California Pilots Association
P.O.Box 6868
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September 16, 2009

By Email with Hard Copy by U.S. Mail
Waymen P. Lee, P.E.
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weyman@baaqmd.gov
Senior Quality Engineer
Bay Area Air Quality Management District
939 Ellis St.
San Francisco, CA 94109

Re: August 2009 Draft PSD Permit for Russell City Energy Center

Dear Mr. Lee,

Our comments for on the draft prevention of significant deterioration (PSD) permit for the proposed Russell City Energy Center (RCEC). California Pilots Association (CalPilots) appreciates that BAAQMD issued an additional Statement of Basis for the new draft permit conditions.

As before the draft permit once again fails to meet and address pilots as receptors for pilots and passengers and aircraft engine operation in our previous comments. This would also include but not limited to start-up and shutdown power plant conditions.

In addition to our previous comments we respectfully submit Ms. Carol Ford, Vice President, CalPilots comments read at the BAAQMD Hearing in Hayward, CA on Wednesday, September 2, 2009 in Attachment A, herein.

We also are submitting in Appendix B herein a National Transportation Safety Board (NTSB) Brief of accident report No. LAX89LA270 File No. 2339 as evidence that power plant plumes are safety hazards to pilots, passengers and aircraft. If you will note the causal affects were lack of Oxygen (starvation), high plume temperature and emission contaminants in the plume itself that resulted in aircraft engine caused failure.

Enclosed in Appendix C herein is ATSDR Ammonia (NH_3). Ammonia along with the other plume contaminants can and do have affects on

receptors that would adversely affect a pilot to safely maintain control of the aircraft.

There are many reasons as to why aircraft would remain in the RCEC plumes some of which would include but not limited to aircraft circling for spacing in the airport pattern under visual flight rules (VFR), engine break-in after maintenance. Holding in the area as instructed by the FAA traffic control personal for spacing as required by Instrument Flight Rules (IFR). Pilot training for slow flight, short field landings and takeoffs, engine out procedures, etc. Also included would be touch and goes for pilots to become current to carry passengers as well as instrument practice approaches to the Hayward Executive Airport which requires a left turn towards and over the plumes. Any of these prolonged practice and training procedures either individually or in combination could and would increase exposure to plume contaminants have an adverse safety affects on pilots, passengers and aircraft.

Health thresholds for pilots, passengers and thresholds for aircraft operation must be far below those that are used for receptors on the ground and engine operation specifications for even a temporary moment in and around RCEC power plant thermal plumes.

CalPilots hereby requests that the RCEC PSD permit be denied.

Respectfully submitted,

Jay White, General Council
California Pilots Association

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Attachment A

PO Box 6868, San Carlos, CA 94070-6868

Mr. Weyman Lee, P.E., Senior Air Quality Engineer
Bay Area Air Quality Management District
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San Francisco, CA 94109
(415) 749-4796

Mr. Bateman, Mr. Lee and Staff,

I am a Vice President of the California Pilots Association, a statewide group of volunteers whose mission is to promote, protect and preserve the state's airports.

We are asking you to deny the PSD the Permit of Significant Deterioration for the Russell City Energy Center for the harm it will do to the Hayward Airport.

This (RCEC) is not a geothermal or green plant. This is a dirty plant which shoots high velocity plumes more than 1200 feet into the air spewing pollution and creating a hazard endangering airplanes.

We have evidence of an aircraft accident caused by a Power Plant's plume. We disagree that your state environmental analysis is complete and request that BAAQMD refer the Determination of Compliance back to the California Energy Commission so that it may be updated and a complete review performed which has not, not been performed.

AB32 is not applied in the present state analysis.

We also disagree with Mr. Stewart that there was any "complete" review by the California Energy Commission as CalPilots was precluded from intervening and participating. Therefore there was NO "complete" review.

In yesterday's (Sept 1st) San Francisco Chronicle, and article named carbon dioxide and five other compounds as dangerous pollutants this plant will contribute two million additional parts of carbon dioxide every year. Or over the 30 year life of the plant, that is 60,000,000 tons. This is unacceptable.

The BAAQMD must weigh 635 *temporary* jobs against the detrimental impacts to Hayward Airport which contributes $90,000,000 in revenue a year, every year, to the surrounding area.

Thank you.

Respectfully submitted,

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Attachment B

National Transportation Safety Board
Washington, DC 20594

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Brief of Accident

Adopted 09/09/1992

LAX89LA270
File No. 2339 | 08/09/1989 | BAKERSFIELD, CA | Aircraft Reg No. N90296 | Time (Local): 11:15 PDT

Make/Model: Bell / 206B
Engine Make/Model: Allison / 250-C20
Aircraft Damage: Destroyed
Number of Engines: 1
Operating Certificate(s): On-demand Air Taxi; Aircraft External Load
Type of Flight Operation:
Reg. Flight Conducted Under: Part 91: General Aviation

	Fatal	Serious	Minor/None
Crew	0	1	0
Pass	0	1	1

Last Depart. Point: VAN NUYS, CA
Destination: Local Flight
Airport Proximity: Off Airport/Airstrip

Condition of Light: Day
Weather Info Src: Witness
Basic Weather: Visual Conditions
Lowest Ceiling: None
Visibility: 20.00 SM
Wind Dir/Speed: Calm
Temperature (°C): 29
Precip/Obscuration:

Pilot-in-Command Age: 51

Certificate(s)/Rating(s)
Commercial; Multi-engine Land; Single-engine Land; Helicopter

Airplane; Helicopter

Flight Time (Hours)

Total All Aircraft: 8000
Last 90 Days: 55
Total Make/Model: 5000
Total Instrument Time: UnK/Nr

THE HELICOPTER CREW WAS FILMING A COGENERATION PLANT. THE HELICOPTER ORBITED THE PLANT THREE TIMES. DURING THE THIRD ORBIT, THE HELICOPTER PASSED OVER THE EXHAUST CHIMNEY OF THE PLANT WHICH WAS OPERATING AT THE TIME. THERE WAS NO VISIBLE INDICATION THAT EXHAUST GASES WERE EMANATING FROM THE CHIMNEY. THE GASES WERE REPORTED TO BE 350 DEGREES FAHRENHEIT WITH A 3.6 PERCENT OXYGEN CONTENT. THE HELICOPTER TURBOSHAFT ENGINE LOST POWER OVER THE CENTER OF THE CHIMNEY. THE PILOT ENTERED AUTOROTATION TOWARDS AN OPEN AREA OF A PARKING LOT. DURING THE FLARE, THE HELICOPTER STRUCK A VEHICLE, AND LANDED HARD, SEVERED THE TAILBOOM, AND ROLLED ON TO ITS SIDE. THE CERTIFICATION STANDARD FOR THE ENGINE WAS 120 DEGREES FAHRENHEIT.

Brief of

The National Transportation Safety Board determines the probable cause(s) of this accident as follows.
THE LOSS OF ENGINE POWER DUE TO THE HELICOPTER BEING FLOWN IN EXHAUST GASES EMANATING FROM A COGENERATION PLANT CHIMNEY STACK THAT EXCEEDED THE CERTIFICATION STANDARDS OF THE POWERPLANT. CONTRIBUTING TO THE ACCIDENT WAS INVISIBLE NATURE OF THE EXHAUST GASES WHICH MADE
THE DETECTION OF THEIR PRESENCE UNLIKELY.

Accident (Continued)

Occurrence #1: LOSS OF ENGINE POWER(TOTAL) - NONMECHANICAL
Phase of Operation: MANEUVERING
Findings
1. (F) WEATHER CONDITION - TEMPERATURE EXTREMES
2. (C) MISCELLANEOUS - STARVATION
3. (F) VISUAL LOOKOUT - NOT POSSIBLE - PILOT IN COMMAND
4. (F) TURBOSHAFT ENGINE - FAILURE,TOTAL
5. (F) DESIGN STRESS LIMITS OF AIRCRAFT - EXCEEDED - PILOT IN COMMAND
6. (C) INFORMATION UNAVAILABLE - PILOT IN COMMAND

Occurrence #2: FORCED LANDING
Phase of Operation: DESCENT - EMERGENCY
Findings
7. (F) AUTOROTATION - PERFORMED - PILOT IN COMMAND

Occurrence #3: IN FLIGHT COLLISION WITH OBJECT
Phase of Operation: LANDING - FLARE/TOUCHDOWN
Findings
8. OBJECT - VEHICLE

Occurrence #4: HARD LANDING
Phase of Operation: LANDING - FLARE/TOUCHDOWN
Findings
9. (F) PROPER DESCENT RATE - NOT POSSIBLE - PILOT IN COMMAND
Findings Legend: (C) = Cause, (F) = Factor
File No. 2339 08/09/1989 BAKERSFIELD, CA Aircraft Reg No. N90296 Time (Local): 11:15 PDT
LAX89LA270

Attachment C

Ammonia (NH_3)
CAS 7664-41-7; UN 2672 (between 12% and 44% solution), UN 2073 (>44% solution), UN 1005 (anhydrous gas or >50% solution)

Synonyms include ammonia gas, anhydrous ammonia, and liquid ammonia. Aqueous solutions are referred to as aqueous ammonia, ammonia solution, and ammonium hydroxide.

- **Persons exposed only to ammonia gas do not pose significant risks of secondary contamination to personnel outside the Hot Zone. Persons whose clothing or skin is contaminated with liquid ammonium hydroxide can secondarily contaminate response personnel by direct contact or through off-gassing ammonia vapor.**
- **Ammonia dissolves readily in water to form ammonium hydroxide a corrosive, alkaline solution at high concentrations.**
- **Ammonia's pungent odor and irritating properties usually provide adequate warning of its presence; however, olfactory fatigue can occur. Inhalation can result in fatalities.**

Description

At room temperature, anhydrous ammonia is a colorless, highly irritating gas with a pungent, suffocating odor. It is lighter than air and flammable, with difficulty, at high concentrations and temperatures. It is easily compressed and forms a clear, colorless liquid under pressure. Anhydrous ammonia is hygroscopic. Ammonia dissolves readily in water to form ammonium hydroxide-an alkaline solution. The concentration of aqueous ammonia solutions for household use is typically 5% to 10% (weight:volume), but solutions for commercial use may be 25% (weight:volume) or more and are corrosive. Aqueous ammonia is commonly stored in steel drums. Anhydrous ammonia is stored and shipped in pressurized containers, fitted with pressure-relief safety devices, and bears the label "Nonflammable Compressed Gas". Despite not meeting the Department of Transport definition of flammable it should be treated as such.

Routes of Exposure

Inhalation

Inhalation of ammonia may cause nasopharyngeal and tracheal burns, bronchiolar and alveolar edema, and airway destruction resulting in respiratory distress or failure. Ammonia's odor threshold is sufficiently low to acutely provide adequate warning of its presence (odor threshold = 5 ppm; OSHA PEL = 50 ppm). However, ammonia causes olfactory fatigue or adaptation, making its presence difficult to detect when exposure is prolonged. Anhydrous ammonia is lighter than air and will

therefore rise (will not settle in low-lying areas); however, vapors from liquefied gas are initially heavier than air and may spread along the ground. Asphyxiation may occur in poorly ventilated or enclosed.

Children exposed to the same levels of ammonia vapor as adults may receive larger dose because they have greater lung surface area:body weight ratios and increased minute volumes:weight ratios. In addition, they may be exposed to higher levels than adults in the same location because of their short stature and the higher levels of ammonia vapor found nearer to the ground.

Skin/Eye Contact

The extent of injury produced by exposure to ammonia depends on the duration of the exposure and the concentration of the gas or liquid. Even low airborne concentrations (100 ppm) of ammonia may produce rapid eye and nose irritation. Higher concentrations may cause severe eye injury. Contact with concentrated ammonia solutions, such as some industrial cleaners (25%), may cause serious corrosive injury, including skin burns, permanent eye damage, or blindness. The full extent of damage to the eyes may not be clear until up to 1 week after the injury is sustained. Contact with liquefied ammonia can cause frostbite injury.

Children are more vulnerable to toxicants that affect the skin because of their relatively larger surface area:body weight ratio.

Ingestion

Ingestion of ammonium hydroxide, while uncommon, results in corrosive damage to the mouth, throat, and stomach. Ingestion of ammonia does not normally result in systemic poisoning.

Sources/Uses

Ammonia is manufactured by reacting hydrogen with nitrogen. About 80% of the ammonia produced is used in fertilizers. It is also used as a refrigerant gas, and in the manufacture of plastics, explosives, pesticides, and other chemicals, as a corrosion inhibitor, in the purification of water supplies, as a component of household cleaners, in the pulp and paper, metallurgy, rubber, food and beverage, textile and leather industries, and in the manufacture of pharmaceuticals. Ammonia is also produced naturally from decomposition of organic matter and under unusual conditions, can reach dangerous concentrations.

Standards and Guidelines

OSHA PEL (permissible exposure limit) = 50 ppm (8-hour TWA).

NIOSH IDLH (immediately dangerous to life or health) = 300 ppm.

AIHA ERPG-2 (the maximum airborne concentration below which it is believed that nearly all individuals could be exposed for up to 1 hour without experiencing or developing irreversible or other serious health effects or symptoms which could impair an individual's ability to take protective action) = 200 ppm.

Physical Properties

Description: Clear, colorless gas at room temperature; easily liquefied; readily dissolves in water to form caustic solutions.

Warning properties: Pungent odor at ~5 ppm; eye irritation at 20 ppm

Molecular weight: 17.0 daltons

Boiling point (760 mm Hg): -28 °F (-33.4°C)

Vapor pressure: >6,000 mm Hg at 68 °F (20 °C)

Gas density: 0.59 (air = 1)

Water solubility: 33.1% at 68 °F (20 °C)

Autoignition temperature: 1,204 °F (650 °C)

Flammable range: 16–25% (concentration in air) Combustible gas, but difficult to burn

Incompatibilities

Ammonia reacts with strong oxidizers, acids, halogens (including chlorine bleach), and salts of silver, zinc, copper, and other heavy metals. It is corrosive to copper and galvanized surfaces.

Health Effects

- **Ammonia is highly irritating to the eyes and respiratory tract. Swelling and narrowing of the throat and bronchi, coughing, and an accumulation of fluid in the lungs can occur.**
- **Ammonia causes rapid onset of a burning sensation in the eyes, nose, and throat, accompanied by lacrimation, rhinorrhea, and coughing. Upper airway swelling and pulmonary edema may lead to airway obstruction.**
- **Prolonged skin contact is prolonged (more than a few minutes) can cause pain and corrosive injury.**

Acute Exposure

Anhydrous ammonia reacts with moisture in the mucous membranes to produce an alkaline solution (ammonium hydroxide). Exposure to ammonia gas or ammonium hydroxide can result in corrosive injury to the mucous membranes of the eyes, lungs, and gastrointestinal tract and to the skin due to the alkaline pH and the hygroscopic nature of ammonia.

Respiratory

The extent of injury produced by exposure to ammonia depends on the duration of the exposure, the concentration of the gas, and the depth of inhalation. Even fairly low airborne concentrations (50 ppm) of ammonia produce rapid onset of eye, nose, and throat irritation; coughing; and narrowing of the bronchi. More severe clinical signs include immediate narrowing of the throat and swelling, causing upper airway obstruction and accumulation of fluid in the lungs. This may result in low blood oxygen levels and an altered mental status. Mucosal burns to the tracheobronchial tree can also occur.

Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. Children may also be more vulnerable because of failure to evacuate an area promptly when exposed.

Dermal

Dilute aqueous solutions (less than 5%) rarely cause serious burns but can be moderately irritating. Exposure to concentrated vapor or solution can cause pain, inflammation, blisters, necrosis and deep penetrating burns, especially on moist skin areas. Skin contact with compressed, liquid ammonia (which is stored at -28 °F) causes frostbite injury, and may also result in severe burns with deep ulcerations.

Ocular

Ammonia has a greater tendency to penetrate and damage the eyes than does any other alkali. Even low concentrations of ammonia vapor (100 ppm) produce rapid onset of eye irritation. Contact with high concentrations of the gas or with concentrated ammonium hydroxide may cause swelling and sloughing of the surface cells of the eye, which may result in temporary or permanent blindness.

Gastrointestinal

Nausea, vomiting, and abdominal pain are common symptoms following ingestion of ammonia. On rare occasions, deliberate ingestion of household ammonia (5–10%) has resulted in severe esophageal burns. Ingestion of more concentrated ammonia can cause severe corrosive injury to the mouth, throat, esophagus and stomach.

Potential Sequelae

Survivors of severe inhalation injury may suffer residual chronic lung disease. In cases of eye contact, ulceration and perforation of the cornea can occur after weeks or months, and blindness may ensue. Cataracts and glaucoma have been reported in persons acutely exposed. Ingestion of ammonia may cause permanent damage to the mucous membranes of the alimentary canal, with bleeding, perforation, scarring, or stricture formation as potential sequelae.

Chronic Exposure

Repeated exposure to ammonia may cause chronic irritation of the respiratory tract. Chronic cough, asthma and lung fibrosis have been reported. Chronic irritation of the eye membranes and dermatitis have also been reported.

Carcinogenicity

Ammonia has not been classified for carcinogenic effects.

Reproductive and Developmental Effects

No data exist to evaluate the reproductive and developmental effects of ammonia in humans. Ammonia is not included in *Reproductive and Developmental Toxicants*, a 1991 report published by the U.S. General Accounting Office (GAO) that lists 30 chemicals of concern because of widely acknowledged reproductive and developmental consequences. Decreased egg production and conception rates have been observed in animals, and ammonia has been shown to cross the ovine placental barrier.

Prehospital Management

- **Victims exposed only to ammonia gas do not pose substantial risks of secondary contamination to personnel outside the Hot Zone. Victims whose clothing or skin is contaminated with liquid ammonium hydroxide can secondarily contaminate response personnel by direct contact or through off-gassing ammonia vapor.**
- **Ammonia causes rapid onset of a burning sensation in the eyes, nose, and throat, accompanied by lacrimation, rhinorrhea, and coughing. Upper airway swelling and pulmonary edema may lead to airway obstruction.**
- **Ammonia gas or solution can cause serious corrosive burns on contact.**
- **There is no antidote for ammonia poisoning. Treatment consists of supportive measures. These include administration of humidified oxygen and bronchodilators and airway management; treatment of skin and eyes with copious irrigation; and dilution of ingested ammonia with milk or water.**

Hot Zone

Rescuers should be trained and appropriately attired before entering the Hot Zone. If the proper equipment is not available, or if rescuers have not been trained in its use, assistance should be obtained from a local or regional HAZMAT team or other properly equipped response organization.

Rescuer Protection

Ammonia is a caustic and corrosive chemical that causes irritation and chemical burns upon contact of the gas or liquid with the eyes, skin, respiratory tract, or alimentary canal.

Respiratory Protection: Positive-pressure, self-contained breathing apparatus (SCBA) is recommended in response situations that involve exposure to potentially unsafe levels of ammonia.

Skin Protection: Chemical-protective clothing is recommended because ammonia can cause skin irritation and burns.

ABC Reminders

Quickly access for a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible.

Victim Removal

If victims can walk, lead them out of the Hot Zone to the Decontamination Zone. Victims who are unable to walk may be removed on backboards or gurneys; if these are not available, carefully carry or drag victims to safety.

Consider appropriate management of chemically contaminated children, such as measures to reduce separation anxiety if a child is separated from a parent or other adult.

Decontamination Zone

Victims exposed only to ammonia gas who have no skin or eye irritation do not need decontamination. They may be transferred immediately to the Support Zone. All others require decontamination as described below.

Rescuer Protection

If exposure levels are determined to be safe (<20 ppm), decontamination may be conducted by personnel wearing a lower level of protection than that worn in the Hot Zone (described above).

ABC Reminders

Quickly access for a patent airway, ensure adequate respiration and pulse. Stabilize the cervical spine with a collar and a backboard if trauma is suspected. Administer supplemental oxygen as required. Assist ventilation with a bag-valve-mask device if necessary.

Basic Decontamination

Rapid skin and eye decontamination is critical. Victims who are able, may assist with their own decontamination. Remove contaminated clothing while flushing exposed areas. Double-bag contaminated clothing and personal belongings.

Flush liquid-exposed skin and hair with water for at least 5 minutes. If feasible, wash exposed skin extremely thoroughly with soap and water. Use caution to avoid hypothermia when decontaminating of children or the elderly. Use blankets when appropriate.

Irrigate exposed or irritated eyes with plain water or saline for at least 15 minutes. Remove contact lenses, if easily removable without additional trauma to the eye. Continue irrigation while transferring the victim to the Support Zone.

In cases of ingestion **do not induce emesis**, perform gastric lavage, or attempt neutralization. **Do not administer activated charcoal.** Victims who are conscious and able to swallow should be given 4 to 8 ounces of water or milk.

Consider appropriate management of chemically contaminated children at the exposure site. Also, provide reassurance to the child during decontamination, especially if separation from a parent occurs. If possible, seek assistance from a child separation expert.

Transport to Support Zone

As soon as basic decontamination is complete, move the victim to the Support Zone.

Support Zone

Be certain that victims have been decontaminated properly (see *Decontamination Zone* above). Victims who have undergone decontamination or have been exposed only to vapor pose no serious risks of secondary contamination. Support Zone personnel require no specialized protective gear in such cases.

ABC Reminders

Quickly access a patent airway, ensure adequate respiration and pulse. If trauma is suspected, maintain cervical immobilization manually and apply a cervical collar and a backboard when feasible. Ensure adequate respiration and pulse; administer supplemental oxygen as required. Establish intravenous access if necessary. Place on a cardiac monitor.

Additional Decontamination

Continue irrigating exposed skin and eyes, as appropriate. In cases of ingestion, **do not induce emesis, do not administer activated charcoal, and do not attempt to neutralize with weak acids**. If the patient is conscious and able to swallow, administer 4 to 8 ounces of water or milk if it has not been given previously.

Advanced Treatment

In cases of respiratory compromise secure airway and respiration via endotracheal intubation. If not possible, perform cricothyroidotomy if equipped and trained to do so. Patients who are hypotensive or have seizures should be treated according to advanced life support (ALS) protocols.

Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Ammonia poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

Patients who are comatose, hypotensive, or are having seizures or have cardiac arrhythmias should be treated according to ALS protocols.

Monitor fluid and electrolyte balance and restore if abnormal. Fluids should be administered cautiously to patients with pulmonary edema.

Transport to Medical Facility

Only decontaminated patients or patients not requiring decontamination should be transported to a medical facility. "Body bags" are not recommended.

Report to the base station and the receiving medical facility the condition of the patient, treatment given, and estimated time of arrival at the medical facility.

If ammonia has been ingested, prepare the ambulance in case the victim vomits toxic material. Have ready several towels and open plastic bags to quickly clean up and isolate vomitus.

Multi-Casualty Triage

Consult with the base station physician or the regional poison control center for advice regarding triage of multiple victims.

The following exposed persons should be evaluated at a medical facility: those who have ingested ammonia, those who have persistent upper respiratory irritation or other acute symptoms of severe inhalation exposure, and those who have eye or skin burns that cover a large surface area.

Persons who have been exposed only to ammonia gas and are currently asymptomatic are not likely to develop complications. After their names, addresses, and telephone numbers are recorded, these patients may be released from the scene with follow-up instructions to seek medical care promptly if symptoms develop (see *Patient Information Sheet* below).

Emergency Department Management

- **Hospital personnel in an enclosed area can be secondarily contaminated by vapor off-gassing from heavily soaked clothing or from the vomitus of victims who have ingested ammonia. Patients do not pose a contamination risk after contaminated clothing is removed and the skin and hair are washed.**
- **Inhaling ammonia causes rapid onset of a burning sensation in the eyes, nose, and throat, accompanied by lacrimation, rhinorrhea, and coughing. Upper airway swelling may lead to airway obstruction.**
- **Ammonia gas or solution can cause serious corrosive burns on contact.**
- **There is no antidote for ammonia poisoning. Treatment consists of support of respiratory and cardiovascular functions.**

Decontamination Area

Previously decontaminated patients and patients exposed only to ammonia gas who have no skin or eye irritation may be transferred immediately to the Critical Care Area. Other patients will require rapid decontamination as described in Basic Decontamination below.

Be aware that use of protective equipment by the provider may cause fear in children, resulting in decreased compliance with further management efforts.

Because of their larger surface area:weight ratio, children are more vulnerable to toxicants absorbed through the skin. Also, emergency room personnel should examine children's mouths because of the frequency of hand-to-mouth activity among children.

ABC Reminders

Evaluate and support airway, breathing, and circulation. Watch for signs of laryngeal edema and airway compromise. Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. In cases of respiratory compromise, secure airway and respiration via endotracheal intubation. If not possible, surgically secure an airway.

Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use

of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Ammonia poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

Patients who are comatose, hypotensive or have seizures should be treated in the conventional manner. Manage hypotension and shock with intravenous fluids (use caution when pulmonary edema is present); pressor agents may be required.

Basic Decontamination

Patients who are able, may assist with their own decontamination. Remove and double bag contaminated clothing and personal belongings.

Because ammonia in solution can cause burns, ED staff should don chemical-resistant jumpsuits (e.g., of Tyvek or Saranex) or butyl rubber aprons, rubber gloves, and eye protection if the patient's clothing or skin is wet. After the patient has been decontaminated, no special protective clothing or equipment is required for ED personnel.

Flush liquid-exposed skin and hair with water for at least 5 minutes. If feasible, wash exposed skin extremely thoroughly with soap and water.

Use caution to avoid hypothermia when decontaminating children or the elderly. Use blankets or warmers when appropriate.

Irrigate exposed or irritated eyes with plain water or saline for at least 15 minutes. Remove contact lenses, if easily removable without additional trauma to the eye. Continue irrigation while transferring the victim to the Critical Care Area. An ophthalmic anesthetic, such as 0.5% tetracaine, may be necessary to alleviate blepharospasm, and lid retractors may be required to allow adequate irrigation under the eyelid.

In cases of ingestion, **do not induce emesis; do not administer activated charcoal**. If the patient is conscious and able to swallow, administer 4 to 8 ounces of water or milk if it has not been given previously (see *Critical Care Area* below for more information on ingestion exposure).

Critical Care Area

Be certain that appropriate decontamination has been carried out. (See *Decontamination Area* above.)

ABC Reminders

Evaluate and support airway, breathing, and circulation as in ABC Reminders above. Children may be more vulnerable to corrosive agents than adults because of the smaller diameter of their airways. Establish intravenous access in seriously ill patients if this has not been done previously. Continuously monitor cardiac rhythm.

Patients who are comatose, hypotensive, having seizures or have cardiac arrhythmias should be treated in the conventional manner.

Inhalation Exposure

Administer supplemental oxygen by mask to patients who have respiratory symptoms. Treat patients who have bronchospasm with aerosolized bronchodilators. The use of bronchial sensitizing agents in situations of multiple chemical exposures may pose additional risks. Also consider the health of the myocardium before choosing which type of bronchodilator should be administered. Cardiac sensitizing agents may be appropriate; however, the use of cardiac sensitizing agents after exposure to certain chemicals may pose enhanced risk of cardiac arrhythmias (especially in the elderly). Ammonia poisoning is not known to pose additional risk during the use of bronchial or cardiac sensitizing agents.

Consider racemic epinephrine aerosol for children who develop stridor. Dose 0.25–0.75 mL of 2.25% racemic epinephrine solution in water, repeat every 20 minutes as needed cautioning for myocardial variability.

Observe patients carefully for 6 to 12 hours for signs of upper-airway obstruction. Patients who have had a severe exposure may develop noncardiogenic pulmonary edema.

Skin Exposure

If ammonia gas or solution was in contact with the skin, chemical burns may result; treat as thermal burns.

Eye Exposure

Continue irrigation for at least 15 minutes or until the pH of the conjunctival fluid has returned to normal. Test visual acuity. Examine the eyes for corneal damage and treat appropriately. Immediately consult an ophthalmologist for patients who have severe corneal injuries.

Ingestion Exposure

Do not induce emesis because this may re-expose the esophagus and mouth to the caustic substance. Do not administer activated charcoal. Do not perform gastric lavage or attempt neutralization after ingestion. If not given during decontamination, give 4 to 8 ounces of water by mouth to dilute stomach contents.

Consider endoscopy to evaluate the extent of gastrointestinal-tract injury. Extreme throat swelling may require endotracheal intubation or cricothyroidotomy.

Antidotes and Other Treatments

There is no specific antidote for ammonia poisoning. Although administration of corticosteroids to limit esophageal scarring is recommended by some toxicologists, this treatment is unproven and may be harmful in patients who have perforation or serious infection. Hemodialysis is not effective.

Laboratory Tests

Routine laboratory studies for all exposed patients include CBC, glucose, and electrolyte determinations. Chest radiography and pulse oximetry (or arterial blood gases measurements) are recommended for severe inhalation exposure or if pulmonary aspiration is suspected. No specific biologic test for ammonia exposure exists.

Disposition and Follow-up

Consider hospitalizing patients who have evidence of respiratory distress or significant skin burns or who have ingested an ammonia solution.

Delayed Effects

Pulmonary injury may continue to evolve over 18 to 24 hours. Residual bronchoconstriction, bronchiectasis and small airway disease may occur, and chronic obstructive pulmonary disease can develop. Patients exposed by inhalation who are initially symptomatic should be observed carefully and reexamined periodically. Pulmonary function tests should be repeated on an annual basis. Patients who develop pulmonary edema should be admitted to an intensive care unit.

Acute ocular exposure to ammonia may result in persistent intraocular pressure, cataract formation, and glaucoma with significant reduction in visual acuity.

Patient Release

Patients who are asymptomatic following exposure or who experienced mild symptoms that have been treated may be released and advised to seek medical care promptly if symptoms recur or develop (see *Ammonia—Patient Information Sheet* below). Cigarette smoking may exacerbate pulmonary injury and should be discouraged for 72 hours after exposure.

Follow-up

Obtain the name of the patient's primary care physician so that the hospital can send a copy of the ED visit to the patient's doctor.

Patients with mild to moderate skin burns should be reexamined within 24 hours.

Patients who have eye injuries should be reexamined by an ophthalmologist in 24 hours.

Reporting

If a work-related incident has occurred, you may be legally required to file a report; note incident details and contact your state or local health department.

Other persons may still be at risk in the setting where this incident occurred. If the incident occurred in the workplace, discussing it with company personnel may prevent future incidents. If a public health risk exists, notify your state or local health department or other responsible public agency. When appropriate, inform patients that they may request an evaluation of their workplace from OSHA or NIOSH. See Appendices III and IV for a list of agencies that may be of assistance.

Ammonia
Patient Information Sheet

This handout provides information and follow-up instructions for persons who have been exposed to ammonia gas or ammonium hydroxide solution.

What is ammonia?
Ammonia is a colorless, highly irritating gas with a sharp, suffocating odor. It easily dissolves in water to form a caustic solution called ammonium hydroxide. It is not highly flammable, but containers of ammonia may explode when exposed to high heat. About 80% of the ammonia produced is used in fertilizers. It is also used as a refrigerant and in the manufacture of plastics, explosives, pesticides, and other chemicals. It is found in many household and industrial-strength cleaning solutions.

What immediate health effects can result from ammonia exposure?
Most people are exposed to ammonia from breathing the gas. They will notice the pungent odor and experience burning of the eyes, nose, and throat after breathing even small amounts. With higher doses, coughing or choking may occur. Exposure to high levels of ammonia can cause death from a swollen throat or from chemical burns to the lungs. Skin contact with ammonia-containing liquids may cause burns. Eye exposure to concentrated gas or liquid can cause serious corneal burns or blindness. Drinking a concentrated ammonia solution can cause burns to the mouth, throat, and stomach. Generally, the severity of symptoms depends on the degree of exposure.

Can ammonia poisoning be treated?
There is no antidote for ammonia poisoning, but ammonia's effects can be treated, and most people recover. Persons who have experienced serious signs and symptoms (such as severe or persistent coughing or burns in the throat) may need to be hospitalized.

Are any future health effects likely to occur?
A single small exposure from which a person recovers quickly is not likely to cause delayed or long-term effects. After a severe exposure, injury to the eyes, lungs, skin, or digestive system may continue to develop for 18 to 24 hours, and serious delayed effects, such as gastric perforation, chronic pulmonary obstructive disease, or glaucoma, are possible.

What tests can be done if a person has been exposed to ammonia?
Specific tests for the presence of ammonia in blood or urine generally are not useful to the doctor. If a severe exposure has occurred, blood and urine analyses, chest x-rays, and other tests may show whether the lungs have been injured. Testing is not needed in every case. If ammonia contacts the eyes, the doctor may put a special dye in the eyes and examine them with a magnifying lamp.

Where can more information about ammonia be found?
More information about ammonia can be obtained from your regional poison control center; your state, county, or local health department; the Agency for Toxic Substances and Disease Registry (ATSDR); your doctor; or a clinic in your area that specializes in occupational or environmental health. If the exposure happened at work, you may wish to discuss it with your employer, the Occupational Safety and Health Administration (OSHA), or the National Institute for Occupational Safety and Health (NIOSH). Ask the person who gave you this form for help in locating these telephone numbers.

Follow-up Instructions

Keep this page and take it with you to your next appointment. Follow *only* the instructions checked below.

[ ] Call your doctor or the Emergency Department if you develop any unusual signs or symptoms within the next 24 hours, especially:
- coughing
- difficulty breathing or shortness of breath
- wheezing or high-pitched voice
- chest pain or tightness
- increased pain or a discharge from exposed eyes
- increased redness or pain or a pus-like discharge in the area of a skin burn
- stomach pain or vomiting

[ ] No follow-up appointment is necessary unless you develop any of the symptoms listed above.
[ ] Call for an appointment with Dr. _____ in the practice of _____. When you call for your appointment, please say that you were treated in the Emergency Department at _____ Hospital by _____ and were advised to be seen again in _____ days.
[ ] Return to the Emergency Department/ _____ Clinic on (date) _____ at _____ AM/PM for a follow-up examination.
[ ] Do not perform vigorous physical activities for 1 to 2 days.
[ ] You may resume everyday activities including driving and operating machinery.
[ ] Do not return to work for _____ days.
[ ] You may return to work on a limited basis. See instructions below.
[ ] Avoid exposure to cigarette smoke for 72 hours; smoke may worsen the condition of your lungs.
[ ] Avoid drinking alcoholic beverages for at least 24 hours; alcohol may worsen injury to your stomach or have other effects.
[ ] Avoid taking the following medications: _____
[ ] You may continue taking the following medication(s) that your doctor(s) prescribed for you: _____
_____
_____
[ ] Other instructions: _____
_____
_____

- Provide the Emergency Department with the name and the number of your primary care physician so that the ED can send him or her a record of your emergency department visit.
- You or your physician can get more information on the chemical by contacting: _____ _____ or _____, or by checking out the following Internet Web sites: _____; _____.

Signature of patient _____ Date _____

Signature of physician _____ Date _____