



September 2, 2009

Mark Stehly
BNSF Railway Company
Assistant Vice President Technical Research and Development
2600 Lou Mink Drive
Fort Worth, TX 76131

RE: BNSF Intermodal Facility, Gardner, KS

Dear Mr. Stehly:

At the request of BNSF Railway Company, the Center for Toxicology and Environmental Health, L.L.C. (CTEH) is pleased to have the opportunity to review and comment on many of the toxicological issues that have been raised regarding potential health risks of the proposed intermodal facility near Gardner, KS. In particular, our review addressed comments provided by Andrea M. Hricko (Community Outreach and Education Program (COEP) of the Southern California Environmental Health Sciences Center) and Melissa Lin Perrella and Andrew E. Wetzler (National Resources Defense Council (NRDC)). Our comments are summarized below.

Acute health effects of diesel exhaust

Concerns have been expressed regarding the potential health effects of increased exposure to diesel exhaust as a result of increased traffic at the facility. At sufficient concentrations, exposure to diesel exhaust in air may be associated with various acute symptoms such as irritation of the eyes, nose, throat, and lungs, headache, lightheadedness, cough, and nausea (USEPA, 2002). In general these symptoms are transient and resolve quickly once an individual is removed from the exposure. Excessive exposures to diesel exhaust also have the potential to aggravate pre-existing respiratory problems such as asthma or chronic obstructive pulmonary disease (COPD). As with any chemical exposure, the key factor as to whether acute health effects will occur is based on the magnitude of exposure including the concentration in air and the duration of exposure. In terms of community exposures, predominant wind direction and distance from the source are key considerations in determining potential exposure levels as well.

In reviewing comments by the COEP and NRDC, we note that there is little or no discussion of the potential exposure levels to diesel exhaust that may result from the proposed facility. However, repeated references are made to studies which were performed by the California Air Resources Board (CARB) in their past evaluations of California railyards. For example, Ms. Hricko noted that the highest cancer health risks [and thereby the highest exposure levels] were found at the San Bernardino intermodal facility. In the risk assessment for this facility, it was noted that the hazard indices for non-cancer chronic risk health hazards were 0.05-0.3 (CalEPA, 2008). CARB noted that health hazard indices which are less than 1.0 are unlikely to be associated with potential non-cancer chronic public health risks. In this situation, CARB suggested that it was more reasonable to examine potential cancer risks rather than acute or chronic non-cancer risks.

CARB used a reference concentration of $5 \mu\text{g}/\text{m}^3$ for inhalation exposure and noted that adverse health effects are not expected with exposures at or below this level. Furthermore, CARB notes that “it should be emphasized that exceeding the chronic reference exposure level does not necessarily indicate that an adverse health impact will occur.” The hazard index is calculated by dividing the air concentration by the reference concentration. Calculated diesel PM levels for the San Bernadino risk assessment were thus $0.25\text{-}1.5 \mu\text{g}/\text{m}^3$. Curiously, the estimated average statewide exposure to diesel PM_{10} for California in 2000 was $1.8 \mu\text{g}/\text{m}^3$ (CalEPA, 1998)

The USEPA also used $5 \mu\text{g}/\text{m}^3$ as a reference concentration for diesel PM exposure (IRIS, 2009). USEPA defines the reference concentration as “an estimate (with an uncertainty spanning perhaps an order of magnitude) of a daily inhalation exposure of the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime.” In other words, the estimated diesel PM concentrations associated with the San Bernadino railyard were well below levels that are considered safe for a lifetime of exposure. In short, it is not reasonable to conclude that diesel PM would be associated with health effects in residents located near the railyard or by inference, a similar facility. These findings are not consistent with the NRDC suggestion that exposure to diesel PM in these circumstances will result in an increase in non-cancer health effects.

Carcinogenicity of diesel exhaust

Many of the comments regarding the proposed facility focused on potential cancer risks due to increased diesel exhaust exposures. In particular, Ms. Hricko noted that: “The EA fails to describe elevated cancer risks at other railyards including at numerous BNSF railyards in California” and that the highest risks were found at the intermodal facility in San Bernadino. Also, the California railyard risk assessments showed elevated levels of cancer risk extending more than one mile. The NRDC notes that while it is difficult to predict cancer risk, “data obtained from California railyards suggests, at the very least, that railyards of similar size and operations (and smaller) to the Proposed Project have been known to create significant health impacts.” Extrapolation of the CARB risk assessment studies to the intermodal facility are problematic for a number of reasons and should not be directly applied.

First, the carcinogenicity of diesel exhaust has not been definitively established. Although the state of California considers diesel exhaust to be a known carcinogen, other public health agencies do not concur with such a strong conclusion. For example, the USEPA (2009) has noted that diesel exhaust is likely to be carcinogenic but identifies a number of limitations in determining the overall strength of the association. They note that while some animal studies have shown lung tumors with diesel exhaust exposure, effects have occurred in species which are more susceptible to tumors and occurred at relatively high exposure levels (i.e., $>3500 \mu\text{g}/\text{m}^3$) which are “far beyond the range of environmental levels.” USEPA concludes that “The rat tumor occurrences, thus, are not particularly influential in judging the hazards at environmental levels of exposure.” While a number of studies examining the association between *occupational* exposure to diesel exhaust and lung cancer have reported a small increased risk (i.e., relative risk typically less than 2.0), the studies are difficult to interpret due to poor exposure assessment and inability to eliminate potential confounding effects of smoking. Relative risk refers to the ratio of illness in the exposed population compared to an unexposed population. In contrast to California, the USEPA (2002) concluded that the diesel exhaust human exposure-response data are considered too uncertain to derive a confident quantitative estimate of cancer unit risk.

Assuming that diesel exhaust can cause lung cancer, it should be noted that studies which reported an association examined individuals with increased occupational exposures. Such exposures are not likely for individuals located at a remote distance from the source. Even under occupational exposure conditions, the relative risks in nearly all studies were significantly less than 2.0. The significance of relative risks less than 2.0 are regarded by epidemiologists as difficult to interpret due to the inability to reliably eliminate confounders. In the case of diesel exhaust and lung cancer, the biggest confounder is cigarette smoking. Occupational groups such as railroad workers and truck drivers which have been studied regarding diesel exhaust exposure and lung cancer are known to have high rates of smoking.

Second, risk assessments such as those performed by the CARB are not intended to prove that living near a railyard actually results in increased lung cancer rates. Furthermore, risk assessments of this type do not establish that railyards “have been known to create significant health impacts.” In the CARB risk assessments, diesel exhaust exposure levels for residents living near the railyards were not measured and only estimated based on source emission estimates. A controversial cancer slope factor derived by the state of California was then applied to the exposure estimates to derive the potential number of cancer cases. Extremely conservative exposure assumptions were used such as exposure for 70 years, 24 hours a day, 7 days a week. Finally, there have been no published studies to determine whether residents living near the railyards actually have an increased rate of lung cancer. In short, the risk assessment information cannot be used to “prove” that living near a railyard or that diesel exhaust exposure actually causes increases rates of lung cancer.

Garshick studies

Much of the impetus for California’s designation of diesel exhaust as a carcinogen are based on studies conducted by Garshick et al. beginning in the late 1980’s. Garshick et al. (2004) was also cited by Ms. Hricko as evidence of the carcinogenicity of diesel exhaust. Due to the heavy reliance on the Garshick railroad study and its conclusions regarding diesel exhaust and cancer, it is reviewed below.

Garshick et al. (1988, 2004) examined lung cancer rates in a cohort of railroad employees who were age 40-64 in 1959 and had been employed for at least 10 years. Lung cancer rates in workers such as conductors and engineers, who were considered to have the highest exposure, were increased with a relative risk generally <1.5. In terms of relative risks, this is not a particularly strong association. For comparison, studies of lung cancer and smoking typically show relative risks for lung cancer 10 or more times higher than this. Younger workers tended to have a higher risk of lung cancer which was attributed to increasing use of diesel locomotives starting in the 1950’s. Primary weaknesses of the study included a lack of exposure assessment for the employees, the absence of a clear dose-response relationship, and no information on smoking for the identified lung cancer cases. Although the studies claim to have controlled for smoking, smoking data was actually obtained from a different cohort of workers in which the next-of-kin were asked about smoking histories. This information was then applied to the study cohort and introduces significant sources of error and misclassification.

The lack of accurate information on known smoking rates in the study group is a glaring weakness. Railroad employees from the study timeframe were known to have extremely high smoking prevalence rates. Sterling and Weinkam (1976) reported in a 1970 survey that railroad conductors and engineers were among the 40 occupational categories with the highest percentage of smokers. A previous study

by Garshick et al. (1987) of railroad retirees with more than 10 years of experience showed that 96% of the lung cancer cases were smokers and over 80% of the railroad worker controls were also smokers. In addition, over 90% of the cases and controls in which smoking information was available had smoked more than 20 years. Thus, smoking and even passive cigarette smoke exposure to individuals working alongside smokers is a significant confounder, particularly given the finding that lung cancer relative risks associated with exposure to passive cigarette smoke is similar to that reported in the Garshick studies for diesel exhaust exposure. In that time period, workers could smoke while on duty. Many of the other epidemiological studies which are often cited in support of an association between diesel exhaust and lung cancer, such as studies of truckers, suffer from the same limitations of limited exposure assessment and minimal, if any, information on smoking.

Smoking is estimated to account for 90% or more of all cases of lung cancer. Because it is such a strong confounder, Covey and Winder (1981) have noted that “an appropriate evaluation of an occupationally related disease also affected by smoking must include detailed and comprehensive smoking data.” Speizer (1986) noted that “Because of the overwhelming effect of cigarette smoking, population-based studies that report on environmental effects, particularly at relatively low levels of excess risk (RR greater than 1.0 but less than 2.0), and that do not attempt to take cigarette smoking into account, must be considered seriously flawed. These studies, therefore, can contribute very little to our understanding of risk factors for respiratory cancer.”

Additional perspective on the problem of smoking as a confounder in studies finding weak associations was provided by Sir Richard Doll, a renowned epidemiologist who stated that: “Lung cancer, of course presents a peculiarly difficult problem, because of its close dependence on cigarette smoking and the way smoking habits vary with geographical region and socioeconomic status...Unfortunately it is seldom, if ever, possible to assess the quantitative contribution of this factor to differences in the risk of lung cancer in different occupations, as we neither know the relative importance of smoking habits at different ages nor, if we did, do we usually have smoking histories available in sufficient detail to enable them to be taken into account. Nor is it likely that such detailed histories could now be obtained with sufficient reliability to enable them to be used, once an alternative explanation is known to be suspected” (Doll, 1985).

One of the factors that appears to be overlooked in the Garshick studies has been the association of increasing lung cancer rates which corresponded with increasing cigarette consumption in the U.S. after World War II. The Garshick cohort has been noted to show lower lung cancer rates in older workers who were employed in 1959 compared to their younger coworkers. The higher lung cancer rates in the younger workers were attributed to increased dieselization of the locomotive fleet around this time frame and increased opportunity for exposure to diesel exhaust while operating the diesel locomotives. However, 1959 also corresponds almost exactly to the peak prevalence of smoking in the U.S. (See Figure 1). The marked rise in lung cancer rates after 1950 closely parallels the increased cigarette consumption rates during that era (Figure 2). Thus, given that the actual smoking rates in the study participants were unknown, increased rates of lung cancer in younger workers from the cohort may be due to increased rates of smoking rather than a diesel exposure effect.

Hesterberg et al. (2006) noted similar weaknesses in their review of the literature on diesel exhaust exposure and cancer. They also note that studies of underground miners, who experience the highest

occupational diesel PM exposures, generally do not show elevations in lung cancer. They concluded that “After decades of research involving numerous epidemiologic studies and extensive investigations in laboratory animals, a causal relationship between diesel exhaust exposure and lung cancer has not been conclusively demonstrated.” Their conclusions were essentially the same as Muscat and Wynder (1995) who also reviewed the association between diesel exhaust and cancer and concluded: “Using common criteria for determining causal associations, the epidemiologic evidence is insufficient to establish diesel engine exhaust as a human lung carcinogen.”

In summary, although California has chosen to regulate diesel exhaust as a known carcinogen, the evidence is far from convincing and is based largely on studies, including those by Garshick et al. with significant limitations.

Figure 1. Prevalence of Smoking in the U.S. by decade (from Slade, 1989)

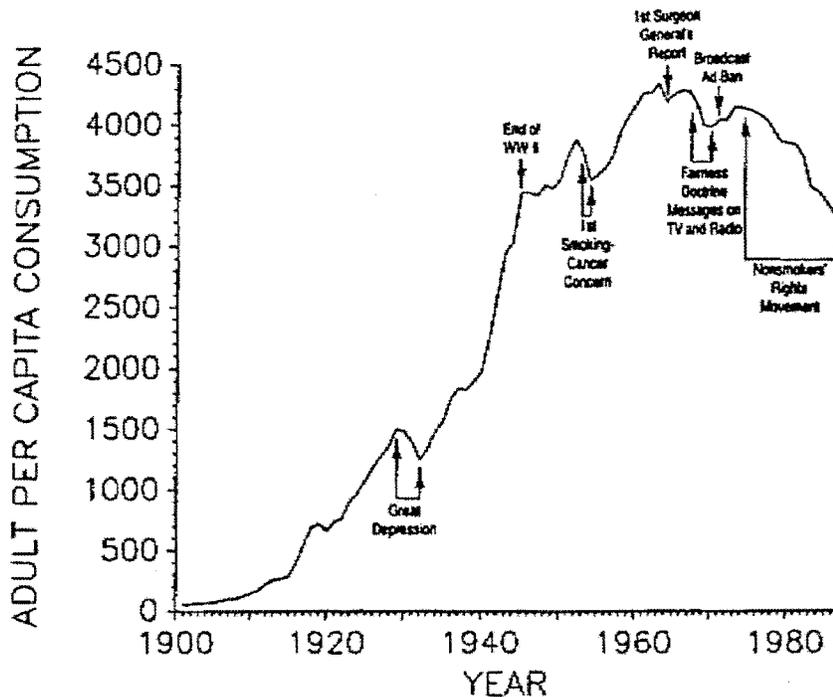
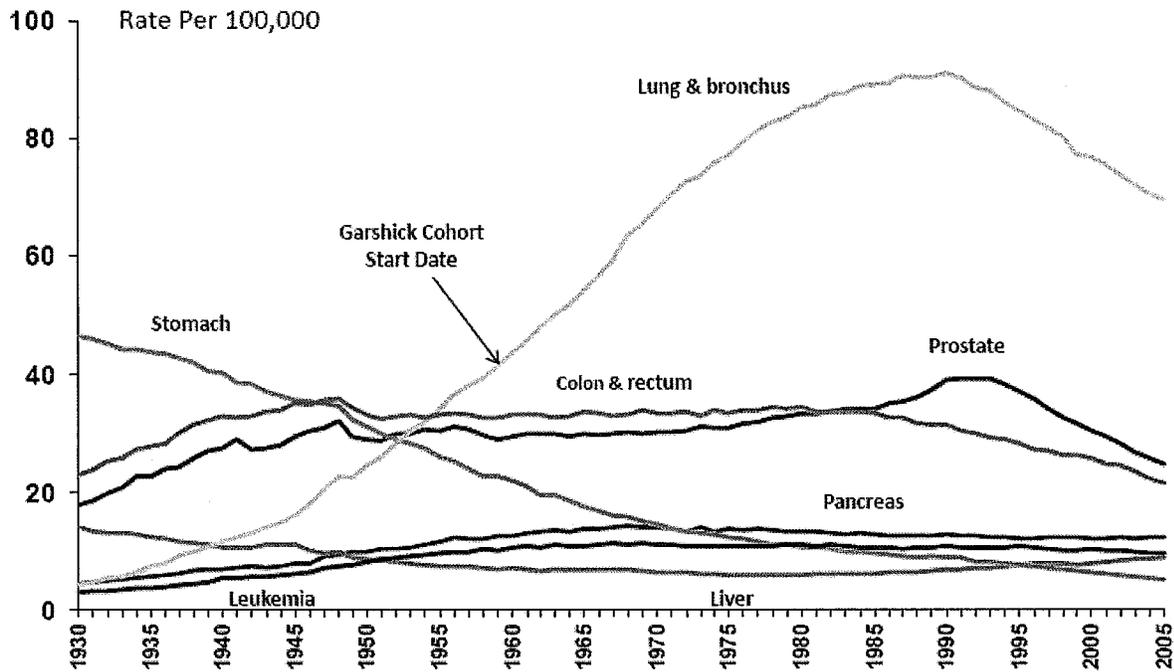


Figure 1. Per capita cigarette consumption, ages 18 and over, and major smoking-and-health events affecting the curve. Adapted from: Warner, K.E. 1985. Cigarette advertising and media coverage of smoking and health. *New England Journal of Medicine* Vol. 312: 384-388.

Figure 2. Cancer death rates among U.S. males, 1930-2005 (from ACS, 2009)



Misleading statements regarding “cancer”

Reviewed comments have repeatedly suggested a link between diesel exhaust exposure and cancer. It should be noted that there are over 100 different types of cancer and the risk factors for each type of cancer are different. It is inappropriate to suggest that exposure to diesel exhaust will increase the rates of cancer in general in an exposed population. As discussed above, studies have primarily examined the association between diesel exhaust and lung cancer. Lung cancer is the most common cancer in U.S. adults. The overwhelming strongest risk factor for lung cancer is cigarette smoking which accounts for 90% of more of all cases. Relative risks of lung cancer due to smoking show an extremely strong and consistent relationship which has not been shown with studies of diesel exhaust. Diesel exhaust exposure is not a known cause of other types of cancer. There are no known studies which have shown an increase in lung cancer rates or cancer in general from diesel exhaust exposure among non-occupationally exposed individuals. It is misleading to insinuate that exposure to increased levels of diesel exhaust from the proposed facility will result in an increase of various other types of cancer.

Other non-cancer health effects

NRDC has suggested that railyards of comparable or even smaller size to the proposed facility have been known to create significant public health impacts. However, the specific health impacts at issue are not specifically defined by NRDC. As noted above, the California risk assessment studies were theoretical evaluations which did not identify a “known” health impact in surrounding communities. In addition, the risk assessments noted that the diesel exhaust exposure levels were significantly less



than the reference concentration for non-cancer health effects and would not be expected to result in any adverse health effects, even with the conservative assumption of a lifetime of exposure, 24 hours a day, 7 days a week. Although comments have provided a number of inferences to increased levels of PM from the facility and their potential association with various health effects, the data cited in the California risk assessment does not necessarily support this observation or that PM levels in the community will be increased to levels of concern. It should be remembered that PM can be derived from many sources including automobile exhaust, wood burning, agricultural activities, and others. Epidemiological studies regarding PM and health effects may include PM from multiple sources other than diesel exhaust.

Review of cited studies regarding non-cancer effects

Ms. Hricko has provided a number of references to support her comments regarding the association between air contaminants and various health outcomes such as asthma, cardiovascular disease, diabetes, and low birth weight. Review of these studies indicates they have limited applicability in assessing the Kansas facility. For example, multiple studies were cited in which health effects were examined among children and/or adults living in several Southern California communities in close proximity to Los Angeles (i.e., Gauderman et al., 2004; Gauderman et al., 2005; Gilliland et al., 2001; Kunzli et al., 2005; McConnell et al., 2006; Salam et al., 2005; Wilhelm and Ritz, 2005). However, no data was provided to indicate that exposures at the proposed facility are comparable in magnitude to that which occurs in the Southern California area secondary to the high of density freeways, vehicular traffic, and the meteorological and topographical conditions unique to that region that result in the familiar smog layer.

Several of the cited studies noted airborne pollutant levels decrease markedly within 150-300 meters of a busy roadway. In fact, McConnell et al. (2006) reported that the effect of the freeway on asthma was only seen in long term residents living within 75 meters of the roadway. Furthermore, this risk was not seen in boys for unknown reasons and suggests a weak association. Kan et al. (2008) noted that the contribution of ultrafine PM from highway traffic becomes indistinguishable from background concentrations at distances >300 meters. These observations are not consistent with CARB health risk assessments claiming increased health risks at increased distances from a railyard. As discussed previously, the CARB assessments were not based on actual air monitoring data showing that air contaminants were elevated at increased distances from a railyard facility. The above studies indicate that it is not plausible to assume that railyard activities would result in increased airborne chemical concentrations (and associated health effects) far off-site.

In terms of respiratory effects and their relationship to vehicular traffic, it is noted that a relationship has not been consistently identified. In fact, one of the studies cited by Ms. Hricko (i.e., Oftedal et al, 2009) notes that a causal relationship between long term exposure to traffic and asthma is so far not clear. In their study of asthma and association with traffic-related exposures they concluded: “We were not able to find positive associations of long-term traffic-related exposures with asthma onset or with current respiratory symptoms in 9- to 10-year-old children in Oslo.” They further note that “Thus it is not clear whether air pollution can induce development of asthma, and we speculate that higher levels of exposure than was present in Oslo may be needed.”



Specific exposures noted in some of the studies cited by Ms. Hricko as having health effects also do not appear relevant to the proposed intermodal facility. Gilliland et al. (2001) examined school absenteeism in Southern California children and attributed an effect primarily to ozone. Effects of NO₂ on school absenteeism were not observed at the levels measured in the communities. The authors further noted that “little evidence exists that symptoms from NO₂ exposure result in school absences.” Ozone has not been specifically identified as a significant substance of concern for the intermodal facility. Wilhelm and Ritz (2005) and Salam et al. (2005) reported an association between carbon monoxide levels and either preterm birth and low birth weights. Carbon monoxide has not been specifically identified as a significant substance of concern for the intermodal facility. High levels of carbon monoxide are not typically associated with diesel engines in comparison to gasoline engines.

Several studies were cited regarding a possible association of air contaminants or other factors with cardiovascular disease. Babisch et al. (2005) was listed in relation to a possible association between traffic noise and myocardial infarctions in Berlin residents. Although an odds ratio of 1.3 for men exposed to sound levels more than 70 decibels during the day was reported, it was not statistically significant. Men who had lived in the area for at least 10 years had a slightly increased risk. However, such a risk was not seen in women which makes the association questionable. Regardless, evidence that the facility would result in noise exposure to this degree in residents living remote from the facility was not presented.

An animal study regarding exposure to ultrafine particles and the occurrence of early atherosclerotic lesions was cited (Araujo et al., 2008). However, it was noted that the exposures in this study were at levels 2-6 times higher than those typically experienced by commuters on Los Angeles freeways. Hartz et al. (2008) was also cited in support of a cardiovascular effect. The study involved direct exposure of brain capillaries from killed rats to diesel exhaust particles and has little practical relevance.

Pope et al. (2004) was cited as evidence of increased cardiovascular mortality due to exposure to fine PM. In the study, the authors reported that a 10 µg/m³ increase in fine PM averaged over several years was associated with an 8-18% increase in cardiovascular mortality risk. No evidence was presented that the proposed BNSF intermodal facility would result in PM increases of this magnitude off-site. Similarly, Kunzli et al. (2005) examined atherosclerosis among Los Angeles residents and noted the annual mean PM_{2.5} was 20.3 µg/m³. Kan et al. (2008) reported a small increase in coronary heart disease for individuals living within 300 meters of major roads compared with those living further away (i.e., hazard ratio of 1.12) but was not statistically significant. As noted above, they found that ultrafine PM levels from highway traffic became indistinguishable from background concentrations at distances >300 meters.

Lucking et al. (2008) and Mills et al. (2007) were cited as evidence of a cardiovascular effect. In these studies, volunteers were exposed to relatively high concentrations of diesel exhaust (300-350 µg/m³) for an hour and blood clotting characteristics subsequently examined. No evidence was presented that the proposed intermodal facility would result in diesel exhaust exposures of this magnitude. As noted above, community diesel exhaust exposures estimated in the CARB studies were orders of magnitude lower than those examined in the Lucking and Mills studies.

In summary, studies cited in the respondent's comments have limited, if any, applicability to the proposed facility based on the circumstances of the studies, levels of exposure, and/or examined substances.

SUMMARY

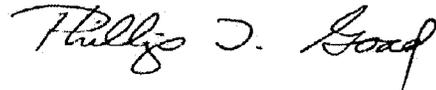
- Exposure to sufficient levels of diesel exhaust in air may cause irritant and other symptoms. These symptoms are transient and resolve quickly when removed from the source of exposure.
- It is unlikely that diesel exhaust levels in air would be at concentrations sufficient to cause either acute or chronic non-cancer health effects as evidenced by CARB risk assessments which used extremely conservative exposure assumptions.
- Diesel exhaust is not a known cause of cancer.
- Studies which have reported an association between diesel exhaust exposure and lung cancer are difficult to interpret due to weak associations, limitations in exposure assessment, and inability to control for the effects of cigarette smoking.
- Diesel exhaust exposure levels in occupational studies reporting an association with lung cancer are not comparable to those which would occur at a remote location from the source. Airborne chemical concentrations decrease rapidly with increasing distance from the source.
- Studies cited by respondents regarding potential health effects of the facility have limited, if any, applicability based on the circumstances of the studies, levels of exposure, and/or examined substances.

Sincerely,

CENTER FOR TOXICOLOGY AND ENVIRONMENTAL HEALTH, L.L.C.



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