HEALTH CONSULTATION

Hudson Farm Nitric Acid Release

July 1-2, 1998

Dobbins & 55th Avenue
Maricopa County
Laveen, AZ

Arizona Department of Health Services
Office of Environmental Health
Under Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry
BACKGROUND

The Arizona Department of Health Services (ADHS) was asked by the Arizona Department of Environmental Quality (ADEQ) to evaluate the potential health effects from inhalation of toxic vapors as a result of an unplanned, concentrated nitric acid release. ADHS was asked what types of health effects the nearby communities would experience from the nitric acid, and what follow up measures would be necessary to ensure public health and address the community concerns.

According to Hudson Farms, at approximately 1 pm on July 1st, concentrated nitric acid began escaping from a small leak in a 33,000 gallon storage tank on private property located at Dobbins and 55th Avenue in Laveen. By 4:30 pm, the first responding fire department units observed an orange colored plume that was moving with the wind direction. [see attachment A for plume maps] The large plume continued to dissipate throughout the area until about 8:30 pm that night. Small amounts of nitric acid that was generally restricted to the Hudson property continued to leak until approximately 8 am the morning of July 2nd when pumping of acid waste waters into emergency storage tanks was completed. It is estimated by ADEQ that a total of 4,0 00-4,500 gallons of concentrated nitric acid was released from the storage tank.

Approximately 600 people from the town of Laveen and the Gila River Indian Community were immediately evacuated [see attachment B for evacuation area]. Due to the nitric acid cloud dispersion, the Phoenix Fire Department evacuated all residences in the town of Laveen and the Gila River Indian Reservation that were in the path of the plume, and thus had the greatest chance for exposure. Residents were evacuated to Cash Elemen tary School and some local hotels. ADHS counseled residents on site at the elementary school at approximately 11 pm that evening about potential health effects of nitric acid exposure. Red Cross nurses were also at the school to treat victims and offer other emergency services. Residents were allowed re -entry to their homes the following day, July 2nd at approximately 10 am.

Due to safety considerations no ambient air samples were collected in the plume during the period when large amounts of nitric ac id were being released. The ADEQ sampled ambient air for concentrated hydrochloric and nitric acids downwind of the release only after the massive release of nitric acid had ceased. Samples collected by the ADEQ downwind of the release between 6 pm and 9 pm revealed trace amounts of both acids were detected in Draeger tubes. Air monitoring samples were collected between 1 am and 2:30 am at eight locations downwind of the release to determine whether it was safe to lift the evacuation of area residents. None of the air samples contained nitric acid above

detectable limits.

The sampling results are summarized in Table 1. [ADEQ Emergency Response Report on Hudson Farms, July 1998].

Table 1:Draeger Tube Air Sampling Data

Time & Location	Chemical	Detection Limit	Concentration Detected in Air	TLV
1815 hrs @ 51st Ave & Elliott	Nitric Acid	1-50 ppm	trace **	2ppm
1820 hrs @51st Ave & Estrella	Nitric Acid	1-50 ppm	trace	2ppm
1830 hrs @51st Ave & Komatke	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
1945 hrs @67th Ave &Elliott	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
2000 hrs @51st Ave & 1mi. South of Komatke	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
2020 hrs @51st Ave& Beltline	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
2110 hrs @51st & Baseline	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
2120 hrs @51st Ave & Dobbins	HCL Nitric Acid	1-10 ppm 1-50 ppm	trace trace	5ppm 2ppm
0059 hrs @4918 W. Piedmont	Nitric Acid	1-50 ppm	non-detect (n/d)	2ppm
0113 hrs @4841 W. Elliott	Nitric Acid	1-50 ppm	n/d	2ppm
0127hrs @ 51st Ave & Carver	Nitric Acid	1-50 ppm	n/d	2ppm
0138 hrs @47th Ave & Estrella	Nitric Acid	1-50 ppm	n/d	2ppm
0150 hrs @Casino on Komatke Ln	Nitric Acid	1-50 ppm	n/d	2ppm
0159 hrs @51st Ave & Komatke	Nitric Acid	1-50 ppm	n/d	2ppm
0214 hrs@47th Ave & Olney	Nitric Acid	1-50 ppm	n/d	2ppm
0224 hrs @ 47th Ave & Piedmont	Nitric Acid	1-50 ppm	n/d	2ppm
0808 hrs @Hudson Farm on 55th Ave	Nitric Acid	1-50 ppm	n/d	2ppm
0811 hrs@55th Ave & Piedmont	Nitric Acid	1-50 ppm	n/d	2ppm
0815 hrs @55th Ave & Olney	Nitric Acid	1-50 ppm	n/d	2ppm

Table 1:Draeger Tube Air Sampling Data				
0819 hrs @ W. Olney, south of hotzone	Nitric Acid	1-50 ppm	n/d	2ppm

**trace means <1ppm (not measurable, but Draeger tube showed a visually detectible color change)[ADEQ HAZMAT Report,1998]

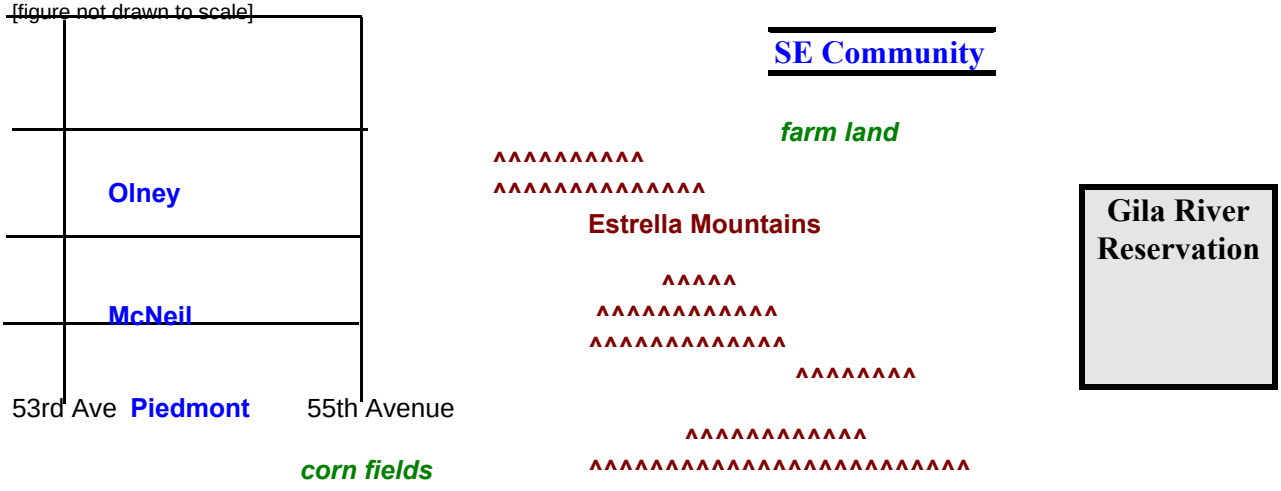
In order to address community concerns, on the morning of July 2nd, prior to residents re-entering the neighborhood, various residences at the nearby neighborhoods were tested for acidity with a pH indicator strip test [See attachment D for map of sampling area]. Four or five samples were taken inside and outside of seventeen homes to determine whether any acid residues remained. Samples were taken on evaporative cooling pads, in window sills, on A/C ducts, kitchen counters, and various other locations inside and outside of homes [Laidlaw Report, 1998]. All of the areas tested indicated a pH of 7 or 8, showing no acid present.

HEALTH EFFECTS SURVEY

Several residential areas were likely to be impacted by the movement of the plume, and an investigation was conducted to collect self reported health complaints. Three communities were targeted. Figure 1 displays the borders of this area. A small residential neighborhood approximately 100 yards southwest of Hudson Farms was surveyed on July 6, 1998 by ADHS staff. All sixty-four homes on five residential streets between 53rd Avenue and 55th Avenue, adjacen t to Hudson Farm were approached by staff from the Office of Environmental Health. A second subdivision of 27 homes southeast of the farm that was in the trail of the plume was also surveyed by ADHS the same day.

Gila River Indian Community worked closely with ADHS to also conduct a random sample investigation using the ADHS Acute Exposure Survey form [see attachment C]. The Gila Environmental Health program surveyed every fifth house on the reservation. The results of the combined investigation are sho wn in Table 2.

Figure 1: Area of Residences Surveyed (July 6, 1998)



La Mirada
Dobbins

Hudson Farm

If residents were home, they were asked fill out a survey questionnaire asking whether they were experiencing health symptoms that began during and after the release of nitric acid. Residents with symptoms were advised to consult with their primary care physician and the Good Samaritan Poison Control Center to ensure proper diagnosis and treatment.

For the residents who were not home, an information packet was issued by ADHS advising the community to be aware of the importance of seeking treatment for related symptoms. ADHS staff received calls from 19 area residents that experienced health symptoms who were not home during our field investigation. The call-in data and reported health complaints are included in Table 2.

Table 2: Health Symptoms Reported

Street or Location	No Symptoms		Had Symptoms		Sought medical attention		Admitted to hospital		Not home/ flyer only		Total Homes	Total People
	homes	persons	homes	persons	homes	persons	homes	persons	homes	persons*		
Dobbins		21		4		0		0	2	7	9	32
La Mirada		10		18		0		0	7	25	15	53
Piedmont		10		14		7		0	7	25	16	49
McNeil		7		10		0		0	13	46	18	63
Olney		3		0		0		0	5	18	6	21
Other (on duty personnel)		5		9		3		0	n/a			14
_ Gila River	42	336	26	38		4		3	272	2176 **	340	2550**
SE Community		18		18		7	0		17	60	27	95
Total		410		111		21		3	323	2357	431	2877
ADHS Call-In Complaints		3		16		10		1				
Hospital surveillance data				114		114		7				

* the average # of people per home is 3.5 people/home [1990 Census Tract Data]
** average persons per home in Gila = 8 people/home [Gila River Indian Community Survey, 1998]
_ Gila River data courtesy of Eric Faisst, Gila River Indian Community

We made direct contact with 44% of the homes in the two neighborhoods targeted by ADHS (40/91). 20%(68/340) of the homes in the Gila River community were reached by environmental investigators from the reservation. Additional data was gathered from local hospitals and clinics, and also from concerned residents calling ADHS to report health problems.

Several local hospitals and clinics were also contacted by ADHS to monitor the number of patients who presented with acute exposure symptoms, as well as to obtain the number of patients admitted for further observation and treatment. The local hospitals / clinics in close proximity to the plume included Gila River Crossing Clinic, the Phoenix Indian Medical Center, Chandler Regional Hospital, and Good Samaritan Hospital. Throughout the evacuation period, residents were seen by nurses in the two emergency treatment centers set up by the American Red Cross at the Cash Elementary School, and at the old Gila River Casino facility. If they needed additional medical attention, they were transferred to one of the area hospitals by the Red Cross. Refer to Table 3 for a summary of hospital and clinic reported data.

Table 3: Area Hospitals & Clinics Reporting Cases

Facility	Patients w/ possible exposure	Treatment/ Dx / Hospitalization
Phoenix Indian Hospital	**47 total=>** 45 patients seen in ER= 2 respiratory distress==	 =>water irrigation, albuterol/breathing therapy =>hospitalization***
Gila River Crossing Clinic	**3 total =>** 2 burning eyes, skin== 1 respiratory distress==	 =>benadryl, water irrigation =>hospitalized
Good Samaritan Hospital	**41 total =>** 21 information calls 20 direct exposure ===	 =>Water irrigation of exposed areas, chest x-rays, albuterol therapy; No hospitalizations
Chandler Regional Hospital	**2 total=>** 1 shortness of breath== 1 burning throat & eyes======	 =>hospitalized ** =>water irrigation
Red Cross @ Cash		

Facility	Patients w/ possible exposure	Treatment/ Dx / Hospitalization
Elementary*	**5 total=>** 1 chest pain, throat irr= 4 shortness of breath,skin burning	 =>hospitalized** =>water irrigation
Red Cross @ Gila River Casino*	**16 total=>** 2 chest pain, seizures= 14 sore throat, tearing,dizzy, skin irritation==========	 =>hospitalized *** =>water irrigation, monitoring vitals signs

*emergency shelters & treatment centers staffed with RN's
** same patient transferred to Chandler Regional Hospital
*** same patients transferred to PIMC

DISCUSSION

Due to safety considerations no ambient air samples were collected in the plume during the period when large amounts of nitric acid were being released. The ADEQ sampled ambient air for concentrated hydrochloric and nitric acids downwind of the release only after the massive release of nitric acid had ceased.

Trace levels of nitric acid and hydrochloric acid were present in air downwind of the release after the massive releases of nitric acid had occurred. The exact amount was not quantifiable, but the color change noted in the Draeger tubes with a minimum detection limit of 1 ppm suggests the presence of the acids. No ATSDR Toxicological Profile for nitric acid exists, but data indicates a threshold limit value (TLV) of 2 ppm for HNO_3, for a worker to be exposed without health effects. [CHRIS, 1998]. [TOMES: Meditext, 1998]. The TLV is an occupational standard that is based upon an 8 hour exposure in relatively healthy workers. It is the only standard of comparison available in the literature, but it was not developed for use in the general population and does not take into consideration sensitive subpopulations.

The TLV for HCL is 5 ppm. There are no reported health effects at an inhaled concentration of 1ppm. While there are no serious health effects for inhalation at the levels detected during environmental sampling, transient irritation to any exposed body parts may occur due to caustic nature of the acids.

Nitric acid is a colorless liquid that when heated may produce red, toxic oxides of nitrogen (NO_x) such as nitrogen dioxide (NO_2), nitric oxide (NO), and the nitrogen

dioxide dimer, which is nitrogen tetroxide (N_2O_4) . When exposed to water, nitric acid converts to form nitrogen dioxide (NO_2), that upon hitting any surface reacts and converts back to nitric acid (HNO_3). HCL in the presence of water reacts to form chlorine gas, an irritating vapor, in an exothermic reaction [Meditext, 1998]. [CHRIS database: Chemical Reactivity, 1998].

Temperatures and other environmental conditions at the time of the release are likely to have facilitated the transformation of nitric acid to nitrogen oxides. The temperature around the time of the release was 39 degrees Celsius, and the relative humidity averaged about 35% and was as high as 54% in the early morning hours of July 2nd. [ADEQ Meteorology Report, 1998]. Moreover, the plume was visibly red, indicative of the presence of NO_2. However, no air monitoring data is available on any of the other compounds formed by oxidation of the acids.

It is likely that inhaled NO_2 reacts with intrapulmonary water to re-form nitric and nitrous acids causing metabolic acidosis [Lipsett, 1992]. Acids denature proteins, and in respiratory tissue, NO_2 causes the formation of highly reactive free radicals that will further cause the oxidation of unsaturated fatty acids. Multiple scenarios of systemic toxic mechanisms are possible, but without known air concentrations of the nitrogen oxides, no dose based evaluation can be established.

Many of the symptoms reported in the literature from mild nitrogen oxide (NO_x) exposure are nonspecific, transient symptoms including " dyspnea, cough, headache, fatigue, nausea, vertigo, and somnolence, which may persist up to two weeks without significant clinically detectible pulmonary findings" on a chest x-ray. Severe exposures in individuals can present in symptoms of chest pain, wheezing, diaphoresis, palpitations, pulmonary edema, and chemical pneumonitis [Lipsett, 1992].

The symptoms reported by residents during the health survey conducted by the ADHS and the Gila River Indian community teams were consistent with the symptoms of HNO_3 and NO_x exposure in the literature. 241 residents reported experiencing some symptoms including cough, irritation of eyes, nose, throat, headaches, skin rashes, nausea, and dizziness. 60% of residents who experienced symptoms sought medical intervention (145/241). Eleven of the 241 people experiencing symptoms, or about 5%, were hospitalized due to serious symptoms that included chest pain, seizures, pharyngitis, shortness of breath, excess cough, as well as the other acute symptoms noted above.

CHILD HEALTH ISSUES

Children are more likely to be sensitive to the effects of nitric acid exposure due to their developing systems and their low body weight, but no evidence of the dose specific health effects exists at this time. The only reference level that exists is an occupational standard that is based on healthy workers. As such, the TLV is not an appropriate

standard of comparison.

At the levels of nitric acid that were measured in the air, children and the elderly may have experienced more health effects than the adults. Several children and elderly reported health symptoms and were admitted to the hospital. While the health recommendations for follow up care are the same for both children and adults, without specific concentrations of NO_x in the air, no dose specific evaluation can be made.

CONCLUSION

The Arizona Department of Health Services concludes that the symptoms reported by the Laveen and Gila River residents during the nitric acid release are consistent with the effects of nitrogen oxide and nitric acid exposure. However, due to the limited air monitoring data, it is difficult to verify the exact concentrations of the by products produced from the oxidation of the acids. At the time of the release, the site posed an urgent public health hazard, and evidence exists that exposures did occur. Currently, though, the site poses no public health hazard, as there is no longer any release of nitric acid or its constituents into the air and no human exposure is occurring.

The low concentrations of HCL and HNO_3 that were measured by ADEQ do not account for all of the health symptoms experienced by residents. However, samples could not be taken inside the plume due the danger posed to emergency response personnel. It is also likely that exposure to nitrogen oxides formed after the release may be responsible for some of the health effects observed.

The acute and severe NO_x exposure symptoms noted are similar to those reported by residents during the exposure investigation. While the lack of air monitoring data makes it impossible to verify, ADHS concludes that the symptoms seen in residents are consistent with NO_x and HNO_3 exposure.

RECOMMENDATIONS

ACTIONS PLANNED:

1. Future ADEQ HAZMAT air sampling needs to measure for all potential toxic by products generated. ADHS must better assist ADEQ to determine what toxic substances to sample for during an emergency release in order to have adequate data to evaluate the public health risk.

2. In the future, Poison Control centers will be contacted as part of the emergency response team in order to disseminate information to all area hospitals and clinics following toxic releases. This will ensure proper treatment and diagnosis by emergency rooms and primary care doctors unfamiliar with treating rare

environmental exposures.

ACTIONS TAKEN:

1. ADHS issued a follow up press release recommending that area primary care doctors to consult with the poison control center to ensure that any remaining residents with symptoms receive proper diagnosis and care.

September 14, 2006
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