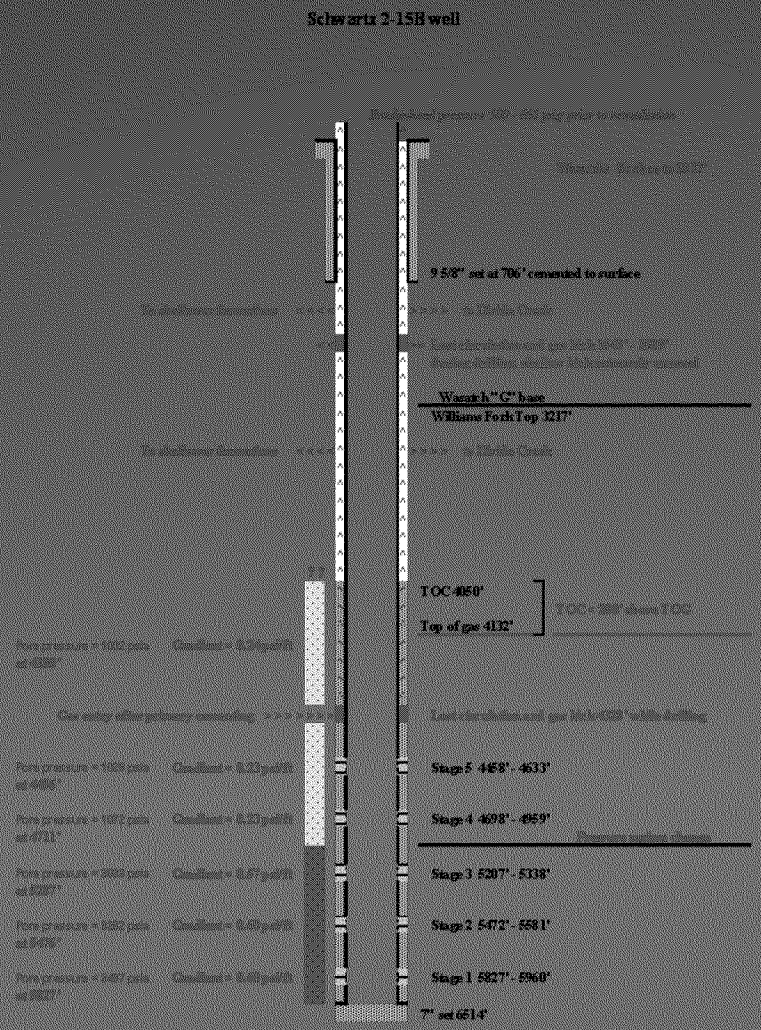
- EnCana submitted a Sundry Notice to COGCC on March 23, 2004, requesting approval to perform remedial cementing operations. COGCC reviewed this Sundry Notice on March 30, 2004 and approved EnCana's request on the same day. EnCana had not reported any downhole problems prior to submittal of the Sundry Notice.
- During the remedial cement job on April 4, 2004, EnCana observed flowing bradenhead pressures ranging from 500 psi to 650 psi, which was generally consistent with shut-in bradenhead pressures.

2017-002976-0000675

Schwartz 2-15B (O2) Well
Gas Sampling and Origin of Bradenhead Gas

- Isotopic and compositional gas sample analytical results from the Schwartz 2-15B (O2) well and other nearby wells suggested that bradenhead gas in the Schwartz 2-15B (O2) well was consistent with Williams Fork gas.
- These analytical results also suggest that an insufficient production casing primary cement job was the cause of high bradenhead pressure. This contention was supported by COGCC and other interested parties (Order No. 1V-276).

Schwartz 2-15B (O2) Wellbore Diagram



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Schwartz 2-15B (O2) Well Post-Remediation Observations and Former Moratorium Area

- Following the remedial cement job, bradenhead pressure decreased to zero.
- Gas discharge to West Divide Creek visibly decreased dramatically within 8 days of remediation, and benzene concentrations in West Divide creek decreased within 12 days.
- The post-remediation cement bond log showed good cement to surface.
- EnCana voluntarily agreed to cease drilling and completion operations within a 2-mile radius of the Schwartz 2-15B (O2) Well until new drilling and completion procedures could be developed.

Current Production Casing Cement Procedures

- EnCana currently does not permit wells with production casing cement to surface because of issues related to highly variable lost circulation zones and excess hydrostatic head. However, EnCana's cement program is designed to circulate cement to 1,500 feet above the top of gas. This is a safety factor to account for a Mamm Creek field requirement to provide cement to 500 feet above the top of gas.
- For comparison, COGCC's statewide standard (Rule 317.i.) requires production casing cement to 200' above the shallowest known producing zone.

Mamm Creek Field Notice to Operators

- COGCC engineering staff currently regulate drilling and completion practices in the Mamm Creek field in accordance with COGCC's rules and regulations.
- More stringent requirements for drilling and completion in the Mamm Creek Field are also required per the Notice to Operators Drilling MesaVerde Group or Deeper Wells in the Mamm Creek Field Area in Garfield County, Well Cementing Procedure and Reporting Requirements, July 23, 2004, Revised February 9, 2007.
- The 2-mile moratorium area was lifted in February 2007, following release of the Notice to Operators.

Mamm Creek Field Notice to Operators

Mamm Creek Field Notice to Operators Procedures

- Production casing cement required to 500 feet above top of gas.
- Production casing annular fluid monitoring and reporting for makeup volumes greater than 20 bbls to keep the annulus full.
- Cement bond logs and temperature logs required.
- Sundry Notice Request to Complete.
- Periodic post-cementing bradenhead pressure monitoring.
- Remedial procedures (venting and/or remedial cement) and reporting for bradenhead pressures greater than 150 psi.
- Bradenhead monitoring during fracture operations.

East Mamm Creek Area Procedures

- Surface casing setting depth must be 15 percent of the total vertical well depth or 500 feet below the total depth of any water well within a one-mile radius.
- Surface casing shoe formation integrity test (FIT) to 13.0 ppg equivalent mud weight.
- Intermediate casing must be set 50 feet below the MesaVerde Group top if the FIT fails.
- Choke pressure monitoring relative to FIT pressure.
- Daily (30 days) and monthly post cementing bradenhead monitoring for 30 days.

Mamm Creek Field
Bradenhead Venting – Monitoring and Reporting

- If bradenhead pressures are reported above 150 psi, and the pressures can be bled down, then COGCC Staff will authorize a 90-day vent to atmosphere after submittal of a venting request on a Sundry Notice, per COGCC Rule 912.
- In order to provide historical comparisons, COGCC Staff has requested EnCana to shut wells in for a period of 7 days to determine if the pressure exceeds 150 psi.
- Depending on pressure measurements and observed flows, COGCC may require remedial cement work to mitigate high bradenhead pressures.

2017-002976-0000684