Water Well Testing-Monitoring

This is a comprehensive update for area residents from Colorado Interstate Gas Company (CIG) that summarizes completed, current, and planned work by CIG and its contractors since a storage well incident occurred on October 22, 2006 at the company's Fort Morgan natural gas storage field and compressor facility, south of Fort Morgan , Colorado.

An accidental release of natural gas into the subsurface occurred from a casing leak in Gas Storage Well Number 26. Subsequently, the leak was discovered to be at a depth of approximately 846 feet below ground level. The well is one of 26 injection/withdrawal wells located at the Fort Morgan complex, which has been owned and operated by CIG since 1961.

Since the event, CIG and contractors, notably including personnel from URS Corporation's Denver office, have conducted indoor air monitoring, well water sampling, and laboratory analyses in the area that surrounds the well. Activities from October 22 through January 2007 included: monitoring methane concentrations in areas where the gas release disturbed the ground surface; monitoring indoor air in selected homes; and testing and sampling residential groundwater supply wells.

The primary objectives of the Phase I work included :

- To determine whether or not residents who were evacuated as a precautionary measure in response to the accidental gas release could safely return home;

- To evaluate health and safety issues related to natural gas exposure through a search of available literature; and

- To assess the effect, if any, of the natural gas release on the water quality of domestic water wells.

Additional Phase I objectives that were established were based on community input received during a public meeting held in Fort Morgan on November 8, 2006. Those included:

- To evaluate whether or not brackish water from the underlying formation(s) were introduced into the alluvial aquifer and if the surface soils were adversely effected by the natural gas release; and

- To communicate analytical results of water well testing to residents and landowners.

Phase II work began in December 2006 and is continuing. Phase II objectives are:

• To assess the long-term effect, if any, to groundwater and land stability in areas disturbed by the natural gas release; and

• To evaluate the need for long-term monitoring and/or mitigation activities.

Summary Findings – Phase I

To date, no indoor air monitor alarms in homes have been triggered by the presence of natural gas or air quality concerns. Additionally, no air monitor alarms have been triggered during sampling activities. As of January 17, 2006, RMLDs had not detected natural gas at any locations where natural gas was previously detected at the ground surface. However, cone penetrometer investigation work as part of CIG's Phase II work has detected methane in the subsurface in these areas. As a result, monthly RMLD monitoring will continue.

Based on the Phase I groundwater results, it does not appear that the natural gas release had any significant effect on groundwater quality at the sampled locations, nor did it release any constituents that adversely affected groundwater quality at concentrations that exceed Colorado groundwater quality standards or COGCC action levels.

Based on soil data collected during Phase I, the natural gas release does not appear to have introduced salts or altered soil pH in the visually disturbed soils, and thus has not impaired the ability of the soils to support crop growth.

The information contained in the Phase I report will be used in conjunction with data collected during Phase II studies to fully determine the need for long-term monitoring and/or mitigation activities.

This Update includes detailed information regarding Phase I work and conclusions, which CIG submitted to the COGCC in early February; please refer to the following sections. Should you have questions, please contact CIG using the contact information at the bottom of this Update.

Comprehensive Phase I Work Summary

Air Monitoring Program

Immediately following the accidental release of the natural gas, CIG employed the use of an infrared camera in a company plane to perform an evaluation of 16 square miles surrounding Gas Storage Well Number 26. Additionally, CIG Fort Morgan personnel began monitoring air quality around 28 local residences, disturbed ground areas, and at the Fort Morgan gas facility with remote methane leak detector (RMLD) instruments. RMLDs were also used to screen for methane prior to entering any locations to collect well water samples.

Initial air monitoring was conducted daily from October 23, 2006 through November 22, 2006. From November 27, 2006 through January 17, 2007 air measurements were taken weekly. As of January 17, 2007 the air monitoring frequency was reduced to every two weeks.

Continuous air monitoring instruments were also placed in selected homes and made available to residents who requested a monitor. Initially, the monitors were placed in eight homes within a one-mile radius of Gas Storage Well Number 26. These eight homes rely solely on their domestic wells for household water. Over time, some residents have chosen to return their air monitors. At the time CIG submitted its Phase I report to the COGCC, three of the continuous air monitors remained in homes.

Air monitors in homes were programmed to sound an alarm if oxygen (O_2) was deficient, or if elevated concentrations of combustible gases, methane, carbon monoxide (CO), or hydrogen sulfide (H_2S) were present at levels that could pose a potential risk. Portable monitors sampled for O_2 and lowest explosive limits, or LELs.

All monitors were supplied with AC voltage adaptors, so that batteries did not have to be relied upon.

Soon after initial installation of the home monitors, two units alarmed because their data log memory was full, and the function was disabled on all in-home monitors to alleviate the problem. A third unit alarmed because it needed re-calibration.

Well Water Sampling Program

The intent of well water sampling was to evaluate whether methane concentrations in groundwater were below the COGCC concentration of two milligrams per liter (2 mg/L) deemed safe to prevent explosive atmospheres from developing during normal household water use. Additionally, results for other natural gas-related constituents were compared to groundwater quality standards.

Based on the initial steps to identify potentially affected residences, first-tier priority residences were identified as those within a one-mile radius of Gas Storage Well Number 26 that rely solely on their domestic well water for household use.

Residences within the one-mile radius having access to two water sources, domestic well water from the alluvial aquifer and water supplied by the Morgan County Quality Water District, were identified as second-tier priority. Third-tier priority was given to residences within 1-2 mile and 2-3 mile radii from Gas Storage Well Number 26.

Well water samples were collected from taps or spigots following standard U.S. Environmental Protection Agency (EPA)-accepted sampling protocols and in accordance with COGCC guidelines for sampling dissolved gases in tap water.

As part of the emergency response activities, field screening analyses of methane in well water were also conducted by CIG during the first week following the natural gas release.

Analysis for methane in well water samples by a commercial laboratory was initiated the first week following the incident as well and has been on-going throughout all sampling activities.

Laboratory Analytical Program

Within 72 hours of the incident, Phase I well water monitoring was initiated with the collection of well water samples for analysis of methane and other natural gas constituents (i.e., dissolved gases) and volatile organic compounds (VOCs), including benzene, toluene, ethylbenzene, and xylenes (so-called BTEX) analytes. BTEX analytes are potential natural gas-related chemicals that have EPA primary drinking water standards.

A third-party accredited laboratory located in Pittsburgh , Pennsylvania performed the dissolved gases' analyses. Another third-party accredited laboratory in Fort Collins , Colorado performed the VOCs' analyses.

To respond to the requirements for Supplemental Data Collection requested by the COGCC on November 8, 2006, following the public meeting, the analytical program was modified for samples collected after December 2, 2006.

The analyte list for selected well water samples was expanded to include major inorganic parameters and dissolved metals for a one-time sampling event conducted the week of December 11, 2006. Additionally, with the concurrence of the COGCC on December 11, 2006, the VOC parameter list for well water samples was reduced to BTEX parameters only.

Well water samples for this one-time sampling event were sent to a third-party accredited laboratory in Houston for analysis because of the lab's ability to analyze for all of the additional

inorganic parameters, including iodide and bromide. Secondly, a soil sampling investigation was conducted and soil samples were submitted to another third-party accredited laboratory in Lafayette , Louisiana for analysis of sodium adsorption ratio (SAR), paste pH, and specific conductance. These soil parameters were useful in determining if the surrounding soils had experienced any impacts from the natural gas storage release.

Preliminary Findings – Phase I

Toxicological Evaluation

Natural gas contains mostly methane, with other minor constituents including ethane, propane, butane, isobutene, pentane, isopentane, hexane, isohexane, nitrogen, and carbon dioxide.

Methane is a colorless, odorless, tasteless gas, is lighter than air and soluble in water, and is formed naturally when vegetation decays in an environment lacking oxygen (underwater/underground).

Methane itself is non-toxic, non-reactive, and is not harmful to human health, if ingested. According to studies by the Centers for Disease Control and Prevention, the EPA, U.S. Department of Interior, and Pennsylvania State University Cooperative Extension, methane gas in drinking water does not cause health problems for animals or humans. There are no published action levels for consuming methane in water.

Methane at Fort Morgan is the major component of natural gas that is stored in and removed from a deep subsurface reservoir based on demand for additional supplies of natural gas.

Methane escapes quickly from water because of its low solubility. If methane displaces enough oxygen in air, this can lead to asphyxiation. Additionally, methane de-gassing from water has the potential to accumulate in poorly ventilated or confined areas, creating an explosion hazard.

To develop an explosive atmosphere, methane has to be present at 5% to 15% of the total air volume in a confined space, and there has to be an ignition source. Some studies indicate that methane levels below 7 mg/L do not pose a risk of explosion (U.S. Geological Survey-La Plata Energy Council), but this project has adopted a more conservative and safety-conscious approach by applying the COGCC guidance level of 2 mg/L of methane in water for evaluation purposes.

In and around the Fort Morgan incident area, as of the early February CIG report on Phase I to the COGCC, the highest methane concentration measured in well water has been 1 mg/l at House 101, which is below the COGCC guidance level of 2 mg/l. This residence remains evacuated, however.

The next highest methane concentration detected, per the report, occurred at House 67 (0.011 mg/L) and at House 34 (0.009 mg/L); however, these results are two and three orders of magnitude below the 1 mg/L found at House 101.

Thus, the methane levels detected in well water to date do not appear to be sufficient to result in an explosive or oxygen-deficient atmosphere.

Air Monitoring

During the weeks following the natural gas release, methane was found emanating from cracks, fissures, and craters in the ground surface within the visually affected areas. Methane was also found venting from water wells at House 100 and House 101.

Methane gas venting along now re-opened County Road 18 (re-opened in late January 2007)

north and south of its intersection with County Road N was not detected after January 3, 2007. The presence of natural gas from venting areas to the southeast, south, and southwest of Gas Storage Well Number 26 was not detected after November 22, 2006.

The presence of natural gas venting from the residential water well at House 101 was not detected after November 9, 2006.

The presence of natural gas venting from the residential water well at House 100 was not detected after December 12, 2006. Although natural gas is no longer detected at these two wells with an RMLD, these two residences remain evacuated.

Continuous air monitoring was also performed in eight residences (Houses 3, 34, 62/63, 64/65, 66, 69, 120, and 121) following the natural gas release. These residences rely solely on well water for their domestic use.

Although continuous gas monitors were made available to any resident who requested the service, no additional requests were made. Several residents have subsequently informed CIG that they no longer need air monitoring in their residences, and the instruments have been removed.

No alarm has been triggered by the presence of natural gas or air quality concerns at any of the continuous air monitors deployed in any of the local residences.

Well Water Sampling

During Phase I, methane (the major component of natural gas) was identified as an indicator parameter that may indicate potential groundwater quality effects caused by the natural gas release. Formation water in the Pierre shale and the Dakota D-Sand gas storage reservoir, which occur below the alluvial aquifer, is naturally more brackish (e.g., saline) than the alluvial aquifer. Thus, chloride, sulfate, and total dissolved solids (TDS) were also identified as potential indicator parameters that may be useful in evaluating whether brackish water migrated into the alluvial aquifer during the natural gas release. For the purpose of data evaluation, the area of concern (AOC) was defined as within a 1.5-mile radius from Gas Storage Well Number 26.

Statistical Evaluation of Background Groundwater

Background groundwater samples were collected from the alluvial aquifer during Phase I studies from 22 wells outside of the gas release AOC to facilitate comparison of pre- and post-release groundwater quality.

Groundwater quality data from the background wells were evaluated by calculating statistical parameters (i.e., maximum, minimum, mean, standard deviation, and one-sided upper tolerance limits, or UTLs) for each analyte.

Phase I results for water wells within a 1.5-mile radius of Gas Storage Well Number 26, the AOC, were compared to the background UTLs to assess whether elevated analyte concentrations may be a result of the natural gas release. Three analytes — boron, lead, and sulfate — appear to statistically exceed background at some sample locations.

Methane

The maximum measured methane concentration in the AOC, 1.0 mg/l detected at House 101, is very likely a result of the accidental natural gas release because natural gas surfaced in the field adjacent to this residence, and natural gas was observed bubbling in the well at this residence during air monitoring.

Methane detections in well water at House 34 (0.009 mg/l) and House 67 (0.011 mg/l) may

also be related to the natural gas release; however, the relationship of these locations to the natural gas release is not clear at this time.

Evidence available as of the February report to the COGCC indicated that the natural gas released from Gas Storage Well Number 26 appears to have traveled in subsurface formations about one-half to one mile south from the well site, where it surfaced northeast, southeast, and southwest of the CIG facility. However, locations House 34 and House 67 are located north of these release areas and north of Gas Storage Well Number 26.

Chloride, Sulfate and TDS

Chloride concentrations found in residential groundwater during Phase I ranged between 2.6 mg/L (House 121/122) and 150 mg/L (House 67). The highest chloride concentrations found within the AOC occurred at House 45 (129 mg/L), House 67 (150 mg/L), and House 98 (135 mg/L). These results are within the range of chloride concentrations measured in background groundwater.

The highest chloride concentrations measured during the Phase I investigation occurred at background wells L401 (361 mg/L) and L301 (172 mg/L). None of the Phase I chloride results exceed either background (i.e., the Upper Tolerance Limit, or UTL) nor the Colorado groundwater standard for chloride (250 mg/L).

Sulfate concentrations found in residential groundwater during Phase I ranged between 35 mg/L (House 121/122) and 1,490 mg/L (House 98). Most of the sulfate results within the AOC are also within the range determined for background. Like chloride, the highest sulfate concentrations within the AOC occur at locations (House 45, House 67, and House 98) that slightly exceed the background UTL.

Sulfate results at these locations exceed the background UTL (1,350 mg/L) and the Colorado groundwater standard (250 mg/L). However, as discussed previously, the background UTL for sulfate calculated for Phase I also exceeds the standard.

Naturally elevated sulfate concentrations in the alluvial aquifer have existed in this area since at least the 1940s (Bjorklund and Brown study, 1957).

TDS concentrations found in groundwater during Phase I ranged between 392 mg/L (House 121/122) and 3790 mg/L (House 45). All of the Phase I TDS results within the AOC are also within the range determined for background. Like chloride and sulfate, TDS concentrations within the AOC are also highest at House 45 (3790 mg/L), House 67 (3190 mg/L), and House 98 (3290 mg/L). These TDS data do not exceed the Colorado basic groundwater standard or background (4,872 mg/L).

Elevated chloride, sulfate, and TDS concentrations at House 45, House 67, and House 98 may be related to the natural gas release; however, their relationship to the natural gas release is not clear. As of the COGCC report filing, evidence indicated that the natural gas released at Gas Storage Well Number 26 appears to have traveled in subsurface formations about one-half to one mile south, where it surfaced northeast, southeast, and southwest of the CIG facility. However, locations (House 45 and Houses 67) are situated north of the natural gas release, and House 98 is located east of the release point.

Comparison of Groundwater Results to Water Quality Standards

The maximum concentrations of boron, lead, and sulfate in well water samples were compared with the Colorado groundwater quality standards to determine whether the concentrations exceed the standards. The maximum boron and lead concentrations found during Phase I do not exceed groundwater quality standards, but the highest levels of sulfate measured in some wells do exceed its standard.

Lead and boron are unlikely related to formation water that may have been entrained into the alluvial aquifer with the natural gas release. Although sulfate results for samples collected in the AOC exceed the sulfate standard, it is important to note that sulfate concentrations in many background samples are also higher than the sulfate standard because of the naturally poor groundwater quality that has existed in this area since at least the 1940s (Bjorklund and Brown study, 1957).

Soil Sampling

Twenty-five surface features caused by natural gas venting to the ground surface were visually identified in three areas — northeast, southeast, and southwest — of the Fort Morgan gas plant. One hundred thirty-two soil samples were collected in these areas to assess the potential effects on soils disturbed by the natural gas release.

Soil samples were collected from two distinct populations, visually-affected areas (VAAs) or unaffected background areas (BAs). These soil samples were analyzed for p aste pH, paste-specific conduc tivity, and sodium absorption ratio (SAR) by a third-party commercial laboratory.

A comparison of the soil results for visually-affected soils and undisturbed background soils indicate that soil specific conductivity and SAR were generally higher in background soils than visually affected soils.

The maximum soil pH values within the visually affected soils was slightly higher than the undisturbed background soils by approximately 5 percent

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