

**An Exposure Prevention Plan for an  
Anhydrous Ammonia Handling System**

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**Abstract**

In July of 1996, the Industrial Hygiene Team of the Environmental Management Office at NASA Lewis Research Center was contacted by the Space Station Program Office to conduct ammonia awareness training for a team of engineers and technicians. The team was tasked with assembling and operating an ammonia handling system for testing of a photovoltaic radiator at the NASA Plum Brook Station Space Power Facility. The ammonia handling system supports a radiator designed to radiate excess heat from a photovoltaic array module used to provide power to the International Space Station. The system would consist of a hazardous materials trailer equipped with an anhydrous ammonia tank, heater, accumulator, chiller, and flow bench.

Meetings were held with representatives from the Space Station Program Office, the engineers and Plum Brook safety personnel. Guidance was also provided by representatives from Kennedy Space Center. Determinations were made concerning the locations and types of potential exposures and a plan was developed which included training, personal protective equipment, engineering controls and emergency response. Various organizations including the Plum Brook Safety Committee, the Lewis Environmental Management Office, the Test Readiness Review Board and the Program Office all had requirements that had to be met in order to satisfy themselves that all personnel involved in the operation of the system would be safe.

What resulted was a comprehensive plan that provided more than adequate safety measures and succeeded in protecting all personnel from the hazards of the ammonia system. Testing of the photovoltaic radiator was successful and although ammonia leaks were detected and maintenance of the system was ongoing, no one was injured. It was felt that the training and controls in place allowed for a comfort level that did not interfere with the operations.

**Project Overview**

An ammonia handling system was designed by the Space Station Program Office of NASA Lewis Research Center to circulate anhydrous ammonia through a radiator. The radiator will distribute excess heat from a photovoltaic array module used to provide power to the International Space Station. The ammonia system consisted of the photovoltaic radiator and a hazardous materials trailer equipped with an anhydrous ammonia tank, heater, accumulator, chiller and flow bench, and supply and return lines from the trailer to the radiator. The Industrial Hygiene Team of the

Environmental Management Office was contacted to provide guidance in the safe handling of ammonia and awareness training for the team of engineers and technicians designing the system. The system was tested in April of 1997 at the Space Power Facility at NASA's Plum Brook Station. The photovoltaic radiator was fully deployed during testing at the Space Power Station.

## **Objectives**

Ensure all personnel working with or potentially exposed to ammonia were trained in the health hazards and safety precautions.

Ensure all personnel working with the ammonia handling system were equipped to work in an ammonia environment.

Ensure all residents of the Space Power Facility (SPF) and the environment were protected from accidental releases of ammonia.

## **Exposure Prevention Plan**

### Training

Level I - All personnel assigned to SPF	Level II - Ammonia Handling/Equipment Repair Team
- Ammonia Awareness	Respiratory Protection/Fit Testing
- Controlled Access Areas	Buddy System
- Evacuation Procedures	Personal Ammonia Monitors
- Ammonia Detection System	Personal Protective Equipment

### Engineering Controls – Ammonia Trailer

General dilution ventilation supplied at 1820 cubic feet per minute. Exhausted to emergency water scrubber at 1600 cubic feet per minute. Scrubber activated when atmospheric levels reached 35 PPM of ammonia or by pressing of panic button.

### Administrative Controls

- Written Emergency Response Plan
- Written ammonia trailer entry procedures
- Controlled access areas

### Additional Safeguards

Facility and trailer ammonia detection system, wired to control room. Five detectors within SPF and two detectors within the trailer.

- Personal ammonia detectors to be worn during all entries into the trailer.
- Two safety showers located near the trailer.

### Personal Protective Equipment

- Full facepiece Air Purifying Respirator with ammonia cartridges
- Full Body Chemical Resistant Suits
- Butyl Rubber Gloves
- Impervious Boots

## **Results**

Testing of the photovoltaic radiator was successful. Entry into an ammonia environment to repair and perform adjustments on the handling system occurred without incident. Training and controls allowed for a comfort level that did not interfere with the operations and the goals of the test.

N. B.: Several pictures were furnished to support this poster: The NASA Plum Brook Station, the Photovoltaic Radiator, the Rocketdyne Ammonia Flow Bench, and Ammonia Handling System, and Personal Protective Equipment (respirators, suit ensembles, gloves, boots, monitors).