



## **Analysis of Products Used for Drilling**

### **Crosby 25-3 Well – Windsor Energy, Park County, Wyoming**

April 2009

#### ***INTRODUCTION***

The following summaries are based on the possible health effects of the products and chemicals used in drilling a natural gas well, Crosby 25-3, northwest of Clark, Park County, Wyoming. This well was directionally drilled with a total vertical depth of 8,038 feet. Natural gas, petroleum condensate, and drilling fluids were accidentally released from the ground adjacent to the well due to a breach in the surface casing at approximately 255 feet below ground surface. Released fluids and natural gas followed near-vertical bedding planes and/or fractures until they reached the surface at two locations. The release occurred over a period of about 58 hours between August 11 and 13<sup>th</sup>, 2006 and resulted in surface soil impacts in an area estimated to cover approximately 25,000 square feet.<sup>1</sup>

TEDX compiled a list of 42 products containing 32 chemicals as of March 2009. Information for the analysis came from Materials Safety Data Sheets (MSDS) for the products in use at the time of the blowout, through information provided in the Terracon Remedial Investigation Work Plan – Final Draft, dated July 2, 2007, and information disclosed in the Terracon Remedial Investigation Work Plan – Amended Draft, dated September 14, 2007. TEDX makes no claim that the list of products and chemicals in this analysis is complete.

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#### ***PRODUCT SUMMARY***

##### **Material Safety Data Sheets (MSDSs)**

MSDSs are designed to inform those who handle, ship, and use the products about their physical and chemical characteristics, and their direct and/or immediate health effects, in order to prevent injury while working with the products. The sheets are also designed to inform emergency response crews in case of accidents or spills. The total reported composition of a product on an MSDS can be less than 0.1% up to 100%. MSDSs are not submitted to the Occupational Safety and Health Administration (OSHA) for review. The product manufacturers determine what is revealed on their MSDSs.

The health information on MSDSs most often warns of possible harm to the skin and eyes, gastrointestinal and respiratory tracts, followed by the nervous system and brain. Many MSDSs do not address the outcome of long term, intermittent or chronic exposures, or adverse health effects that may not be expressed until years after the exposure.

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<sup>1</sup> Terracon Consulting Engineers & Scientists. 2007 Sep 14. Remedial Investigation Work Plan - Final Draft: Crosby 25-3 Natural Gas Well Release, Road 1AB, Clark, Park County, Wyoming, submitted to Windsor Energy Group, LLC, Oklahoma City, Oklahoma Project No. 26067064.

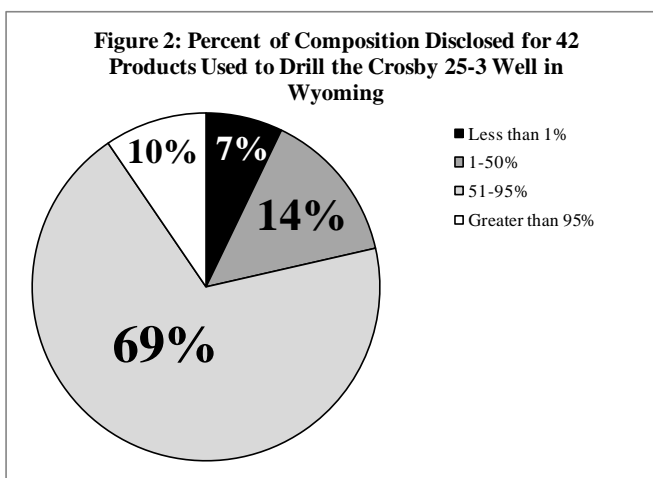
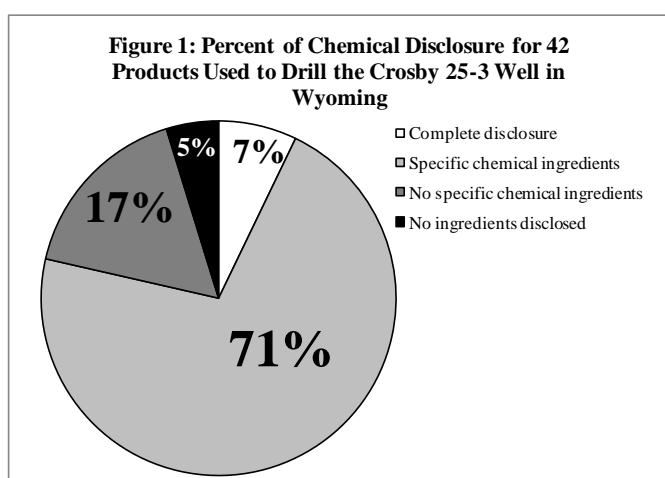
Of the 42 products known to be used to drill the Crosby Well, TEDX has obtained MSDSs for 37 of them. Two of the MSDSs listed “no hazardous ingredients” as the composition of the product. Seven MSDSs listed at least one ingredient, but no CAS numbers<sup>2</sup>, and one of these MSDSs provided no percent of composition. Of the 28 MSDSs that listed at least one ingredient with a CAS number, five provided information on less than 50% of the total composition and 20 listed between 51% and 95%. Three MSDSs disclosed over 95% of the product ingredients and all the CAS numbers.

### **Other Sources of Information**

The remaining five products on the TEDX list came from the Terracon reports listed above. The Terracon reports list a single chemical in each of the products. Information on the composition ranges from 10 to 30% and 60-100%, but no product in these reports provides complete information on the specific chemical makeup for 100% of the composition.

### **Evaluation of the information available about the 42 products**

Thirty products (71%) list specific chemical ingredients (Figure 1). Seven (17%) contain chemicals with only general or non-specific names and no information for two (5%) of the products was provided. The remaining 3 (7%) of the products disclose all of the ingredients.

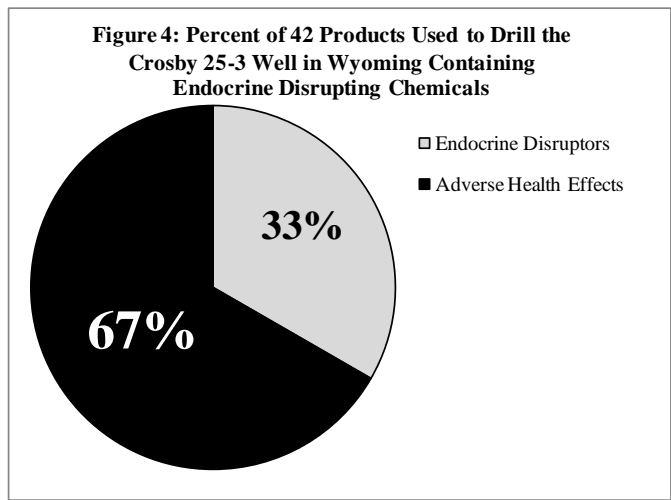
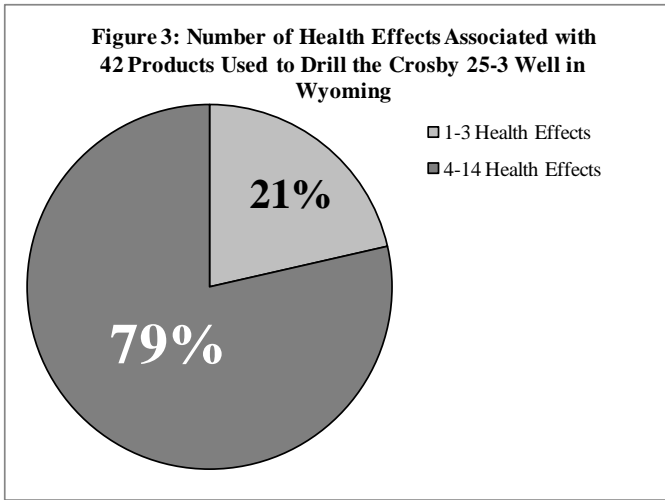


Less than 1% of the total composition is known for 3 (7%) of the 42 products used to drill the Crosby Well (Figure 2). Less than 50% of the composition is known for 6 (14%) of the products, and between 51% and 95% of the composition is known for 29 (69%) of the products. Four (10%) of the products have information about more than 95% of their full composition.

### **Evaluation of the health effects associated with the 42 products**

All of the products on TEDX’s list are associated with adverse health effects, even though two of the MSDSs stated that they contained no hazardous ingredients. Twenty-one percent had one to three associated health effects, and 79% had 4-14 health effects (Figure 3). Thirty-three percent of the products contained one or more chemicals considered to be endocrine disruptors (Figure 4), chemicals that interfere with development and function.

<sup>2</sup> CAS =Chemical Abstracts Service, provided by the American Chemical Society. This unique number is used to identify a specific substance. A single substance can have many different names, but only one CAS number. A substance may be a single chemical, an isomer of a chemical, a mixture of isomers, polymer, biological sequences, or a mixture of related chemicals.



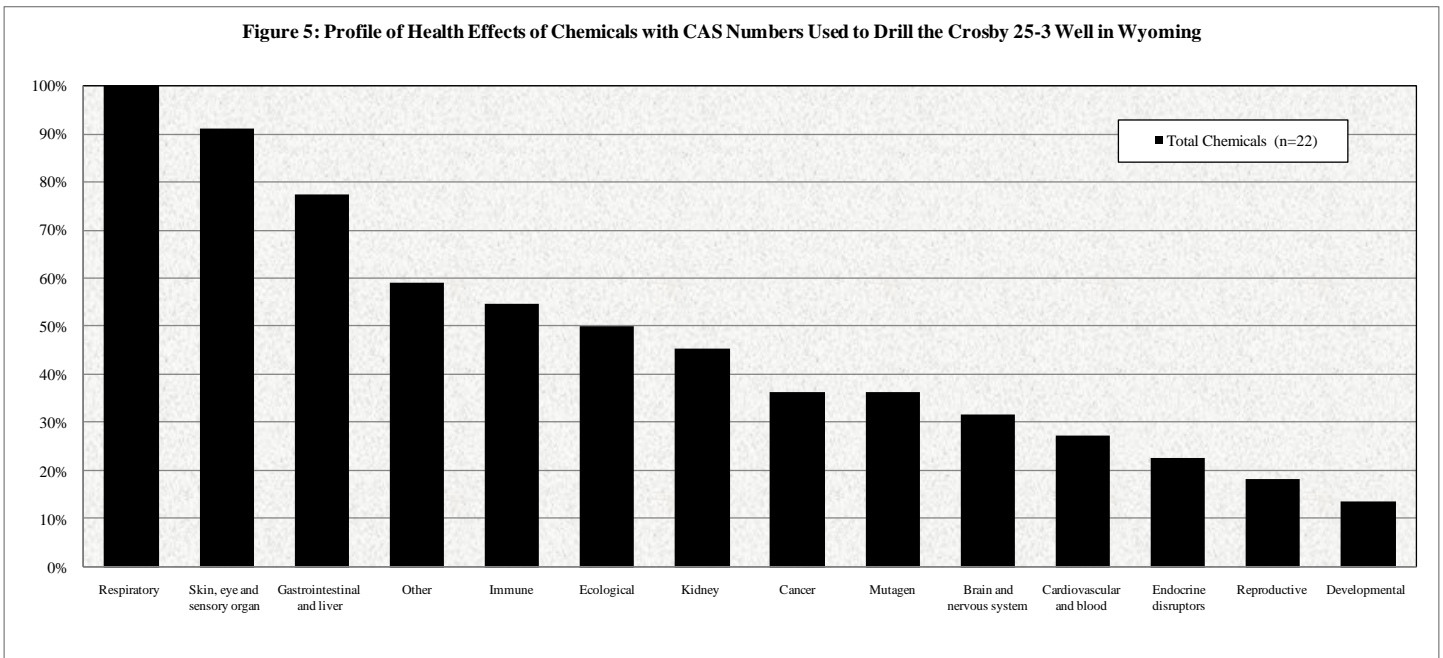
***CHEMICAL SUMMARY***

**Evaluation of the information available about the 32 chemicals**

Products may contain more than one chemical, and a given chemical may occur in more than one product. In the 42 products identified above, there were a total of 32 chemicals. Specific chemical names and CAS numbers could not be determined for 10 (31%) of the chemicals on TEDX’s list. The names provided were too general (e.g. cellulose derivative, inert material), or they were listed as “mixtures,” or “no hazardous ingredients/substances.” It was impossible to link these 10 chemicals without CAS numbers to any health category aside from the health data reported on an MSDS. The limitations of MSDS data for possible health effects are noted above.

**Summary of the health effects associated with the 22 chemicals with CAS numbers**

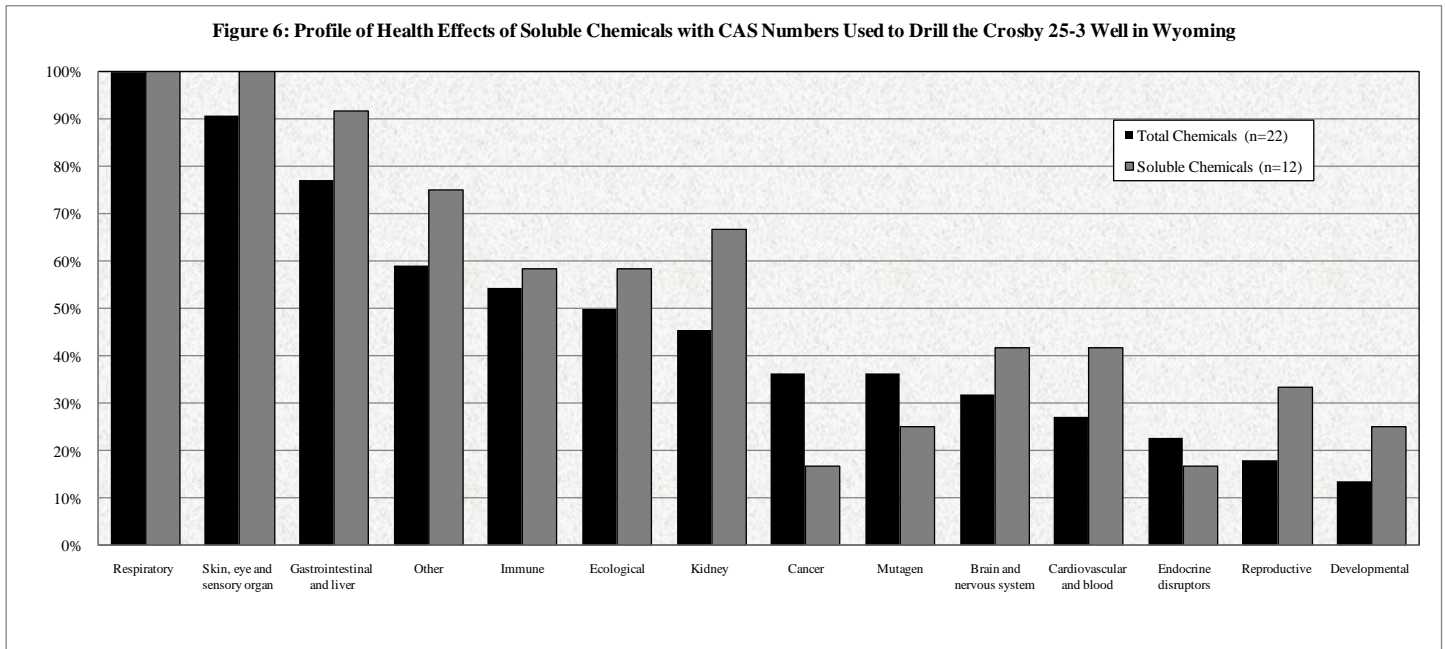
Figure 5 shows the percentages of the 22 chemicals with CAS numbers associated with the general health categories used in government reports. Chemicals are often included in more than one category.



When all of the chemicals are combined, 100% are associated with respiratory effects. Over 90% cause skin, eye and sensory organ problems, and 77% are associated with damage to the gastrointestinal system or liver. The immune system damage can result from exposure to 55% of the chemicals and 50% can cause ecological

effects (harm to aquatic species, birds, amphibians or invertebrates). Fifty-nine percent of the chemicals have health effects in the ‘Other’ category. The ‘Other’ category includes such effects as changes in weight gain, or effects on teeth or bones, for example, but the most often cited effect in this category is the ability of the chemical to cause death.

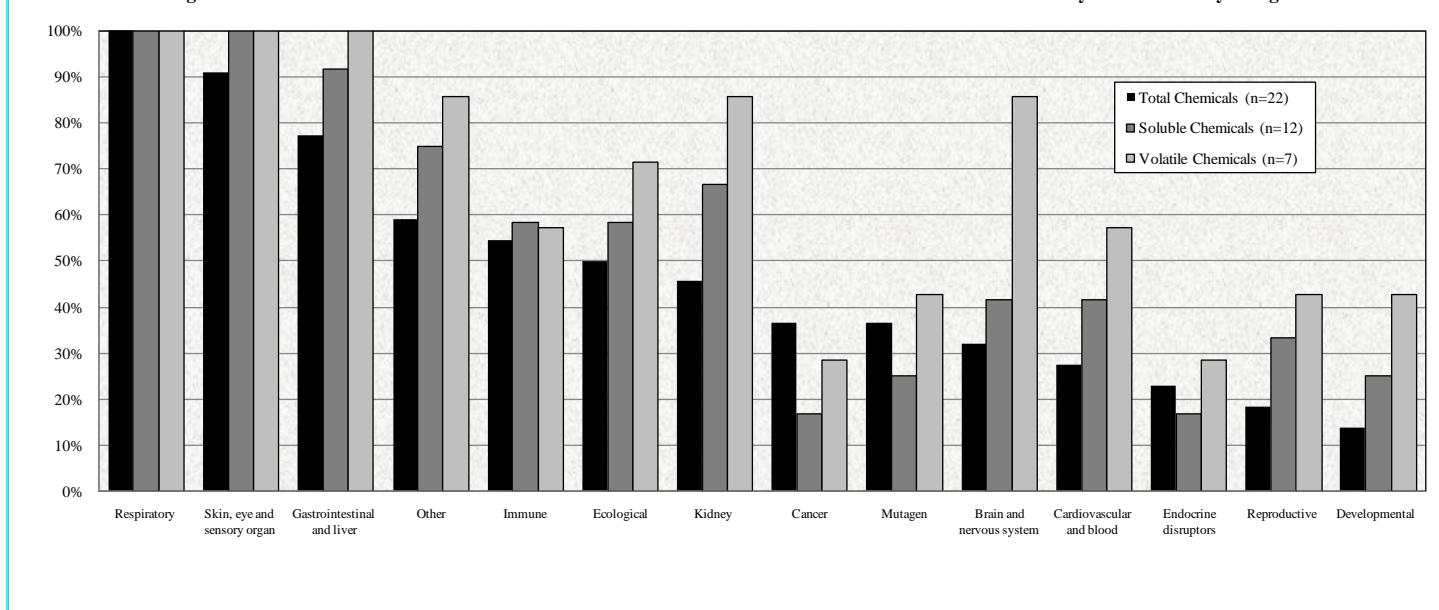
The health effects on the left side of the figure are those effects that are more likely to appear immediately or soon after exposure. These effects include symptoms such as burning eyes, rashes, coughs, nausea, vomiting and diarrhea. The health effects on the right side of the figure are long term and would tend to appear months or years later, such as some cancers, the results of organ damage, harm to the reproductive system, or developmental effects as the result of prenatal exposure, all of which were associated with over 10% of the chemicals in this analysis.



Twelve (54%) of the chemicals with CAS numbers are water soluble. When examined alone (Figure 6), they produce a similar profile of health effects as all the chemicals combined, but with higher percentages in every category except Cancer, Mutagen and Endocrine disruptors. Notably, 100% of these chemicals can harm the respiratory system and the skin, eyes and sensory organs.

Seven (32%) of the chemicals are volatile (Figure 7), in other words, they can become airborne. All of these chemicals can harm the respiratory system, the skin, eyes or sensory organs, and the gastrointestinal system or liver. Over 80% of the volatile chemicals harm the kidneys, the brain and nervous system, or have ‘other’ effects. Overall, the volatile chemicals produce a different profile with higher percentages than the water soluble chemicals. Because they can readily become airborne and can be inhaled as well as swallowed, and they can reach the skin, the potential for exposure to these chemicals is greater.

Figure 7: Profile of Health Effects of Volatile & Soluble Chemicals with CAS Numbers Used to Drill the Crosby 25-3 Well in Wyoming



## COMMENTS

The health effects summary for the chemicals used in Crosby Well is not a weighted analysis. Each chemical is included only once in the summary whether it is in only one product, or in many. Some of the most prevalent chemicals are among those associated with the most health categories.

The products used to drill this Wyoming well eventually made their way to the surface because of an accident. However, most drilling fluids are deliberately brought back to the surface during the drilling process and either reused in a closed loop system, or deposited into pits on the pad for later disposal. The chemicals in these pits can evaporate and be carried off-site to neighboring land, wildlife, livestock and people. Many drilling pits are unlined, and the soluble chemicals can seep into the ground and contaminate sources of water. Accidents, such as berm failure or overflow, can also deposit these chemicals onto the surrounding area.

Besides the chemicals used in drilling a natural gas well, “produced” water (water that comes up from underground during drilling) that can contain benzene, toluene, ethylbenzene, xylene and a variety of other toxic hydrocarbons, is also stored in drilling pits. These are highly volatile chemicals with a host of adverse health effects associated with them. Most of this water is left to evaporate on site, or trucked to treatment facilities that employ evaporation as a main processing method. The residues left in the pits are then “land farmed” where they are incorporated into the soil through disking. Here, toxic metals and silica fines could continually build up in the disked soils and be mobilized on dust particles. Because of the many biocides used throughout natural gas operations it is questionable whether bacteria in the soil can break down the chemicals.

This list provides only a hint of the combinations and permutations of mixtures possible and the possible aggregate exposure. Each drilling incident is custom-designed depending on the geology, depth, and resources available. The chemicals and products used, and the amounts or volumes used, can differ from well to well. The only way to get a realistic picture of what is potentially being introduced into our watersheds and air is to record complete information for each specific well site (state, county, township, section, etc.), the formulation of chemicals and products used at each stage, the quantity of each product (weight and/or volume), total volume injected and recovered, and the depths at which material/mixtures were injected and recovered, the composition of the recovered liquids and of liquids and solids removed from the site. This needs to be public information. From the data in this list, we know for certain that a great deal more than industry’s claim that only water and soap is being used to drill a natural gas well.

