

Letter Health Consultation

Sinclair Refinery

Located East of Sinclair, Wyoming and Rawlins, Wyoming

NOVEMBER 19, 2013

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
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Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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LETTER HEALTH CONSULTATION

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Located East of Sinclair, Wyoming and Rawlins, Wyoming

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In our 21 June 2012 petition acknowledgement letter, the Agency for Toxic Substances and Disease Registry (ATSDR) concluded that the limited amount of sampling data was not sufficient to conduct a detailed exposure pathway evaluation that is characteristic of a Public Health Assessment. However, as a follow-up to the petition acknowledgement letter, ATSDR agreed to review/evaluate available data on ambient air concentrations of sulfur dioxide (SO₂) to determine if additional investigation is necessary. The data was collected during a 10-month period between April 2011 and July 2011, and October 2011 and March 2012. This is the most recently available data at the time we received your petition letter. No data was available August through September 2011. Our evaluation of the available data and information is detailed below.

Background

The Sinclair Refinery is directly to the east of the town of Sinclair, Wyoming (WY) and approximately 6 miles east of the city of Rawlins, WY. The refinery monitors for SO₂ in ambient air as part of its regulatory requirements as an operating facility. The monitoring station is ¼ to ½ mile downwind of the facility toward the east northeast. The predominant wind direction at the Sinclair Refinery is from the west. So the highest ambient concentrations are expected to be east of the facility. Therefore, the monitoring station is appropriate to meet the requirements for ambient air monitoring from emissions of the refinery. No monitoring results are available that would represent the SO₂ concentrations in the community, located west of the refinery.

It is important to note that there were wildfires that occurred during the monitoring period. It is our understanding that the wildfires occurred towards the west of the community and refinery. It is also important to know that soil remedial work was occurring just to the north of the refinery and northeast of the community.

Data Reviewed and Methodological Approach

ATSDR reviewed ambient SO₂ monitoring reports (provided by the Wyoming Department of Environmental Quality's Air Pollution Control Division) and meteorological reports for the 10-month period from April 2011 to July 2011, and October 2011 to March 2012. The data included summary information of atmospheric conditions and concentrations of SO₂, including summary reports of SO₂ (maximum 5 minute concentration and averaged hourly SO₂ concentration for most hours), and summary reports of meteorological data and information (including average hourly wind speed and direction [at 10 meters and 30 meters] for most hours for which SO₂ data is available, as well as temperature, barometric pressure, wind velocity, and wind roses) [AECOM 2011a-2012d].

During the periods of data reviewed, ATSDR identified days that had at least one 5 minute SO₂ measurement of 100 parts per billion (ppb) or more, as well as weather conditions for that event. This concentration was chosen as a conservative screening value (see the table below and the enclosure to this letter which briefly describes the known health impacts of SO₂). It is a value associated with airway resistance in people with asthma breathing through a mouthpiece

[Sheppard 1981]. The meteorological conditions associated with the measurements were compared to the overall conditions for the period. These data were tabulated to determine trends in SO₂ concentrations and meteorological conditions.

Sulfur Dioxide (SO₂) Concentration/range (parts per billion [ppb])	Population	Comment	Exposure conditions
Reference >1,000 EPA 2008	General	Lowest effect in non-sensitive populations	Nose and mouth
>600 EPA 2008	People exercising who have asthma	May require taking medication, stopping exercise, or seeking medical attention	Nose and mouth
400-600 EPA 2008	People exercising who have asthma	Symptoms begin (cough, wheeze, chest tightness)	Nose and mouth
200-250 Horstmann 1986 Boushey 1985	People exercising who have asthma	Lowest asymptomatic effects begin (bronchoconstriction)	Nose and mouth
250 Horstmann 1988	People exercising who have asthma	Effects from exercise alone, no SO ₂ exposure	Nose and mouth
100 Sheppard 1981	People exercising who have asthma	Lowest oral effects using mouthpiece	Oral only

Next, ATSDR identified those days during the period evaluated with peak 5 minute SO₂ concentrations at other levels, especially those greater than 400 ppb because the reported symptoms identified in studies included coughing, wheezing, and chest tightness [EPA 2008]. Most of these days seemed to have occurred at the same time as the wildfires mentioned above.

ATSDR Evaluation

Within the 10 months of data that ATSDR reviewed, there were 25 days when SO₂ was higher than 100 ppb, the lowest level shown to cause airway restriction in people with asthma. There were six days (in 10 months) when air levels were above 400 ppb—the level at which many studies found respiratory effects. Four of six elevated days (between April 20 2011 and June 24 2011) are thought to be impacted by regional wildfires (reported west of the town of Sinclair) and by the soil remedial activities (to the northeast of town). We shared this information with EPA who could find no other evidence that distant wildfires produce such high SO₂ levels.

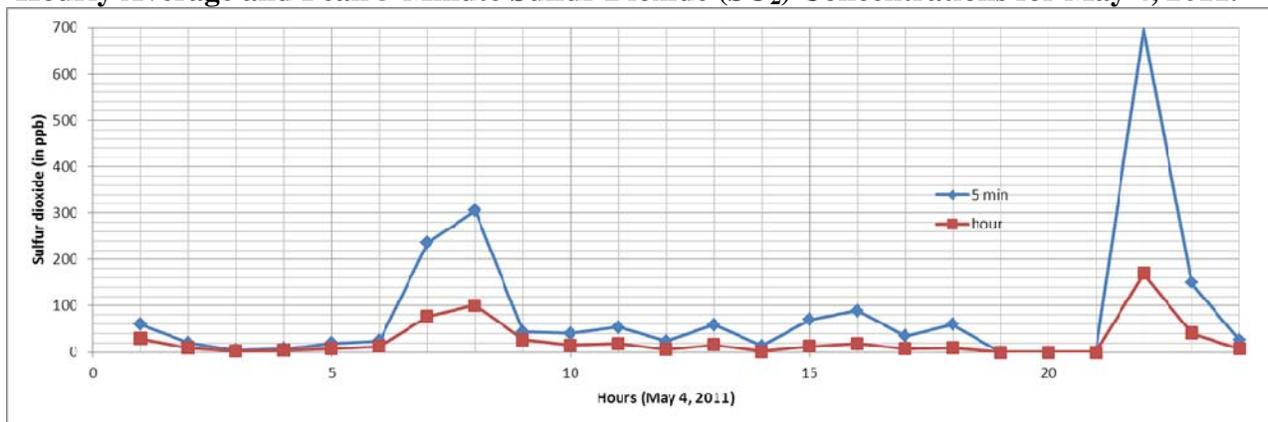
Nevertheless, the wind direction data during these elevated SO₂ events indicate that the soil remediation, the refinery, and the wildfires could have contributed to SO₂ from April through June. The two remaining (of the six) elevated SO₂ events appear to be the result of wind blowing directly from the refinery alone.

Based upon the observed wind and SO₂ trends, ATSDR concluded that Sinclair residents with asthma might experience respiratory symptoms (e.g., cough, wheeze, chest tightness) 1-3 days a month when the winds blow toward the west. It was possible for residents with asthma to have had effects two days a month during the days when there were many potential SO₂ sources and less than once a month for the refinery alone. However, a typical frequency is difficult to determine for several reasons: wildfires and soil remedial activities occurred in the early part of the data; a lapse of data for 2 months before sampling resumed; several sources were in different directions from the community; and, the infrequency of wind blowing from the refinery to the community.

SO₂ was elevated throughout many of the days when wildfires and soil remediation were reported. A few weeks contained peak events (above 100 ppb) throughout the day for several days. However, we cannot determine if there was any direct impact from the refinery on the community because of the many possible sources during that time.

The two events above 400 ppb that are not thought to be influenced by the many potential sources were very short in duration (much less than one hour) and no other peaks above 100 ppb occurred on those days. Furthermore, the elevated levels only occurred when the winds only blew from the southwest during these days and not from the west or northwest. If the SO₂ on these days were the result of the refinery emissions, then the winds blew away from the community of Sinclair for these two days. The single highest maximum 5-minute measurement was 701 ppb at 10 pm (2200 Hours) on May 4th. The chart below is a plot of the 5-minute and 1-hour average SO₂ concentrations on that day.

Hourly Average and Peak 5-Minute Sulfur Dioxide (SO₂) Concentrations for May 4, 2011.



The chart identifies two SO₂ peaks above 100 ppb, at 8 am and at 10 pm. The SO₂ peak events occurred with winds from the west, which is the prevailing wind direction. The winds blew from directly west for the first peak at 8 am –placing the wildfires and the soil remedial activities upwind of the monitor. The winds blew more from the southwest for the second peak after 10 pm., which places the refinery, the soil removal activities, and the wildfires all upwind. These concentrations were measured at the monitor site, located to the east northeast of the refinery and the town of Sinclair.

ATSDR Findings

Because winds seldom blow from the refinery to Sinclair, the refinery emissions will infrequently impact the population center of Sinclair. Winds are also infrequent from the area where soil remediation was occurring.

The highest SO₂ concentrations measured at the air monitor were at levels that could cause short term-respiratory effects in people with asthma. Most of these elevations occurred when wildfires were taking place west of the community and while soil remediation activities were occurring to the northeast of the community. Only during a few occasions were elevated SO₂ concentrations found to occur when there were no wildfires or remedial activities. These occasions may be the result of refinery emissions. However, these elevations did not impact Sinclair because the winds were not blowing toward the community at those times.

The area most likely impacted by emissions from the refinery (and the remedial activities) is located toward the north and east of the refinery. This area is currently undeveloped. ATSDR recommends that consideration be given to conducting additional air quality investigations prior to development (e.g. residential, recreational, etc.) of land in this area or extreme event periods (e.g. soil removal, wild fires, etc.). Additionally, although the wind infrequently blows from the location where soils were being remediated, it would be prudent to cease peak emission-producing activities during those few periods when the community is downwind.

After reviewing the measured SO₂ concentrations in conjunction with the prevalent wind conditions, ATSDR determined that additional monitoring of the SO₂ in Sinclair is only necessary during periods when there are multiple sources.

The Wyoming Department of Environmental Quality (DEQ) has developed monitoring network plans and placed them on the following website for public inspection for people to review and comment: <http://deq.state.wy.us/aqd/Annual%20Network%20Plans.asp>

We will share the information from this letter with the DEQ, but we encourage you to comment should you have additional concerns.

Enclosure

Review of Scientific Literature Regarding Potential Sulfur Dioxide (SO₂) Human Health Impacts

Human studies have found that SO₂ caused airway restriction in people with asthma at levels similar to those measured on several days at the monitoring station to the east/northeast of the Sinclair Refinery. There are twelve human exposure studies that found health effects from SO₂ at levels between 100-500 parts per billion (ppb) in people with and without asthma, which is near the peak levels measured at the monitoring station. In nine of the studies, airway resistance and broncho-constriction were measured after 3–10 minutes of exposure to concentrations of 100–750 ppb [Sheppard 1981, Linn 1983, Linn 1985, Linn 1990, Bethel 1983, Bethel 1984, Bethel 1985, Horstmann 1986, Boushey 1985]. Most of these studies involved people with asthma and the lowest effect levels were observed when people breathed through their mouth only. The results of three studies showed an increase in airway resistance after 10–75 minutes of exposure to 400–500 ppb SO₂ [Koenig 1985, Linn 1987, Roger 1985].

References Used for the Evaluation

Site-specific data files

- AECOM 2011a. Sinclair Wyoming Refining Company, Meteorological Monitoring Program, Second Quarter 2011 Report, 60154267-6, August 2011. (and supporting data files)
- AECOM 2011b. Sinclair Wyoming Refining Company, Ambient SO₂ Monitoring Program, Second Quarter 2011 Report, 60198203-7, August 2011. (and supporting data files)
- AECOM 2011c. Sinclair Wyoming Refining Company, Meteorological Monitoring Program, Third Quarter 2011 Report, 60154267-6, November 2011. (and supporting data files)
- AECOM 2011d. Sinclair Wyoming Refining Company, Ambient SO₂ Monitoring Program, Third Quarter 2011 Report, 60198203-7, November 2011. (and supporting data files)
- AECOM 2012a. Sinclair Wyoming Refining Company, Meteorological Monitoring Program, Fourth Quarter 2011 Report, 60154267-6, February 2012. (and supporting data files)
- AECOM 2012b. Sinclair Wyoming Refining Company, Ambient SO₂ Monitoring Program, Fourth Quarter 2011 Report, 60198203-7, February 2012. (and supporting data files)
- AECOM 2012c. Sinclair Wyoming Refining Company, Meteorological Monitoring Program, First Quarter 2012 Report, 60154267-6, May 2012. (and supporting data files)
- AECOM 2012d. Sinclair Wyoming Refining Company, Ambient SO₂ Monitoring Program, First Quarter 2012 Report, 60198203-7, May 2012. (and supporting data files)

Health-related references

- ATSDR 1998. Toxicological Profile: Sulfur Dioxide, DHHS, December 1998.
<http://www.atsdr.cdc.gov/ToxProfiles/TP.asp?id=253&tid=46>
- HA Boushey, Bethel RA, Sheppard D, Geffroy B, et al. 1985. Effect of 0.25 ppm sulfur dioxide on airway resistance in freely breathing, heavily exercising, asthmatic subjects. *Am Rev Respir Dis.* 131:659-661.
- EPA 2008. Integrated Science Assessment for Sulfur Oxides – Health Criteria. National Center for Environmental Assessment. Office of Research and Development. Research Triangle Park, North Carolina. EPA/600/R-08/047-F.
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D. Sheppard et al., 1981. Exercise increases sulfur dioxide-induced bronchoconstriction in asthmatic subjects. *Am Rev Respir Dis* 123:486-491.