Health Consultation

ENDRES PROCESSING, LLC:
REVIEW OF AIR EMISSIONS DATA

CITY OF ROSEMOUNT, DAKOTA COUNTY, MINNESOTA

EPA FACILITY ID: MNR000062612

SEPTEMBER 7, 2005

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

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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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HEALTH CONSULTATION

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Prepared by:

Minnesota Department of Health
Under a Cooperative Agreement with the
U.S. Department of Health and Human Services
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

FOREWORD

This document summarizes human health concerns related to emissions from the Endres Processing, LLC facility in Rosemount. It is based on a formal evaluation prepared by the Minnesota Department of Health (MDH). A number of steps are necessary for this evaluation:

- **Evaluating exposure:** MDH scientists begin by reviewing available information about emissions from the facility and potential receptors. The first task is to review emissions data and dispersion analyses. Usually, MDH does not conduct our own environmental sampling data. We rely on information provided by the Minnesota Pollution Control Agency (MPCA), U.S. Environmental Protection Agency (EPA), Minnesota Department of Agriculture (MDA) and other government agencies, private businesses, and the general public. In addition, MDH looks at the industrial process to determine if there are any additional chemicals or routes of exposure that need to be addressed.
- **Evaluating health effects:** If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. Their report focuses on public health; that is the health impact on the community as a whole—and is based on existing scientific information.
- **Developing recommendations:** In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by emissions, and offers recommendations for reducing or eliminating human exposure to chemicals of concern. The role of MDH in dealing with individual sites is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including EPA, MPCA and MDA. However, if an immediate health threat exists, MDH will issue a public health advisory warning people of the danger, and will work to resolve the problem.
- **Soliciting community input:** The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the individuals or organizations responsible for cleaning up the site, and community living near the site. Any conclusions about the site are shared with the individuals, groups, and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public.

If you have questions or comments about this report, we encourage you to contact us.

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(toll free call—press "4" on your touch tone phone)

Introduction

Endres Processing, LLC (Endres) is located on a bluff over the Mississippi River near the City of Hastings, in the northwestern corner of the City of Rosemount, Dakota County, Minnesota (Attachment 1). Endres processes discarded food products such as baked goods, dried foods, snack foods, candy, dairy and grain products, and converts them into animal feed. These discarded foods are mixed and dried in a direct-fired rotary kiln dryer. Discarded deep-fry cooking oil is also directly injected into the dryer. The dried product is then ground and screened into a finished product. The burner used to heat the dryer is fired primarily with sawdust. However, this fuel is supplemented with shredded food packaging material. Waste gases from the dryer are either recycled to the hot air supply side of the dryer or vented through the stack. The pollution control system consists of a medium efficiency cyclone and a wet scrubber. (Barr Engineering Co., 2003)

Endres' product, Endres Processed and Dried Food By-Product, is designed as a replacement for corn at 10-40% by weight in swine and poultry diets. It is also recommended for beef and dairy rations up to 35% of the dry matter fed (Endres Processing Ltd., 1996).

The Endres facility is surrounded by farmland, a landfill and other industrial facilities (see Attachment 1). Because of community complaints about the facility, the Minnesota Department of Health (MDH) was asked by the Minnesota Pollution Control Agency (MPCA) to review documents on the emissions from Endres, and to submit recommendations to the MPCA, Endres, local officials and the community.

Facility Emissions

For the 12 month period from August 2003 through July 2004, the Minnesota Duty Officer received 48 complaints from the public about emissions from Endres (Attachment 2). Complaints received by the Minnesota Duty Officer and the MPCA describe adverse health effects including: pulmonary effects (difficulty breathing and pneumonia); burning eyes and chest; and headaches. While all of the complaints listed in the attachment identify Endres as a responsible party, a couple of nearby facilities may also contribute to local poor air quality events. Spectro Alloys, a secondary aluminum smelter, is less than ¼ mile west-northwest of Endres and the Flint Hills refinery is about 1½ miles west of Endres (see Attachment 1).

Because of complaints at the location, the MPCA has conducted ambient air monitoring at a site about 2 kilometers (km) south of the facility on a schedule of one 24-hour sample per 6 days since 2003. These data do not show exceedances of chronic (long-term) health-based criteria for the chemicals measured including acetaldehyde, formaldehyde and acrolein. However, there are numerous problems with using these data to determine the impact of a facility on its neighboring community. These include:

- much of the potentially exposed community lies closer to the facility than the monitors.

- a monitoring station is not likely to be placed at the location of the maximum exposure – nor can that location be accurately predicted.
- samples must be collected over a long period of time to determine chronic exposures at the sampling location because only 1 sample per 6 days is collected.
- wind direction and maximum emissions must coincide in order to collect a maximum 24-hour sample at a specified distance from a facility.
- a maximum 24-hour sample is not likely to approach the maximum 1-hour exposure duration, even at the monitor location, due to changes in wind direction, wind speed and facility emissions, and averaging of the air sample over the 24-hour sample collection period. A 1-hour sampling period is needed to evaluate potential acute (short-term) impacts of chemical exposures.

Modeled emission data for the limited number of chemicals analyzed in stack test (discussed below), does not suggest that they will have adverse health impacts 2 km from the facility. In addition, emissions from other industrial facilities, farms and highways make it difficult to assign responsibility for pollutants found in ambient air to a single facility. Further, a monitoring system that would meet all of these objectives (frequency and duration of sample collection, number of monitors needed to provide coverage not dependent on wind direction) and measure many types of chemicals in the field would be prohibitively expensive to operate through time. Therefore, there is no further discussion of monitoring in this health consultation.

There have been 3 stack testing events at Endres. These tests were conducted to determine emission rates and the type of air permit required for the company. Plant configuration, recorded test parameters and emissions analyzed were different for all three. Particulate matter emissions from Endres were measured during performance testing of three stacks on July 5-6, 2001 (Interpoll Laboratories Inc., 2001): the East and West Dryer Scrubber Exhaust Stacks and a cooling cyclone stack. The summary of results are included in Attachment 3. Further stack testing of particulates occurred on November 29, 2001 (Barr Engineering Co., 2001). The November 2001 sampling measured emissions from 2 locations: the east and west scrubber stacks. A summary of these data can be found in Attachment 4. Cooling stack emissions were not measured. It was unclear if the stack was operational in November 2001.

Performance testing on the burner and drum dryer scrubber exhaust took place on March 26, 2003. At this time, exhaust from the west scrubber were recycled through the dryer and emissions from the dryer to outdoor air were confined to a single stack: the east scrubber stack. Fuel used to fire the dryers during testing contained a mean of 5444 pounds (lbs) of sawdust and 940 lbs of wrappers per hour. Dryer scrubber stack emissions data during this test were obtained for total volatile organic compounds, carbon monoxide, acetaldehyde, methane, and formaldehyde. In addition, testing was done for acrolein, benzene and styrene. However, concentrations of these chemicals in stack gases were below detection limits. Stack visible emissions opacity data were also recorded. Attachment 5 (a and b) contains the test summary sheets from the March 2003 stack tests (Barr Engineering Co., 2003). As with the November 2001, the March 2003 report did not mention the cooling stack. It is unclear if the stack was operational.

Endres stack emissions appear to change density and color over even short periods of time, as noted by MDH staff during a site visit (MDH, 2004a). Changes in fuel and changes in raw materials could result in emissions with fluctuating amounts of chemicals or particulates. The potential range of the emissions during operations may be reflected in variability between testing runs on a given day and the variability between testing events on different days.

Table 1, below, describes the testing parameters during each of the 3 testing events (July and November 2001 and March 2003). The table includes the means of available data for each testing event, maximum and minimum reported values for individual testing runs and percent coefficient of variability between runs (% CV; standard deviation / mean x 100).

Raw materials processed during the 3 stack testing events varied from 33.8 tons per hour (tph) to 72.8 tph. This variation may be typical, as production varies from 18 - 60 tons per hour (tph) (Interpoll Laboratories Inc., 2001) and is typically between 25 and 30 tph (Barr Engineering Co., 2003). Finished product was reported during 2 of the 3 testing periods, with a range from 28.1 tph to 43.0 tph. Total emission air flow rate was also different during each test event. Table 1 contains a summary of operating parameters during each of the 3 reviewed stack-testing events. Note that Table 1, column 1 is the total measured stack emissions. Therefore, July 2001 testing includes emissions from 3 stacks, November 2001 includes emissions from 2 stacks, and March 2003 measures emissions from a single stack. As a result, it is difficult to compare emissions between the 3 testing events. There is a poor relationship between total emission volume (in dry standard cubic feet per minute: dscfm) and total production (dscfm = 0.0004 * tph + 30.423; R^2 = 0.4194).

Table 1: Test Parameters Summary

7/5/2001 Test Parameters - Sum of 3 (East, West, Cooling) emission stacks									
	DSCFM	Raw material tons per hr (tph)	Moisture %	Finished material tph	Inlet Temp ºF	Stack Temp ºF	Fuel (lb/hr) sawdust	fiber	MBTU
Mean *	97506	72.8			585				
Maximum *	101545	72.8			621				
Minimum *	93730	72.8			520				
% Variability *	4.0%				9.7%				
n #	9	1 †			3 †				
11/29/2001 Test Parameters - Sum of 2 (East, West) emission stacks									
	DSCFM	Raw material tph	Moisture %	Finished material tph	Inlet Temp ºF	Stack Temp ºF	Fuel (lb/hr) sawdust	fiber	MBTU
Mean *	64666	38.5	27.2%	32.9		120			
Maximum *	67000	41.8	28.2%	35.7		123			
Minimum *	62000	33.8	25.8%	28.1		118			
% Variability *	3.9%	10.8%	4.6%	12.7%		2.4%			
n #	6	3 †	3 †	3 †		6			
3/26/2003 Test Parameters - Single (East) emission stack									
	DSCFM	Raw material tph	Moisture %	Finished material tph	Inlet Temp ºF	Stack Temp ºF	Fuel (lb/hr) sawdust	fiber	MBTU
Mean *	35167	51.1	29.3%	39.8	682	142	5444	940	54.8
Maximum *	35600	54.8	31.5%	43.0	748	143	6077	940	59.9
Minimum *	34500	45.2	27.0%	35.9	645	142	4937	940	50.8
% Variability *	1.7%	10.1%	7.7%	9.1%	8.4%	0.41%	10.7%	0.0%	8.5%
n #	3	3	3	3	3	3	3	3	3

Results of Analysis of Variance between stack test parameters for different testing dates p=0.1 in red

	Sample Dates	DSCFM	Raw material	Moisture	Finished material	Inlet Temp	Stack Temp	sawdust	fiber	MBTU
Total	11/29/2001 - 3/26/2003		0.030	0.232	0.095		0.00016 **			
East	7/5/2001 - 11/29/2001	0.00017								
West	7/5/2001 - 11/29/2001	0.0095								

* Statistic calculated from n samples during single test event
\# Number of samples = ∑ (East Stack Samples, West Stack Samples, Cooling Tower Samples)
† Data not credited to a specific stack/equipment
** East Stack comparison only

Sampling analytical results are reported in Attachments 3-5 and summarized in Table 2. Table 2 includes the means of results from each testing event, maximum and minimum data for individual testing runs and % CV between runs.

Note the high % CV of analyte emissions between testing runs (7.3 – 95.7%) suggesting large variability between test runs during single testing events.

Table 2: Test Results Summary

7/5/2001 Test Results - Sum of 3 (East, West, Cooling) emission stacks					
	PM_{10}	Dry+Organic	Dry	Organic	Aqueous
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Mean *	43.7	41.9	40.1	1.83	1.79
Maximum *	48.5	46.6	44.3	2.32	1.92
Minimum *	39.6	37.9	35.9	1.25	1.66
% Variability *	10.3%	10.5%	10.4%	29.5%	7.3%
n #	9	9	9	9	9

11/29/2001 Test Results - Sum of 2 (East, West) emission stacks					
	PM_{10}	Dry+Organic	Dry	Organic	Aqueous
	lb/hr	lb/hr	lb/hr	lb/hr	lb/hr
Mean *	23.6	22.1	18.6	3.45	1.54
Maximum *	26.1	24.3	21.2	3.92	1.76
Minimum *	20.5	19.3	15.4	3.07	1.14
% Variability *	12.2%	11.5%	15.9%	12.5%	22.6%
n #	6	6	6	6	6

3/26/2003 Test Results - Single (East) emission stack									
	VOC(wet basis)	CO(dry basis)	Acetaldehyde	*Acrolein*	*Benzene*	*Styrene*	Methane	Formaldehyde	Evaluated
	lb/hr	lb/hr	lb/hr	*lb/hr †*	*lb/hr †*	*lb/hr †*	lb/hr	lb/hr	% VOCs
Mean *	45.7	33.3	7.10	*0.471*	*0.252*	*0.740*	0.293	0.413	17.1%
Maximum *	50.0	38.0	8.60	*0.646*	*0.252*	*0.740*	0.410	0.820	19.7%
Minimum *	40.0	25.0	6.00	*0.361*	*0.252*	*0.740*	0.220	0.030	14.1%
% Variability *	11.2%	21.7%	18.9%	*32.5%*			34.8%	95.7%	
n #	3	3	3	*3*	*3*	*3*	3	3	3

Analysis of Variance between stack test results for different testing dates -- p ≤ 0.1 in red						
Scrubber	**Sample Dates**	**PM_{10}**	**Dry+Organic**	**Dry**	**Organic**	**Aqueous**
East	**7/5/2001 - 11/29/2001**	**0.012**	**0.012**	**0.013**	**0.034**	0.738
West	**7/5/2001 - 11/29/2001**	**0.082**	**0.075**	**0.047**	0.154	0.679

* Statistic calculated from n samples during single test event
\# Number of samples = ∑ (East Stack Samples, West Stack Samples, Cooling Tower Samples)
† Detection Limit (italics)

Tables 1 and 2 also include the results of an Analysis of Variance (ANOVA) comparing similar test parameters and data from different testing events to determine whether the events could likely be from the same data set. Parameters and data differences between tests resulting in p values of less than or equal to (≤) 0.10 are highlighted in red. These differences may have been caused by changes in raw materials, fuel, operating procedures or equipment between the 3 different testing events.

Chlorinated dibenzo-p-dioxins / dibenzofurans
In addition to stack test data, Endres submitted to the MPCA the results of chlorinated dibenzo-p-dioxins and dibenzofurans (dioxins) analysis of a single composite sample identified as finished feed product and as bakery meal. The sample, collected on January 13, 2003, was a composite of 74 samples of finished feed retained from November 4, 2002 through January 13, 2003. Reporting limits for 2,3,7,8-tetrachlorinated dibenzo-p-dioxin (2,3,7,8-TCDD) and 2,3,7,8-tetrachlorinated dibenzofuran (2,3,7,8-TCDF) were 0.99 nanograms per kilogram (ng/Kg) or parts per trillion (ppt); the reporting limit for octachlorinated dibenzo-p-dioxin (OCDD) and octachlorinated dibenzofuran (OCDF) was 9.90 ppt; and 4.90 ppt was the reporting limit for all other chlorinated dibenzo-p-dioxins and chlorinated dibenzofurans. No detections were recorded for all 2,3,7,8-like dioxin congeners. TCDF homologues were present at 13 ppt (Pace Analytical, 2003).

MDH, EPA, ATSDR and many international agencies evaluate dioxins as a group and use a 2,3,7,8-TCDD toxic equivalency quotient (TEQ) to characterize the toxicity of these mixtures (Van den Berg et al., 1998). With the TEQ approach, the concentrations of different dioxins (chlorinated dibenzo-p-dioxins and dibenzofurans) are converted to equi-toxic concentrations of 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD). TCDD TEQs are added together for a total TCDD TEQ that can be directly compared with screening guideline values for TCDD. The U.S. Food and Drug Administration (FDA) has recommended that dioxin concentrations in meat be less than 1 ppt, when evaluated as 2,3,7,8-TCDD TEQs (USDA, 1997).

Cattle regularly fed dioxin-contaminated feed are likely to accumulate dioxins in their meat and milk. The amount accumulated will depend on the fraction and total amount of contaminated feed that they are fed. An animal eating a large portion of contaminated feed may accumulate dioxins in their meat and milk to a higher concentration than found in feed. The portion of an animal's current diet, the total amount they are fed (are they being finished or is this a lifelong diet) and the rate of bioaccumulation into milk and/or meat are all important. Data on bioaccumulation in the meat of cattle are sparse (personal communication with Paul South, US Food and Drug Administration); in dairy cattle there is an accumulation in milk fat at about 6-times the feed (Huwe and Smith, 2005). Appropriate reporting levels for dioxins in feed are therefore lower than those of the January 13, 2003 composite feed sample at Endres.

Emissions data for dispersion modeling

Long-term dispersion modeling depends on relatively accurate estimates of yearly emissions from a source. Because the ANOVA between testing events indicates that emissions from different testing events are not comparable, and because of the large range in emission rates during individual testing events (%CV), MDH has concluded that data are not sufficient to estimate yearly emissions or resulting levels of pollutants in air. Accordingly, hourly emission data from March 26, 2003 and November 29, 2001 are used to estimate only short-term ambient air concentrations of pollutants that may have occurred under certain meteorological conditions near Endres during testing. Inter-event and intra-event data variability suggest that emissions and resulting short-term ambient air concentrations at different times may be higher or lower. There are no available data or information showing that testing occurred during "worst-case" conditions.

Chemical information and human health standards and values

Many volatile chemicals are emitted from Endres stacks. As the chemicals mix into the air, they become diluted. Over time most will be broken down chemically into common non-toxic environmental compounds. However, some may persist for sufficiently long periods of time in the atmosphere, in soils or in water that they may be breathed, eaten and drunk. As long as exposure is limited to low levels, these chemicals are not likely to adversely affect the health of an individual.

MDH, and other state and federal agencies that develop public health standards and guidelines (e.g. the US Environmental Protection Agency (EPA), California Office of Environmental and Health Hazard Assessment (OEHHA)), review available research and develop conservative standards and values that are protective of public health for many chemicals found in the environment. MDH has developed Health Risk Values (HRVs) as health standards that are safe levels of exposure for the general public and sensitive populations for 1 hour (acute); 3 - 12 months (sub-chronic), and; 1 year to a lifetime (chronic) (MDH, 2002). HRVs with cancer endpoints are associated with incremental risks of no more than 1 additional cancer in 100,000 individuals exposed over a lifetime (70 years). EPA reference concentrations (RfCs) and California Reference Exposure Levels (RELs) are similarly derived. Table 3 shows standards, guidelines and endpoints for chemicals known to be emitted from Endres and other chemicals that may be found in Endres emissions. While chronic hazards and cancer risk from emitted chemicals are not calculated in this document, these criteria are included in Table 3 because they will be needed in subsequent analyses of risks that may be associated with Endres emissions.

National Ambient Air Quality Standards (NAAQS) are promulgated by the EPA and are concentrations of specific pollutants, not to be exceeded from 0 to 3 times (chemical and standard dependent) during a specified averaging period. NAAQS are available for at least three pollutants that are emitted from Endres: carbon monoxide, particulate matter less than 10 microns in size (PM_{10}) and particulate matter less than 2.5 microns in size ($PM_{2.5}$). The NAAQS sets a legal limit for ambient air, and MDH believes that the general public should not be exposed to concentrations of these pollutants approaching these levels. Research has shown that health effects may result from exposure to certain pollutants at levels equal to or below the NAAQS (e.g., Lippmann and Schlesinger, 2000 contains a review of ozone and particulate matter epidemiology and toxicology).

Table 3: Chemicals of concern

Compound (odor threshold - from CHRIS)	Acute health-based values - µg/m^3	Short-term Toxic Endpoint	Sub-chronic health-based values - µg/m^3	Chronic health-based values - µg/m^3	Long-term Toxic Endpoint
acetaldehyde (0.09 mg/m^3)				5 - HRV 9 - RfC	Cancer Olfactory epithelium
acetic acid (2.5 mg/m^3)					
acrolein (0.5 mg/m^3)	2 - MDH HBV	eye irritation	0.2 - HRV	0.02 - RfC	Respiratory system
acrylamide				0.0077 - RfC	Cancer
acrylonitrile (47 mg/m^3 -rapid odor fatigue)				0.15 - HRV 2 - RfC	Cancer nasal inflammation - degeneration of epithelium
benzene (21 mg/m^3)	1000 - HRV	Reproductive / developmental		1.3 - 4.5	Cancer
chlorinated dibenzo-p-dioxins / dibenzofurans				0.007 pg/kg/d TEQ - MDH Guidance	Cancer
formaldehyde (1 mg/m^3)	94 - HRV	eyes and respiratory system		0.77 - HRV 3 - REL	Cancer Respiratory and eyes
formic acid (40 mg/m^3) (Verschueren, 1977)					
2-furfuraldehyde			500 - HEAST	50 - HEAST	Olfactory degeneration
glutaraldehyde				0.08 - REL	Respiratory system
methane (130 mg/m^3)					
N-nitroso-di-n-butylamine				0.0063 - RfC	Cancer
N-nitroso-N-methylethylamine				0.0016 - REL	Cancer
N-nitrosodi-N-propylamine				0.005 - REL	Cancer
N-nitrosodiethanolamine				0.01 - RfC*	Cancer
N-nitrosodiethylamine				0.00023 - RfC	Cancer
N-nitrosodimethylamine				0.00071 - RfC	Cancer
N-nitrosodiphenylamine				3.8 - REL	Cancer
N-nitrosopyrrolidine				0.02 - IRIS	Cancer
styrene (0.65 mg/m^3)	21,000 - HRV	Irritant - eye and respiratory system		1,000 - HRV	Nervous system

* Calculated from oral reference dose
CHRIS - Chemical Hazards Response Information System (US Coast Guard, 2005)
HRV - Minnesota Department of Health, Health Risk Value (MDH, 2002)
RfC - Environmental Protection Agency, Reference Concentration (EPA IRIS, 2004)
MDH HBV - Minnesota Department of Health, Health-based value (MDH, 2004b)
HEAST - Environmental Protection Agency, Health Effects Assessment Summary Tables (EPA, 1997)
REL - California Environmental Protection Agency, Reference Exposure Levels (CA OEHHA, 2003)

Potential exposures to chemicals associated with Endres

This health consultation does not include a quantitative evaluation of the potential risk of any sub-chronic, chronic or cancer endpoints. The variability of the emissions data does not appear to correspond with operating parameters and product load. Therefore, predicting long-term (seasonal or annual) emissions from available data are problematic (see Tables 1 and 2 and facility emissions discussion above).

The MPCA uses a DISPERSE model (based on dispersion factors from the EPA AERMOD dispersion model; EPA, 2005) to conservatively screen potential exposures to emissions from industrial facilities. Emissions, stack heights and distance to the nearest receptor are entered into the model. From these facility-specific information the model calculates the potential concentrations of the emissions in ambient air at the location of the nearest receptor. The MPCA and MDH believe these modeled data reliably estimate potential maximum concentrations in ambient air resulting from facility emissions. In addition modeled ambient air concentrations are not limited like ambient air monitoring, by sampling and analytical difficulties such as: averaging of sample concentrations over the typical 24 hour sampling duration; and accounting for potential exposures below ambient air detection limits.

Modeled concentrations in ambient air ($\mu g/m^3$) are divided into health guidelines or standards ($\mu g/m^3$), to determine the potential hazards of exposure as hazard quotients (unitless). An interactive spreadsheet version of this screening model (MPCA RASS) is available on the web at: http://www.pca.state.mn.us/air/aera-risk.html . Individual inputs to the RASS, including chemical-specific health and regulatory criteria are discussed below.

MDH used the MPCA RASS (MPCA, 2005) to calculate potential acute exposures to measured emissions from Endres based on the highest values obtained in stack tests. The Endres stack is assumed to be 6.86 meters (22.5 feet) high (Barr Engineering Co., 2003). There are 3-4 homes within about 500 meters (m) of the Endres stack. Currently, there are no houses near the Endres fenceline which is about 200 m from the stack. Acute (1 hour) exposures may occur at distances closer than the residences.

Note that the acute values calculated below are based on already completed stack tests. The large range in testing results discussed above suggests that stack testing may not have occurred under worst-case conditions. Stack testing under worst case conditions could result in an upward revision of hazard estimates.

The RASS reports screening exposures as multiples of the health-based standards or values for all chemicals over acute durations (and also sub-chronic, chronic and lifetime exposure durations when applicable). That is, the model calculates a maximum hazard quotient for each chemical for which there are health-based standards or values by dividing the maximum exposure estimate (averaged over 1 hour in the present case) by the appropriate health-based criterion (e.g. HRV, RfC, HBV). The hazard quotients for all chemicals for each duration are then added, resulting in an acute hazard index. The

RASS does not discriminate between different endpoints when calculating a hazard index.

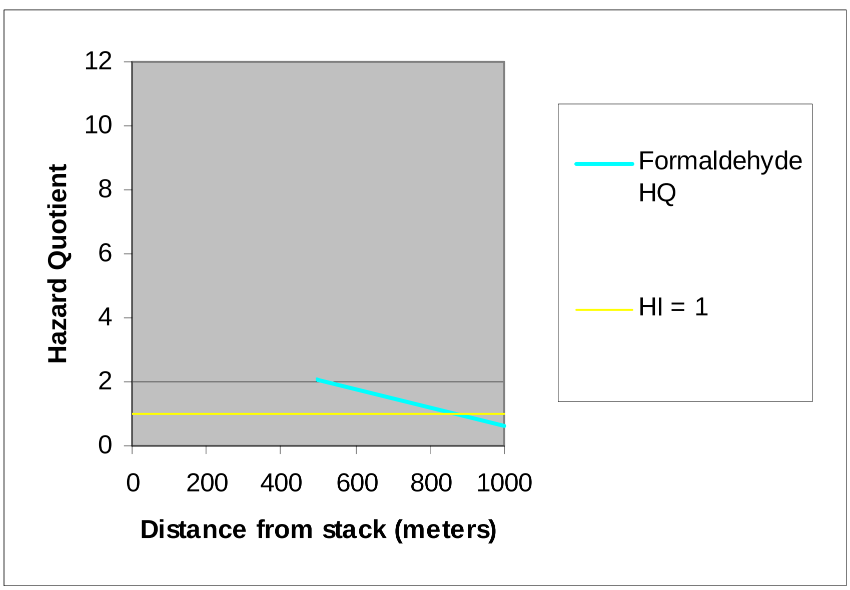
If the acute hazard index is greater than 1 then there may be some risk or hazard to an individual a certain distance from the facility, exposed to emissions for a 1 hour period. If the individual is further from the facility, or exposed for a shorter period of time, risks may be lowered. Conversely, if an individual is nearer to the facility, or exposed for a longer period of time, risk may be higher.

Chemicals of concern in air emissions

Acetaldehyde
Inhalation exposure to acetaldehyde can lead to eye, skin and respiratory irritation (CA OEHHA, 2003). However, there is no acute criterion for quantitative evaluation of short-term exposure to acetaldehyde. Therefore, the short-term effects of acetaldehyde are not evaluated. Chronic and cancer standards for acetaldehyde are listed in Table 3.

Formaldehyde
Formaldehyde is an respiratory and eye irritant and a carcinogen (CA OEHHA, 2001a; MDH, 2002; EPA IRIS, 2004). MDH has an acute HRV for formaldehyde of 94 µg/m^3. Chronic and cancer standards for formaldehyde are listed in Table 3. Figure 1 shows the potential acute hazard from formaldehyde for individuals, from 50 m to 1000 m (1 km) from the stack, exposed for one hour.

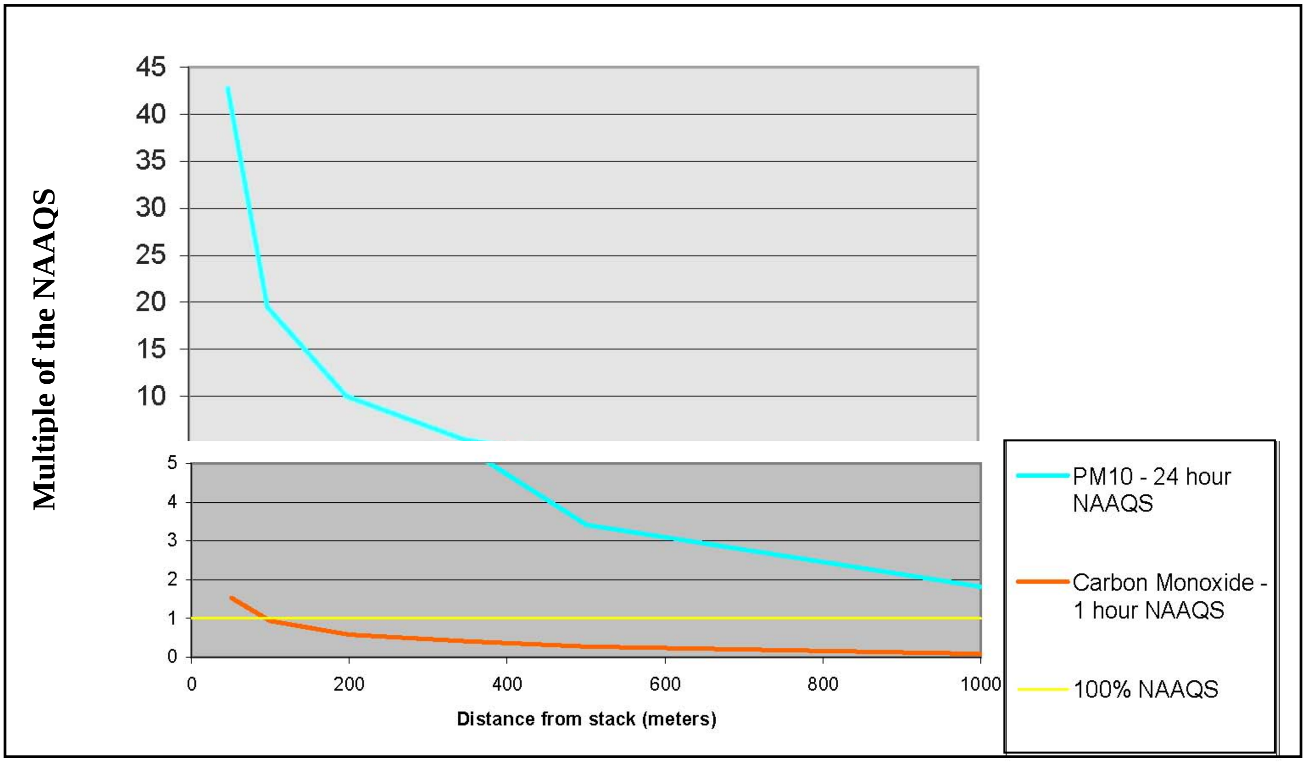
Figure 1: Potential acute hazard vs distance from Endres: Formaldehyde



Carbon Monoxide
Carbon monoxide has 2 NAAQSs. The carbon monoxide NAAQSs, not to be exceeded more than once during one year, are 10,000 µg / m^3 and 40,000 µg / m^3 for eight hours and one hour, respectively (EPA, 2004).

Figure 2 shows the maximum fraction of the one hour carbon monoxide NAAQS that may be in ambient air 50 meters to 1 kilometer from Endres. The RASS model does not calculate hazards over eight hour averaging times.

Figure 2: Relationship between modeled NAAQS pollutant concentrations in ambient air and distance from Endres: PM_{10} and carbon monoxide



Particulate Matter

Breathing particulates in air (i.e. PM_{10} or $PM_{2.5}$) can result in significant health problems, including: aggravated asthma, increases in respiratory symptoms like coughing and difficult or painful breathing, chronic bronchitis, decreased lung function, or even premature death (EPA: http://www.epa.gov/air/urbanair/pm/hlth1.html). Particulates can also act as physical substrates and help catalyze chemical reactions which produce tropospheric ozone and photochemical smog (EPA, 1985).

Particulates (PM_{10} and $PM_{2.5}$) are regulated under the NAAQS (EPA, 2004). No data are available on $PM_{2.5}$ emissions from Endres. The 24-hour PM_{10} standard of 150 µg/m^3 may not be exceeded more than once per year. The annual PM_{10} NAAQS is 50 µg/m^3.

Figure 2 shows the maximum fraction of the 24 hour that may be in ambient air 50 meters to 1 kilometer from Endres.

Acrolein

MDH has developed an acute health-based value for acrolein of 2 µg/m^3 based on eye irritation (MDH, 2004b). Acrolein exposure has also been shown to cause histopathological changes in the respiratory system of laboratory animals, as well as increased mortality, decreased food consumption and decreased weight gain (CA

OEHHA, 2001b; EPA IRIS, 2004). Sub-chronic and chronic standards for acrolein are listed in Table 3.

Acrolein was not detected during stack testing at Endres on March 26, 2003 (3,700 µg/m^3 mean detection limit). However, acrolein is typically emitted from facilities similar to Endres, and analytical detection limits were high, as shown in Table 2. For the purpose of modeling, acrolein emissions from Endres were assumed to be ½ of the analytical detection limit. The range of potential acute hazard quotients for acrolein from 50 m to 1 km from the facility may be 215 to 12.

To determine the hazards associated with arcolein exposure, detection limits should be at least 430 times lower than the detection limits used during testing on March 26, 2003.

Benzene
MDH has an acute HRV for benzene of 1000 µg/m^3, based on reproductive and developmental endpoints. Chronic and cancer standards for benzene are listed in Table 3.

When the detection limit for benzene during stack tests is assumed to be equal to benzene emissions, the largest modeled hazard quotient for benzene is 0.34 for acute exposure, 50 meters from the stack. The detection limit used for analyzing benzene emissions on March 26, 2003 (1,750 µg/m^3) was sufficient for determining if benzene is an acute, chronic or cancer risk 200 meters or more from the facility stacks.

Methane
Methane demonstrates little toxicity below its lower explosive limit (LEL: 5% by volume) (National Library of Medicine, 2005) and therefore, is of no toxicological significance.

Styrene
Styrene is an organic solvent that is an irritant and also has general neurological effects. Excessive occupational exposure to styrene has also been shown to cause color-blindness which may, or may not, be reversible (Gong et al., 2002). MDH has an acute HRV of 21,000 µg/m^3 (MDH, 2002). A chronic standard for styrene is listed in Table 3.

The maximum modeled hazard quotient for styrene emissions at the detection limit is 0.05 for acute exposure at 50 meters. The detection limit for styrene during the March 26, 2003 stack tests (5,800 µg/m^3) is sufficient to determine acute and chronic hazard quotients for styrene.

Dioxins in airborne emissions and feed
Chlorinated dibenzo-p-dioxins and dibenzofurans (dioxins), if they are produced in sufficient quantities at Endres, may be found in both the air emissions and the feed product. Endres uses a direct-fired rotary kiln dryer to dry their product. This allows air combustion products to commingle and adhere to the feed product. Dioxins are lipophilic compounds (having great affinity for fatty substances). They may attach to the feed product, or they may be emitted into the air. Dioxins in feed consumed by livestock accumulate in edible tissues as well as in dairy products. As a result, when people

consume meat and dairy products, they also consume a portion of the dioxin that the animal consumed. Therefore, dioxins at high enough concentrations in Endres' feed product could be a public health concern. Many of the other chemicals of concern listed above can also be found in both airborne emissions and feed. However, these chemicals do not accumulate in the livestock, and therefore people will not be exposed to greater amounts of them if these chemicals are ingested by livestock.

Dioxins are ubiquitous in the environment, and all people have body burdens of these chemicals. Current body burdens of dioxins approach levels of health concern for the general public. The inhalation of dioxins is not typically a public health concern. Food is the largest source of dioxins for the general public (ATSDR, 1998; MDH, 2003b). Reduction of human exposures to dioxins likely requires restriction or elimination of significant sources of dioxins to farmland and fishable waters. This includes limiting dioxin emissions from industrial facilities.

Dioxins are accidental products of burning or incineration processes, and they have been inadvertently formed during the manufacture of some feed supplements (Hileman, 2002). There are 3 possible sources of dioxin production at Endres:

- Formation when sawdust is burned
- Formation when fiber, or wrappers, are burned
- Formation in the feed during the drying process

Dioxins are formed when organic chemicals, especially larger, synthetic, chlorine-containing chemicals like plastics, are incompletely burned. Burn-barrels and solid waste incinerators can be significant producers of dioxins (EPA, 2003). In addition, burning CCA-treated wood has been shown to cause an increase in dioxin generation by several orders of magnitude (Tame et al., 2003). It is suspected that copper from the pesticide is a very effective catalyst in the formation of dioxin. Therefore burning of copper, including copper from other pesticides, such as ACQ, or any other copper-containing material, or the addition of copper to the feed itself may result in the generation of additional dioxin (UK Food Standards Agency, 2002).

Burning plastics, such as candy and bakery wrappings, may cause dioxin formation. Wrappers are up to 30% of the total fuel used to fire the dryers at Endres. During testing on March 26, 2003, Endres burned wrappers at a rate of about 11 tons per day and they have the potential to burn about 12 tons of food wrappers per day (Endres Processing Ltd., 1996; Barr Engineering Co., 2003).

Dioxins may be formed in Endres' dryer. *De novo* synthesis of dioxins has been seen at a Minnesota feed supplement production facility (FDA Center for Veterinary Medicine, 2002). Formation of dioxins is known to occur preferentially between 500 and 1200º F (250 and 600º C) in municipal waste combusters (Kilgroe, 1996). Inlet temperatures to the dryer during 2 tests at Endres were between 520 and 748º F, and stack temperatures ranged from 118 to 143º F.

Dioxins are associated with a variety of health effects in humans and animals including altered reproduction and development of offspring, immune dysfunction and cancer. The MDH website contains guidance on characterizing dioxin cancer risk (MDH, 2003a). MDH uses a cancer slope factor of $1.4 * 10^{-3}$ picogram per kilogram per day ($(pg/kg/d)^{-1}$) to calculate risk. MDH considers lifetime incremental cancer risks of no more than one additional case per 100,000 people exposed for a lifetime to be negligible. Uptake of 0.007 pg/kg/d of dioxins for a lifetime will result in an incremental risk of about 1 in 100,000 using the slope factor recommended by MDH. The EPA has recently published a range of slope factors ($5.1 * 10^{-3}$ to $8.9 * 10^{-4}$ $(pg/kg/d)^{-1}$) for calculating cancer risk (EPA, 2003). An older EPA slope factor of 1.6×10^{-4} $(pg/kg/d)^{-1}$ is also sometimes used.

In addition to cancer risk, ATSDR has a Minimal Risk Level (MRL) of 1 pg/kg/day for 2,3,7,8-TCDD based on the non-cancer endpoint of altered social interactions with peers in monkeys exposed prenatally and during lactation (ATSDR, 1998).

Endres has stated that their annual dioxin (TEQ) emissions are less than 0.14 lbs per year (Endres Processing Ltd., 2005). Total dioxin or TEQ emissions approaching 0.14 lbs per year going into air (modeled in the MPCA RASS (MPCA, 2005)) and/or feed (applied to the yearly product) could substantially exceed levels of concern for nearby farmers, for people consuming dairy products and meat from Endres product-fed livestock and even for individuals exposed to emissions in the air they breathe. The focus of the impacts would be determined by the amount released through either feed-product or airborne emissions.

Additional chemicals of interest in airborne emissions

All of the chemicals discussed below may be formed during the manufacturing process at Endres and either be emitted to the air or incorporated into the feed product. However, there are no analytical data available on these chemicals for either emissions or feed product. This discussion is included to inform planning and evaluation of future emissions testing at Endres.

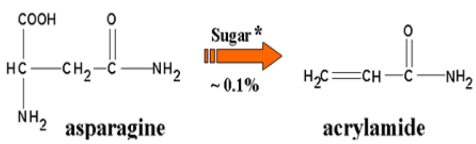
Aldehydes and organic acids

Fermenting or heating feeds will cause relatively low molecular weight aldehydes and organic acids to be formed and volatilized. Emitted compounds may include: formaldehyde, acetaldehyde, acrolein(2-propenal), propionaldehyde, 2-butenal (crotonaldehyde), butyraldehyde, 2-methyl-propenal, 2-furfuraldehyde, 3-methyl-butanal, and other 2-6 carbon non-substituted and substituted aldehydes; formic acid, acetic acid, oxalic acid, propionic acid, lactic acid, butyric acid, maleic acid, succinic acid. Formaldehyde and acetaldehyde are the smallest organic aldehydes with 1 and 2 carbons, respectively, and both have been shown to be emitted by Endres (Barr Engineering Co., 2003).

There are health standards or guidelines available to evaluate formaldehyde, acetaldehyde, acrolein, glutaraldehyde (a hydroxylated di-aldehyde) and 2-furfuraldehyde. In addition, MDH is currently evaluating the toxicity of formic and acetic acids. All aldehydes and acids are also expected to be respiratory and eye irritants, but it is likely that smaller aldehydes (formaldehyde, acetaldehyde, acrolein) are more effective irritants than larger ones (Brabec, 1993). Larger aldehydes and acids may condense upon cooling in the air above the exhaust stack and form aerosols that may fall out of the air more rapidly than the smaller compounds. If these larger aldehydes and acids are not a large fraction of the total aldehyde and acid emitted, it is likely that their relative impact on public health will be much less than the impact of smaller aldehydes and organic acids. The MPCA Risk Assessment Screening Spreadsheet model (MPCA, 2005) uses formaldehyde as a surrogate for all aldehydes in ambient air that do not have individual standards or guideline values. MDH believes these screening criteria are conservative.

Acrylamide, nitrosamines and acrylonitrile
The major reaction pathway responsible for the formation of acrylamide is shown in Figure 3. Formation of acrylamide by this process is also dependent on the temperature to which the mixture is heated, moisture, and residence time at temperature (Becalski et al., 2003).

Figure 3: Formation pathway of acrylamide in foods.



(Health Canada, 2005)

- Glucose, fructose, decomposition products of sucrose and other sugars as well as other suitable intermediates (e.g. aldehydes).

Asparagine, reducing sugars and aldehydes are all raw materials or fermentation products of raw materials at Endres. Furthermore, it has been demonstrated that acrylamide can be generated when rat chow is autoclaved (heated in the presence of steam) to sterilize the feed (Twaddle et al., 2004). The autoclaving process is somewhat similar to the sanitizing process that occurs at Endres. Therefore, acrylamide may occur in both stack emissions (where it could be a human health concern) and feed product (unlikely to be a human health concern). Acrylamide is listed by the EPA as a probable carcinogen for both ingestion and inhalation exposure routes (EPA IRIS, 2004).

Nitrosamines are formed by nitrosation of secondary and tertiary amines by compounds like nitrogen oxides (Scanlan, 1983). In addition, they can be formed when primary amines react with aldehydes in the presence of alcohols and nitrite under mildly acidic conditions (Magee et al., 1974). N-nitrosodimethylamine (NDMA) is the most common volatile amine found in food, but other nitrosamines are also found in food, including: N-nitroso-di-n-butylamine, N-nitroso-N-methylethylamine, N-nitrosodi-N-propylamine, N-nitrosodiethanolamine, N-nitrosodiethylamine, N-nitrosodiphenylamine, and N-nitrosopyrrolidine. The EPA considers all of the above-listed nitrosamines as probable human carcinogens (EPA IRIS, 2004). It has been shown that some NDMA found in processed foods can be the result of direct-fire drying. However, given the complex make-up of foods and food products it is difficult to predict the extent of nitrosation that may occur during any process (Scanlan, 1983; ATSDR, 1989).

Lifetime average inhalation concentrations that will result in additional incremental cancer risk of no more than 1 in 100,000 exposed individuals, for acrylamide and some nitrosamine compounds, are listed in Table 3.

MDH concerns about acrylonitrile are similar to concerns about nitrosamines and acrylamide. Acrylonitrile has not been tested at Endres, but the process suggests that it may be emitted. In 1977, acrylonitrile was banned by the FDA for use in non-alcoholic beverage containers because of fears that it could leach into the drink. However, because only small amounts were shown to leach into beverages and other foods, the FDA reversed its' position in 1982 and now allows acrylonitrile to be used in food wrapping. If chemicals from food wrappings are incompletely burned in the Endres furnace, acrylonitrile may enter the dryer and be incorporated into the product or emitted with stack emissions. There is a MDH HRV for arcylonitrile of 0.15 $\mu g/m^3$ based on cancer, and an EPA RfC of 2 $\mu g/m^3$ based on nasal inflammation and degeneration of epithelium (see Table 3).

Acrylamide, nitrosamines and acrylonitrile are all compounds that may either become a part of the product at Endres, or be emitted into the atmosphere in the stack emissions. None of these chemicals should accumulate in livestock that are fed contaminated feed. Therefore, feed contamination with these chemicals is not a concern for MDH. (However, animal health may be an issue if the feed is contaminated with acrylamide, nitrosamines or acrylonitrile.) Emissions of any of these compounds into the air may be of concern to MDH if the amounts emitted approach about 0.005 lbs/hr, 0.0002 lb/hr, and 0.1 lb/hr, respectively. All of these chemicals are expected to breakdown in sunlight. Therefore, the highest exposures may be limited to cloudy days, twilight and nighttime hours.

Perfluorinated alkyl compounds

Perfluorinated alkyl compounds (PFCs) are chemicals used in paper food wrappers to keep oils from penetrating the paper. Currently, Endres supplements their use of sawdust as fuel with up to 12 tons a day in food wrappers (Endres Processing Ltd., 1996), including paper wrappers that likely contain PFCs. There is no information available about the types of PFCs that may be burned at Endres, their destruction during combustion, their possible incorporation into feed, or their emission. In addition, there is only limited information available on the toxicity of a few PFCs (see OECD, 2002; 3M, 2004; Martin et al., 2003 for additional information on bioaccumulation and toxicity of a few PFCs).

Polycyclic aromatic hydrocarbons (PAHs)

A facility that burns 3 tons sawdust and ½ ton wrappers an hour and 25,000 tons sawdust and 5,000 tons of wrappers in a year, likely emits a large amount of PAHs. While concerns about dioxin risk are much higher, risks from PAHs, including the 25 carcinogenic PAHs (cPAHs), could be significant and may need to be addressed in the future.

Discussion

Inspection of the data from the different test periods, as well as ANOVA suggest that the testing parameters, operating procedures, and/or processing equipment were different during the 3 testing periods. Furthermore, the % CV of individual test parameters and emissions between runs during single test events demonstrated large variance.

Thus, the conditions under which the available testing data were acquired were highly variable and, therefore, it is difficult to determine whether they characterize worst-case short-term emissions from the facility. As a result, the short-term hazards calculated here may not be conservative. Never the less, these data do represent actual emissions from the facility. It may be necessary to limit the operating parameters, including fuel and raw materials, so that a reliable range of emissions can be determined. Emissions testing and air modeling, under either "worst case" or a range of conditions is necessary to evaluate chronic health hazards and to reliably characterize short-term health hazards.

Acetaldehyde, formaldehyde, methane, carbon monoxide and PM_{10} were the only chemicals/particles emitted from the Endres dryer stacks and measured during testing on November 29, 2001 or March 26, 2003. The results of a screening analysis suggest that there may be acute health and criteria pollutant concerns related to formaldehyde and PM_{10} emissions. Furthermore, formaldehyde and acetaldehyde are carcinogens, and additional data are needed to evaluate long-term cancer risks from these 2 chemicals, as well as from dioxins.

There is a potential for the *de novo* production of dioxins at this facility. Available information for dioxin is limited to testing data with insufficient detection limits and an upper bound estimate of total dioxin emissions. This information is not sufficient to determine if dioxin is a health concern in feed or in airborne emissions. Endres appears to have the characteristics of facilities that have been shown to produce dioxins: burning mixed wastes that may contain plastics, and dryer and stack temperatures within the range for dioxin formation. If dioxins are produced they can accumulate in the feed product or be emitted into the air. Both of these potential paths can ultimately result in additional exposure to dioxins for some people. Levels of dioxins in ambient soils and sediments already result in bioaccumulation in the food chain and exposure to the general population throughout the US and the world at levels that approach concern.

Modeled formaldehyde emissions from Endres resulted in an acute hazard quotient of 2.0, 500 meters from the stack. While we know that acetaldehyde is also an irritant, there is no acute health criterion available with which to quantify any additional hazard to individuals exposed to acetaldehyde released from Endres. Furthermore, as noted above, acrolein and other small aldehydes and organic acids are also likely to be emitted from the dryer stack. These chemicals are also irritants. Many of them are likely to be less potent than formaldehyde. It is likely that the actual acute hazard index from all Endres emissions (500 meters from the stack) is somewhat greater than 2. When a hazard index is greater than one there could be a health impact. However, the likelihood of a health impact is uncertain.

Acetaldehyde makes up about 12% of the total carbon emitted in VOC emissions from Endres. Formaldehyde and methane make up an additional 2% of emitted VOCs (Barr Engineering Co., 2003). Eighty-six percent of the emitted VOCs (as carbon) have not been identified. It is expected that relatively non-toxic chemicals such as ethanol make up a large portion of emitted VOCs (as carbon). However, very small amounts of carbon emitted as dioxins, acrolein, nitrosamines and acrylamide could have a large impact on acute and chronic hazard indices and cancer risk. While it is not possible to quantify all chemicals released from Endres, analyzing for the above listed chemicals should provide some assurance that most of the risks are evaluated.

RASS modeling of particulate matter emission data suggests that the EPA NAAQS Standard for PM_{10} may be exceeded in the area of the Endres facility. PM_{10} concentrations may be 3.4 times the PM_{10} 24-hour NAAQS of 150µg/m^3 at 500 m. There are additional industrial facilities near Endres, as well as 2 major highways, that may contribute significantly to the PM_{10} in the area. The NAAQS are "bright line" standards and should not be exceeded. Health effects have been observed when ambient particulate levels approach the NAAQS.

While there is a $PM_{2.5}$ NAAQS and $PM_{2.5}$ is emitted from Endres, there are no data available that quantify $PM_{2.5}$ emissions.

Carbon monoxide near Endres is of less concern than PM_{10}. In November 1999 EPA designated the Twin Cities an attainment area, in compliance with the carbon monoxide NAAQS. Prior to that time the Twin Cities were a "non-attainment" area. Endres emissions may result in levels equivalent to about 55 % of the NAAQS near the facility. About 70% of carbon monoxide in Minnesota is a result of motor vehicle exhaust (http://www.pca.state.mn.us/air/emissions/co.html). While there are a couple of busy highways near Endres, the area generally has less traffic than other areas in the Twin Cities.

The Spectro Alloy facility, which is ¼ mile west of Endres, emits hydrogen chloride (HCl) and dioxins (Interpoll Laboratories Inc., 2003). MDH is currently in the process of preparing a health consultation on Spectro Alloy emissions. Both Spectro Alloy and Endres emissions could contribute to air quality complaints in northeast Rosemount.

Summary

Endres recycles up to 1,200 tons of baked goods, dried foods, snack foods, candy, dairy and grain by-products per week into feed for agriculture. The product is dried in a direct-fired rotary kiln dryer that allows direct contact between the exhaust from the heat source and the product. Used fryer oil is injected directly into the dryer for incorporation into the product. The dryer is heated primarily with sawdust fuel, supplemented with up to 12 tons a day of discarded food wrappers.

Endres is located in a rural area on the edge of the Twins Cities, generally surrounded by farmland, industrial facilities and a landfill. There are a few residences about 500 meters from the facility. Three ways that people may be exposed to contaminants that may be unintentional by-products of production at Endres are:

1. Emissions from the facility may be directly inhaled.
2. Long-lived chemicals, most notably dioxins, may be locally deposited on soil. People can be exposed to these chemicals either through direct contact with the soil or through consumption of food grown or raised near the facility.
3. Chemicals, including dioxins which bioaccumulate, may be incorporated into the animal feed product. Human exposures may result when animals given the contaminated food enter the human food supply. Incorporation of contaminants into the feed product has been demonstrated at facilities with similar processes.

Data from the 3 emissions tests conducted at Endres suggest that raw material, production rates, inlet and stack temperatures, and emissions are highly variable. This makes it difficult to accurately quantify emissions. In addition, changes in the process may result in the formation of different chemicals in the burner, dryer or stack. Dioxin testing was performed on one composite sample. Laboratory reporting limits were too high to determine whether the product is contaminated at levels that might present a public health hazard if cattle consume sufficient quantities of feed and if consumers eat sufficient quantities of this beef.

About 14% of the VOC emissions during one testing period were characterized. Eighty-six percent of emissions have not been identified. The cancer risk, from 2 chemicals known to be emitted (acetaldehyde and formaldehyde), needs to be evaluated after more accurate assessment of long-term emissions. The potential acute hazard, when only formaldehyde is evaluated at 500 m, is above levels of concern (2.0 HQ). But the likelihood of health impacts is unknown, especially given the variability of emissions and uncertainty as to whether worst-case emissions were characterized. It is likely that there are many additional chemicals released as a result of the manufacturing process at Endres. These chemicals may include: small aldehydes (including acrolein) and organic acids (including formic and acetic acids), acrylamide, acrylonitrile, dioxins, and nitrosamines. All of these chemicals, except the dioxins, may be acute irritants, but many will be less toxic than formaldehyde. Acylamide, acrylonitrile, dioxins, and nitrosamines are probable carcinogens.

PM_{10} and carbon monoxide are evaluated in the RASS as criteria pollutants and not as toxic chemicals. PM_{10} may exceed the 24 hour NAAQS 500 m from the facility by 3.4 times and levels were elevated over 1 kilometer (km) from the facility. Possible exceedances of the PM_{10} standard could have health impacts.

Conclusions

The magnitude of potential hazards from breathing air emissions decrease as one moves further away from the facility. Refinement of the MPCA screening model to specific site conditions, and additional emissions data are needed to determine whether emissions are a public health hazard, especially to the nearest residents. Therefore, emissions from this facility are classified as an Indeterminate Health Hazard for individuals living in the vicinity.

Available data suggests that Endres emissions may cause adverse health effects in exposed people. However, better characterization of Endres emissions and products are needed to help clarify the potential hazards and risks. In particular, dioxins are a potential contaminant of concern in feed product and airborne emissions from Endres. Installing effective emission control equipment as an alternative to testing emissions, would need to be coupled with product testing to assure that contaminants do not enter the human food supply. Controlling the materials burned as fuel, by assuring that there are limits on heavy metals and pesticides and by limiting the amount of plastic burned, will limit the production of unintended chemical contaminants such as dioxins.

Recommendations

1. Endres product should be analyzed for dioxins that may accumulate in agricultural animals, or alternatively, tissue or milk from cattle eating Endres product should be analyzed.
2. Air emissions from Endres should be tested for the following chemicals at appropriately low detection limits:
    a. dioxins
    b. small aldehydes (including acrolein, benzaldehyde, crotonaldehyde and gluteraldehyde)
    c. small organic acids (including formic and acetic acid)
    d. nitrosamines.
    e. acrylamide
    f. acrylonitrile
    g. heavy metals
3. Attempts should be made to determine the factors that result in “worst case” emissions, and these criteria should be employed during testing to assure “worst case” conditions at each stack.
4. Site-specific dispersion modeling (as opposed to the screening / default model used by MDH) of emissions should be performed.
5. Quality control should assure that all sawdust burned for fuel is from pesticide-free wood.

Public Health Action Plan

MDH will provide information to neighbors, residents, Endres and interested governmental agencies (including MPCA, Dakota County, City of Rosemount, Minnesota Department of Agriculture, U.S. Food and Drug Administration) of the recommendations contained in this Health Consultation. MDH will complete an assessment of the emissions from Spectro Alloys in 2005. In addition, MDH will support the efforts of the MPCA, the community, local authorities and the company to better understand emissions and take action, if necessary, to reduce emissions.

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Certification

This Endres Processing, LLC, Rosemount, Minnesota Public Health Consultation was prepared by the Minnesota Department of Health under a cooperative agreement with the federal Agency for Toxic Substances and Disease Registry (ATSDR). It was completed in accordance with approved methodologies and procedures existing at the time the health consultation was initiated. Editorial review was completed by the Cooperative Agreement partner.

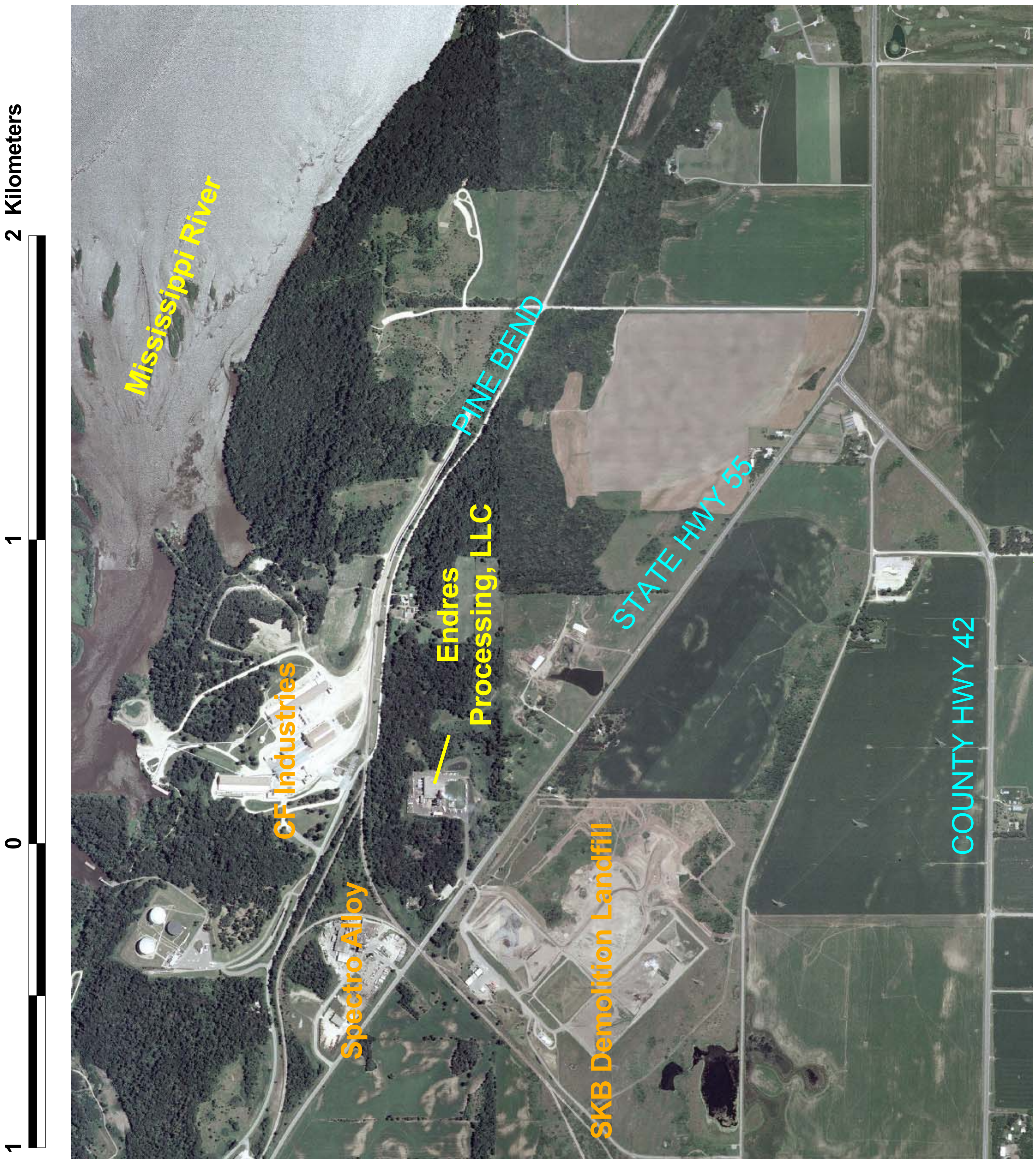
Technical Project Officer, CAT, SPAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

Gregory V. Ulirsch for AY

Team Lead, CAT, SPAB, DHAC, ATSDR

Attachment 1



Attachment 2a

AqRpCo	AqRpAdd	AqRpCity	AqRpState	AqTypeRep	AqIncDate	AqIncTime	AqMaterial	Narrative
Endres Company	Hwy 52 and Hwy 55	Rosemount	MN	Complaint	09-Aug-03	9:00:00	heavy smoke	Caller says there is heavy smoke that is covering the___________ Golf Course. Caller said that this has happened every Saturday for the last three weeks. Caller says it bad at different times of the day.
Endrus Processing		Rosemount	MN	Complaint	24-Aug-03	19:55:00	haze, odor	Haze, odor from plant causes instant headache and eyes to burn.
Endrus Corp	Hwy. 55 & Hwy. 52	Rosemount	MN	Complaint	04-Aug-03	19:56:00	black plume	black plume is very bad.
Endrus Corp.		Rosemount	MN	Complaint	04-Aug-03	20:04:00	Black smoke	Pollution coming out of business
Endres Processing Company		Rosemont	MN	Complaint	01-Sep-03	9:00:00	odors and heavy smoke	Odors are really bad and there is heavy black smoke coming from there stack.
Endres Company		Rosemont	MN	Complaint	07-Sep-03	10:40	Odor and black smoke	Strong odors and a large amount of black smoke coming from there smoke stack. The smoke is causing headaches. Caller said that when she calls the FD, the FD says that they don't need to go out to the scene if the Citizen has called the Duty Officer.
Endres Processing		Rosemount	MN	Complaint	09-Sep-03	17:00	odor/fumes	Yesterday afternoon, this morning 0700, and again this afternoon about 1600 odor was so bad caller became nauseated. Ongoing problem.
Endres Co.		Rosemount	MN	Complaint	13-Sep-03	00-Jan-00	odors and smoke	Smoke is hanging really low.
Endres Processing		Rosemont	MN	Complaint	12-Sep-03	7:30:00	black smoke and odors	caller says there is very dark smoke coming out of the stack and there are obnoxious odors which make the caller sick to his stomach.
Endres Corp	Hwy 55	Rosemount	MN	Complaint	12-Sep-03	11:45:00	very strong odors and smoke	Caller said the odors and smoke burned her eyes as she drove down the road. Caller feels this is a hazardous situation and is calling the State Patrol.
Endres				Complaint	12-Sep-03	10:30:00	smoke	caller said the smoke was really dark.
	Enders Processing	Rosemount	MN	Complaint	12-Sep-03	7:30:00	Odor	Very strong odors coming from the plant. Caller said its hard to be outside because roblems she has with breathing due to the odors.
Endress Processing		Rosemount	MN	Complaint	16-Sep-03	21:15	Blue Haze and odor	Caller complaining of a blue haze from the RP hanging in the air last night and a strong odor all morning. Caller cannot go outside.
Endres Processing		Rosemount	MN	Complaint	19-Sep-03	8:00:00	Odor	Odor complaint.
Unknown				Complaint	19-Sep-03	7:00:00	Odor	Caller works at _______________ Golf Course and has had staff and golfers complain about a strong odor this morning. Caller is not sure where it is coming from but thinks it smells more like Endres than Flint Hills.
Endres Processing		Rosemount		Complaint	22-Sep-03	6:30:00	Odor	Caller complaining of a very strong odor from the RP causing headache and burning in the chest.
Endres Processing		Rosemont	MN	Complaint	24-Sep-03	16:30	Odor	Caller says that due to the odors the caller cant be outside.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	26-Sep-03	18:00:00	stinky cloud	Caller noticed odor at 1800, came home at 1925 and the odor is worse. There is a complete haze to the west of caller's home. Smell is awful, can't be outside.
Endres and Spector Alloy		Rosemount	MN	Complaint	26-Sep-03	21:30:00	Smells like combination of the 2 facilities	Sweet metallic odor. Caller complaining of nausea when he came home last.
Endres Processing	Hy 55	Rosemount	MN	Complaint	29-Sep-03	17:00	unknown blue and white haze	Caller reporting a white cloud with a blue haze coming from RP's stacks. Caller reports headache and chest pain associated with release.
Endrus		Rosemount	MN	Complaint	29-Sep-03	20:45	Smoke	Caller states the plume is bad from company
Enders Inc		Rosemount	MN	Complaint	18-Oct-03	10:10:00	Odors, Black smoke	Caller said the odor is bad and that the smoke comes out of the stack white but then turns to black.
Endres Company		Rosemount	MN	Complaint	20-Oct-03	19:58:00	strong odors	caller just got home with the family and she said that you cant breath outside because of the odors.

Attachment 2b

AqRpCo	AqRpAdd	AqRpCity	AqRpState	AqTypeRep	AqIncDate	AqIncTime	AqMaterial	Narrative
Endres Processing		Rosemont	MN	Complaint	02-Nov-03	7:30:00	odor and dark grey smoke	caller was out duck hunting near an island and the smoke was very thick and the odor was terrible smelling.
Endres Processing		Rosemount	MN	Complaint	04-Nov-03	8:30:00	smoke and odor	Caller reporting the smoke and odor from the RP is hugging along the ground. Caller had to drive through the smoke this morning.
Endres Processing		Rosemount	MN	Complaint	30-Nov-03	16:10:00	odor	Caller noticed haze and strong odor; can't take young daughter outside. Slight headache right away.
Endres Inc		Rosemount	MN	Complaint	22-Dec-03	20:00:00	strong odor	Very strong odor, giving caller headaches and causing wheezing.
Endres Processing		Rosemount	MN	Complaint	31-Dec-03	12:10:00	Heavy Black Smoke, wood burning odor	Caller complaining of a thick black smoke coming from the RP. Caller stated that the smoke from the RP usually is white.
Enders Processing		Rosemount	MN	Complaint	02-Mar-04	19:00:00	Strong odors	Caller just got home and the odors are causing headaches , and eyes are burning.
Endres Processing & Spectra Alloys		Rosemount	MN	Complaint	09-Mar-04	00-Jan-00	Haze	Caller complaining of a low hanging haze in his neighborhood. Both companies appear to be contributing to the haze.
Endrus Processing		Rosemount	MN	Complaint	18-Mar-45	18:45:00	black smoke	Noticed black cloud coming into Inver Grove Heights by Concord and Hwy 52/55. No physical symptoms, noticed no smell. Drove under the black cloud of smoke on Hwy 55.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	11-Apr-04	7:04:00	Black Smoke	Caller reporting heavy black smoke coming from the RP.
Endros processing		Rosemount	MN	Complaint	17-May-04	18:00:00	smoke	Caller states that there is smoke coming from plant.
Endress Processing	Hwy 55	Rosemount	MN	Complaint	04-Jun-04	7:00:00	Smoke / haze and odor	Caller complaining of smoke, haze, and odor from the RP. Caller stated that there is a haze covering a large area. Caller requested that this report be to the attention of __________ (MPCA).
Endres Processing Co	Hwy 55	Rosemount	MN	Complaint	12-Jun-04	8:00:00	black smoke	caller said the smoke was black and the odor was punjunt. This was occuring also today.
Endres Company		Rosemount	MN	Complaint	13-Jun-04	10:30:00	odor	Very bad odor and black smoke.
Endres processing		Rosemount	MN	Complaint	14-Jun-04	19:00:00	black smoke	caller said the smoke is so thick that she cant breath. She has tightning of the chest, and the child can't play outside.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	20-Jun-04	8:45:00	Black smoke with Odor	Caller reporting a strong odor.
Endres Processing	Hy 55	Rosemount	MN	Complaint	21-Jun-04	9:00:00	Black smoke	Caller reports thick black smoke from RP as he drove by this morning.
Enders Company		Rosemount	MN	Complaint	22-Jun-04	19:15:00	smoke and odor	Caller said that there is black smoke coming from the RP. Caller stated that the smoke has an odor that is causing breathing problems and the callers family can't be outside.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	23-Jun-04	20:00:00	Black smoke	Caller reports thick black smoke from RP at 20:00 on 6/22/04 and again at 07:00 6/23/04.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	24-Jun-04	20:50:00	black smoke	Caller is seeing black, opaque smoke coming from plant.
endres processing		Rosemount	MN	Complaint	24-Jun-04	9:18:00	black smoke, odor	Black smoke and strong odor; can't breathe.
Endres Processing		Rosemount	MN	Complaint	24-Jun-04	19:30:00	black smoke and odor	Caller noticed thick black smoke over the highway for at least 20 minutes; no physical symptoms
Endres		Rosemount	MN	Complaint	26-Jun-04	7:00:00	odor and black smoke	caller said the smoke was bad this morning and is still going as of the time of the call.
Endres Processing	13420 Courthouse Blv	Rosemount	MN	Complaint	27-Jun-04	21:20:00		Caller reports black smoke coming from plant, haze in yard. Can't be outside without coughing and tightness in chest. Friday and Saturday every two hours.
Endres Processing	Hwy 55	Rosemount	MN	Complaint	27-Jun-04	17:45:00	black smoke	Caller is reporting "black, billowing smoke;" occurs every morning and night. No physical symptoms.
Endres		Rosemount	MN	Complaint	10-Jul-04	10:00:00	odor, dark haze	caller said the odor and haze is really bad.

Attachment 3

	PARAMETER	Limit	MEASURED
	EAST SCRUBBER		
	Particulate		
PM10	*dry + Method 202* ..... (GR/DSCF)	N/A	0.052
	.... (LB/HR)	*Variable	18.44
PM	*dry + MN wet catch*... (GR/DSCF)	N/A	0.050
	.... (LB/HR)	*Variable	17.60
	dry catch only............ (GR/DSCF)	N/A	0.048
	.... (LB/HR)	N/A	16.99
	Opacity .... (%)	20	13.33
	WEST SCRUBBER		
	Particulate		
PM10	*dry + Method 202* ..... (GR/DSCF)	N/A	0.053
	.... (LB/HR)	*Variable	18.72
PM	*dry + MN wet catch*... (GR/DSCF)	N/A	0.051
	.... (LB/HR)	*Variable	17.92
	dry catch only............ (GR/DSCF)	N/A	0.048
	.... (LB/HR)	N/A	16.78
	Opacity .... (%)	20	13.33
	SECONDARY COOLER		
	Particulate		
PM10	*dry + Method 202* ..... (GR/DSCF)	N/A	0.051
	.... (LB/HR)	2.67	6.54
PM	*dry + MN wet catch*... (GR/DSCF)	N/A	0.050
	.... (LB/HR)	2.67	6.39
	dry catch only............ (GR/DSCF)	N/A	0.050
	.... (LB/HR)	N/A	6.31
	Opacity .... (%)	20	5.21

* Combined Limit for Scrubber Stacks

From:

Interpoll Laboratories Inc. (2001). Results of the July 5-6, 2001 Particulate Emission Compliance Tests at the Endres Processing Facility in Rosemount, Minnesota. Prepared for Endres Processing, LLC, Rosemount, MN. Report, August 2, 2001.

Attachment 4

Test Parameter	East Scrubber	West Scrubber	Combined Results
Test Date	11/29/01	11/29/01	---
Stack Temperature °F	118	122	---
Volumetric Air Flow Rate			
ACFM	39,000	42,000	80,000
SCFM	35,000	37,000	72,000
DSCFM	31,000	33,000	65,000
Particulate Concentrations, gr/dscf			(1)
Dry Catch Only (filterable)	0.033	0.034	0.034
Dry Catch Plus Organic Condensibles	0.040	0.040	0.040
Total (dry + organic + aqueous)	0.043	0.042	0.042
Particulate Concentration Limit, gr/dscf			
MN. Rules Limit – Based on volumetric airflow rate (2)	---	---	0.049
Particulate Emission Rate, lb/hr			
Dry Catch Only (filterable)	8.9	9.7	18.6
Dry Catch Plus Organic Condensibles	10.7	11.4	22.1
Total (dry + organic + aqueous)	11.5	12.1	23.6
Particulate Emission Limit, lb/hr (3)	---	---	30.3

(1) Particulate matter concentration calculated as per the MPCA approval letter to B. Bergquist, 11/21/01 (located in Appendix F).

(2) Emission Limit calculated by Minn. Rules 7011.0735 Table 2 based on the combined stack dry standard airflow rate. The emission limit is compared to dry catch plus organic condensibles particulate.

(3) Emission limit calculated by Minn. Rules 7011.0730 Table 1 based on the production throughput rate of 32.9 tons of finished product per hour. Emission limit compared to dry catch plus organic condensibles particulate.

Endres Processing
Rosemount, Minnesota

Attachment 5a

Barr Engineering Co.
April 29, 2003

TABLE 1

TEST RESULTS SUMMARY

Dryer Scrubber Stack

Parameter	Run 2	Run 3	Run 4	Average
Test Date	3/26/2003	3/26/2003	3/26/2003	-
Test Period	1649-1749	1829-1929	2015-2115	-
Air Flow Rate				
ACFM	51,200	52,400	52,100	51,900
SCFM	44,200	45,400	45,100	44,900
DSCFM	34,500	35,600	35,400	35,167
Volatile Organic Compounds (VOC)				
Concentration, ppm as Carbon (Wet basis)	483	555	588	542
Emission Rate, lb/hr as Carbon	40	47	50	46
Carbon Monoxide (CO)				
Concentration, ppm (dry basis)	163	239	248	217
Emission Rate, lb/hr	25	37	38	33
EPA Method 18 Results				
Concentration, ppm (dry basis)				
Acetaldehyde	28.3	25.4	36.2	30.0
Acrolein	1.20 ND	1.35 ND	2.15 ND	1.57 ND
Benzene	0.538 ND	0.538 ND	0.538 ND	0.538 ND
Styrene	1.33 ND	1.33 ND	1.33 ND	1.33 ND
Methane	2.54	2.88	4.71	3.38
Formaldehyde	0.16	2.44	5.09	2.56
Emission Rate, lb/hr				
Acetaldehyde	6.7	6.0	8.6	7.1
Acrolein	0.361	0.407	0.646	0.47
Benzene	0.252	0.252	0.252	0.25
Styrene	0.74	0.74	0.74	0.74
Methane	0.22	0.25	0.41	0.29
Formaldehyde	0.03	0.39	0.82	0.41

Attachment 5b

TABLE 2

VISIBLE EMISSIONS TEST SUMMARY
EPA Method 9
Dryer Scrubber Stack- SV001

Observer	Mark Petersen
Observer Certification Date	October 16,2002
Test Date	March 26, 2003
	Run 1
Test Time	1700-1730
Maximum Opacity Observation, %	20
Minimum Opacity Observation, %	5
30 Minute Average Opacity, %	11.8
Consecutive Six-Minute Periods	
Period #	Average Opacity, %
1	12.9
2	14.4
3	9.2
4	10.0
5	12.3
Highest Six-Minute Average Opacity[1]	14.8

[1] The highest six-minute average opacity is a moving average, and therefore may not coincide with any of the reported consecutive six-minute period averages.