**Indian Point 3**
**Nuclear Power Plant**
P.O. Box 215
Buchanan, New York 10511
914 736.8001

**New York Power Authority**

**L. M. Hill**
Resident Manager

June 2, 1995
IPN-95-063

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D.C. 20555

SUBJECT: Indian Point 3 Nuclear Power Plant
Docket No. 50-286
License No. DPR-64
**"Proposed Change to Indian Point 3's (IP3) State Pollution Discharge Elimination System (SPDES) Permit No. NY0004472"**

Dear Sir:

In accordance with Indian Point 3's Technical Specifications, Appendix B, Part I, section 3.2, the Authority hereby transmits to the Nuclear Regulatory Commission a copy of the Authority's proposed change to IP3's SPDES permit. The proposed change requests permission, via a chemical use permit, to add ethanolamine (ETA) for chemistry control of the secondary side of the plant.

The Authority is making no commitments in this letter. Should you have any questions regarding this matter, please contact Mr. Matthew Kerns, General Chemistry Supervisor, at (914) 736-8452.

Very truly yours,

L. M. Hill
Resident Manager
Indian Point 3 Nuclear Power Plant

LMH/vjw

Attachment

cc: See next page



A001
1/1

cc: Mr. Thomas T. Martin
Regional Administrator
Region I
U.S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

Mr. Nicola F. Conicella, Project Manager
Project Directorate I-1
Division of Reactor Projects I/II
U.S. Nuclear Regulatory Commission
Mail Stop 14 B2
Washington, D.C. 20555

U.S. Nuclear Regulatory Commission
Resident Inspectors' Office
Indian Point 3 Nuclear Power Plant

123 Main Street
White Plains, New York 10
914 681.6200

June 2, 1995

Mr. Paul Kolakowski
New York State Department of
Environmental Conservation
50 Wolf Road
Albany, New York, 12233-3506

**Re: New York Power Authority Indian Point Unit No.3 Nuclear Power Plant Chemical Use Request - Addition of Ethanolamine as an Approved Chemical For Usage In Plant Secondary Steamside Chemistry**

The New York Power Authority (NYPA) requests permission, via a chemical use request, to add ethanolamine for chemistry control of the secondary steamside at the Indian Point Unit No. 3 Nuclear Power Plant ( IP-3), SPDES ID No. NYO004472. The use of ethnolamine may or may not preclude the use of morpholine pending the results of future chemical analysis of the corrosion products produced on the secondary steamside. The benefits for using ethanolamine (ETA) over morphline are greater corrosion control of the plant's secondary steam side and a reduction in chemical costs.

Morphline is permitted for use on the secondary steam side at IP-3 for pH control. The control of pH directly influences corrosion of plant piping systems. Through the use of morpholine corrosion inhibition and prolonged plant life can be achieved. Morpholine is injected into the IP-3 feedwater to a concentration of 4-5 ppm. A fraction of the morpholine is continuously removed by both the condensate polisher and the steam generator blowdown recovery demineralizers. When the resins in the demineralizers are exhausted, they are regenerated in the condensate polisher facility. Morpholine is removed from the resins along with other impurities and transferred to the high Total Dissolved Solids (TDS) tank for discharge to the Hudson River. In addition, IP-3 has the capability to bypass the steam generator blowdown demineralizers and discharge directly into the Hudson River although this path way is seldom used. During continuous power operation the annual release of morpholine is approximately 119,000 pounds as released from the high TDS tank.

Ethanolamine (ETA) would be used in the same way as morpholine but in lower concentrations. Initially the Authority proposes to use ethanolamine for a test period with concentrations in the 0.5-5.0 ppm range. Ultimately, if the product proves to be successful, the concentrations of the product are predicted to be between 2-3 ppm.

Based upon a predicted concentration of 3 ppm the annual average usage rate will be 112,000 pounds. This total is less the currently permitted discharge rate for morpholine of 119,00 pounds.

Currently, 60% morpholine is stored in a 5000 gallon tank located outside of the north loading well of the turbine building at IP-3. Once the existing supply of morpholine is exhausted the ETA will then be stored in the former 5000 gallon morpholine storage tank. It is anticipated that the ETA will be used in bulk concentrations of 40-80% by weight. Initially, ETA will be stored in 200-400 gallon totes for the testing period. The introduction of ETA will occur in one of two ways. The first operating scheme involves the gradual introduction of ETA in combination with morpholine, this will result in a period when both ETA and morpholine will be present. The second operating scheme would be the addition of ETA without morpholine.

Recently, the Department has granted permission to Rochester Gas and Electric for the substitution of ETA for morpholine at their Ginna Nuclear Power Station on a trial basis. The Electric Power and Research Institute (EPRI) estimates that 17 nuclear power plant across the country are currently using ETA.

For your information I have enclosed toxicity testing conducted on ETA for Connecticut Yankee Atomic Power Company and the Catawba Nuclear Station, as attachment I. Material Safety Data Sheets (MSDS) for both morpholine and ETA are given as attachment II.

If you have any questions please contact John Kahabka at (914) 681-6308.

Sincerely,

John W. Blake, Ph.D.
Director
Environmental Division

Enclosure

**NORTHEAST UTILITIES**

THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

February 22, 1993

D06123

Mr. James Grier
Department of Environmental Protection
122 Washington Street
Hartford, Connecticut 06106

References: 1) Permit (C04782), NPDES No. CT0003123, dated September 30, 1992.

Dear Mr. Grier:

Connecticut Yankee Atomic Power Company
Haddam Neck Plant
NPDES Permit CT0003123 - Minor Modification

Connecticut Yankee Atomic Power Company (CYAPCO) has scheduled a refueling outage at its Haddam Neck Plant starting May 1, 1993 and lasting until September 1993. Northeast Utilities Service Company (NUSCO), on behalf of CYAPCO, hereby requests a minor modification to NPDES Permit CT0003123 in accordance with the provisions of permit paragraph 2, D, (7)(C) as follows:

> NUSCO requests that morpholine be approved for discharge at a concentration of less than or equal to 125 mg/L from Discharge Serial Number (DSN) 001-B during the refueling outage.
>
> NUSCO also requests that ethanolamine (ETA) be permitted for discharge from DSN 001-B at a concentration of less than or equal to 10 mg/L for the last five days prior to shutdown and for normal operations at a concentration less than or equal to 6 mg/L following this shutdown. ETA will not be discharged during the shutdown.

Explanation for Morpholine Use:

During refueling outages, a hydrazine concentration of up to 125 mg/L is maintained in the steam generators to control oxygen and to mitigate corrosion. This is referred to as "secondary side wet layup." Maintenance activities related to the refueling operations often require that the steam generators be filled and drained several times during the outage via DSN 001-B.

Nuclear power industry experience has recently shown that the use of morpholine, in addition to hydrazine, during secondary side wet layup can significantly improve the overall heat transfer efficiency of the steam

generators upon return to power. San Onofre nuclear power station in California added morpholine (100 mg/L) to their steam generators during wet layup and realized an estimated 10 to 20 megawatts electric increase upon start-up. At Connecticut Yankee, it is estimated that the use of the requested concentration of morpholine during layup could improve electricity production by as much as 1.5%.

For discharge calculation purposes, there are four steam generators, each with a volume of 20,000 gallons during wet layup. A maximum cycle of two generator drains per day is expected. With a nominal discharge rate of 50 gpm via DSN 001-B flowing into DSN 001 which will be discharging at a rate of 180,000 gpm during the shutdown, the resulting concentration of morpholine discharged to the environment would be 0.035 mg/L. Mr. Thomas Haze, Senior Environmental Analyst at the Connecticut Department of Environmental Protection (DEP) Water Compliance Unit, determined that the LC50 of morpholine, using Daphnia pulex as the test organism, was on the order of 24 mg/L, several hundred times higher than the proposed discharge concentration.

Additionally, the use of morpholine during secondary side wet layup will allow a reduction in the permitted discharge of hydrazine from 125 mg/L to 95 mg/L. This is in keeping with the DEP's request to minimize the use of hydrazine.

Explanation for ETA Use:

Pressurized water reactors, throughout the nuclear industry, are experiencing steam generator pressure losses due to the presence of deposits on the secondary side of the SG tubes. The Electric Power Research Institute (EPRI) research indicates that it is possible to loosen these deposits by injecting ETA into the feedwater during the last five (5) days of operation prior to a refueling outage. The ETA is expected to change the morphology of the deposits on the tubes, thereby making them more susceptible to removal during a shutdown evolution. Ultimate deposit removal from the SGs would be via sludge lancing during the refueling outage. As a result of using ETA prior to the upcoming outage, CY could recover some or all of the 40 psi pressure loss they are presently experiencing. Recovered pressure loss could result in as much as a nine (9) MWe increase in the station's output.

Following the shutdown, ETA would be used in conjunction with hydrazine for normal operations to provide for corrosion mitigation by reducing iron and copper transport within the feedwater system, thereby reducing the pollutants iron and copper in the final effluent.

For discharge calculation purposes, the concentration of ETA in the steam generator blowdown during the last five operating days preceding the refueling outage would be 10 mg/L at a discharge flow of 60 gpm. DSN 001-B flows into DSN 001 which has an operating flow of 400,000 gpm, resulting in ETA discharging to the environment at a concentration of 0.0015 mg/L.

During normal operations, ETA would be injected such that the discharge concentration from DSN 001-B was less than or equal to 6 mg/L, which would result in a discharge of ETA to the environment at a concentration of 0.001 mg/L.

Northeast Utilities Environmental Laboratory has conducted toxicity tests for ETA. Copies of the results are enclosed.

In order to expedite this matter, Mr. Thomas P. Arcari of NUSCO Generation Environmental Licensing will contact your office next week to make arrangements for a meeting in order to provide any additional information you may require.

Should you have any questions, please call Mr. Arcari, at (203) 665-3713.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for The Connecticut Yankee
Atomic Power Company

R. G. Chevalier
Vice President

Enclosure

GWLN
DCP
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Table 1. Results of Diaminoethane toxicity test (April 22-24, 1992) with *Daphnia pulex*.

| Diaminoethane | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 9 | 8.4 | 8.2 | 7.5 | 7.2 | 50 |
| | 2 | 10 | 10 | 9 | 8.4 | 8.2 | 7.5 | 7.3 | 50 |
| 6.25% | 1 | 10 | 10 | 8 | 8.3 | 8.3 | 7.6 | 7.4 | |
| (0.16ppm) | 2 | 10 | 10 | 9 | 8.3 | 8.3 | 7.6 | 7.5 | |
| 12.5% | 1 | 10 | 10 | 9 | 8.4 | 8.3 | 7.6 | 7.5 | |
| (0.31ppm) | 2 | 10 | 10 | 8 | 8.4 | 8.2 | 7.6 | 7.6 | |
| 25% | 1 | 10 | 10 | 10 | 8.5 | 8.2 | 7.6 | 7.6 | |
| (0.63ppm) | 2 | 10 | 10 | 10 | 8.5 | 8.2 | 7.6 | 7.6 | |
| 50% | 1 | 10 | 10 | 10 | 8.5 | 8.4 | 7.6 | 7.6 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 8.5 | 8.4 | 7.6 | 7.6 | |
| 100% | 1 | 10 | 10 | 7 | 8.5 | 8.5 | 7.8 | 7.6 | |
| (2.5ppm) | 2 | 10 | 10 | 5 | 8.5 | 8.5 | 7.8 | 7.6 | |
| 200% | 1 | 10 | 9 | 7 | 8.5 | 8.5 | 8.6 | 7.7 | 50 |
| (5.0ppm) | 2 | 10 | 8 | 5 | 8.5 | 8.5 | 8.6 | 7.7 | 50 |

Table 2. Results of Diaminoethane toxicity test (May 8-10, 1992) with *Daphnia pulex*.

| Diaminoethane | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.4 | 8.0 | 7.6 | 7.6 | 50 |
| | 2 | 10 | 10 | 10 | 7.4 | 8.0 | 7.6 | 7.6 | 50 |
| 6.25% | 1 | 10 | 10 | 10 | 7.9 | 8.0 | 7.7 | 7.7 | |
| (0.16ppm) | 2 | 10 | 10 | 10 | 7.9 | 8.0 | 7.7 | 7.7 | |
| 12.5% | 1 | 10 | 10 | 10 | 7.9 | 8.0 | 7.7 | 7.7 | |
| (0.31ppm) | 2 | 10 | 10 | 10 | 7.9 | 8.0 | 7.7 | 7.7 | |
| 25% | 1 | 10 | 10 | 10 | 7.4 | 8.0 | 7.7 | 7.7 | |
| (0.63ppm) | 2 | 10 | 10 | 10 | 7.4 | 8.0 | 7.7 | 7.7 | |
| 50% | 1 | 10 | 10 | 10 | 7.6 | 8.0 | 7.8 | 7.7 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 7.6 | 8.1 | 7.8 | 7.7 | |
| 100% | 1 | 10 | 8 | 6 | 7.7 | 8.0 | 8.0 | 7.7 | |
| (2.5ppm) | 2 | 10 | 10 | 5 | 7.7 | 8.0 | 8.0 | 7.7 | |
| 200% | 1 | 10 | 5 | 5 | 7.3 | 8.1 | 8.6 | 7.8 | 46 |
| (5.0ppm) | 2 | 10 | 6 | 6 | 7.3 | 8.0 | 8.6 | 7.8 | 46 |

*Table 3.* Results of Diaminoethane toxicity test (April 22-26, 1992) with Pimephales promelas.

| Diaminoethane | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 48h | 96h | 0h | 96h | 0h | 96h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 8.4 | 7.9 | 7.5 | 6.9 | 50 |
| | 2 | 10 | 10 | 10 | 8.4 | 8.4 | 7.5 | 7.0 | 50 |
| 6.25% | 1 | 10 | 10 | 9 | 8.3 | 7.9 | 7.6 | 7.1 | |
| (0.16ppm) | 2 | 10 | 10 | 10 | 8.3 | 7.7 | 7.6 | 7.1 | |
| 12.5% | 1 | 10 | 10 | 10 | 8.4 | 7.6 | 7.6 | 7.1 | |
| (0.31ppm) | 2 | 10 | 10 | 9 | 8.4 | 7.5 | 7.6 | 7.1 | |
| 25% | 1 | 10 | 9 | 9 | 8.5 | 7.6 | 7.6 | 7.2 | |
| (0.63ppm) | 2 | 10 | 10 | 8 | 8.5 | 7.1 | 7.6 | 7.1 | |
| 50% | 1 | 10 | 10 | 10 | 8.5 | 8.2 | 7.6 | 7.2 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 8.5 | 7.4 | 7.6 | 7.3 | |
| 100% | 1 | 10 | 10 | 9 | 8.5 | 7.6 | 7.8 | 7.2 | |
| (2.5ppm) | 2 | 10 | 10 | 10 | 8.5 | 7.4 | 7.8 | 7.2 | |
| 200% | 1 | 10 | 10 | 10 | 8.5 | 7.5 | 8.6 | 7.2 | 50 |
| (5.0ppm) | 2 | 10 | 10 | 10 | 8.5 | 7.3 | 8.6 | 7.2 | 50 |

Table 7. Reference toxicant testing results with copper nitrate and *Daphnia pulex* and *Pimephales promelas*.

| Date | Test species | Source of organisms | Toxicant source | $LC_{50}$ (95% CI) |
|---|---|---|---|---|
| 4/22/92 | *Daphnia pulex* | ARO[a] | Fisher Sci. | 5.1 ug/l(4.0-6.5) |
| 4/22/92 | *Pimephales promelas* | Cosper Env.[b] | Fisher Sci. | 40.1 ug/l (26.3-61.2) |
| 5/8/92 | *Daphnia pulex* | NUEL Stock | Fisher Sci. | 3.23 ug/l (2.5-4.2) |

[a] Aquatic Research Organisms Inc., Hampton, N.H. (ARO).
[b] Cosper Environmental Services Inc., Bohemia, N.Y.

Table 4. Results of Monoethanolamine toxicity test (April 22-24, 1992) with *Daphnia pulex*.

| Monoethanolamine | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 7 | 8.6 | 8.6 | 7.2 | 7.5 | 50 |
| | 2 | 10 | 10 | 7 | 8.6 | 8.3 | 7.2 | 7.5 | 50 |
| 6.25% | 1 | 10 | 10 | 7 | 8.6 | 8.2 | 7.3 | 7.6 | |
| (0.16ppm) | 2 | 10 | 10 | 10 | 8.6 | 8.2 | 7.3 | 7.6 | |
| 12.5% | 1 | 10 | 10 | 6 | 8.5 | 8.3 | 7.4 | 7.6 | |
| (0.31ppm) | 2 | 10 | 10 | 8 | 8.5 | 8.2 | 7.4 | 7.6 | |
| 25% | 1 | 10 | 10 | 8 | 8.6 | 8.3 | 7.5 | 7.6 | |
| (0.63ppm) | 2 | 10 | 10 | 7 | 8.6 | 8.2 | 7.5 | 7.6 | |
| 50% | 1 | 10 | 10 | 10 | 8.6 | 8.4 | 7.6 | 7.7 | |
| (1.25ppm) | 2 | 10 | 10 | 9 | 8.6 | 8.4 | 7.6 | 7.6 | |
| 100% | 1 | 10 | 10 | 10 | 8.6 | 8.4 | 7.9 | 7.7 | |
| (2.5ppm) | 2 | 10 | 10 | 8 | 8.6 | 8.4 | 7.9 | 7.6 | |
| 200% | 1 | 10 | 10 | 10 | 8.6 | 8.5 | 8.5 | 7.7 | 48 |
| (5.0ppm) | 2 | 10 | 10 | 9 | 8.6 | 8.5 | 8.5 | 7.7 | 48 |

Table 5. Results of Monoethanolamine toxicity test (May 8-10, 1992) with *Daphnia pulex*.

| Monoethanolamine | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.4 | 8.2 | 7.8 | 7.4 | 50 |
| | 2 | 10 | 10 | 10 | 7.4 | 8.0 | 7.8 | 7.4 | 50 |
| 6.25% | 1 | 10 | 10 | 10 | 7.3 | 8.0 | 7.7 | 7.5 | |
| (0.16ppm) | 2 | 10 | 10 | 10 | 7.3 | 8.0 | 7.7 | 7.5 | |
| 12.5% | 1 | 10 | 10 | 10 | 7.4 | 7.9 | 7.7 | 7.5 | |
| (0.31ppm) | 2 | 10 | 10 | 10 | 7.4 | 8.0 | 7.7 | 7.6 | |
| 25% | 1 | 10 | 10 | 10 | 7.7 | 8.0 | 7.8 | 7.6 | |
| (0.63ppm) | 2 | 10 | 10 | 10 | 7.7 | 8.0 | 7.8 | 7.6 | |
| 50% | 1 | 10 | 10 | 10 | 7.6 | 8.0 | 7.8 | 7.6 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 7.6 | 8.0 | 7.8 | 7.6 | |
| 100% | 1 | 10 | 10 | 10 | 7.0 | 8.0 | 8.2 | 7.6 | |
| (2.5ppm) | 2 | 10 | 10 | 10 | 7.0 | 7.9 | 8.2 | 7.6 | |
| 200% | 1 | 10 | 10 | 10 | 7.5 | 8.0 | 8.6 | 7.7 | 48 |
| (5.0ppm) | 2 | 10 | 10 | 10 | 7.5 | 8.0 | 8.6 | 7.7 | 48 |

Table 6. Results of Monoethanolamine toxicity test (April 22-26, 1992) with *Pimephales promelas*

| Monoethanolamine | | Number Surviving | | | D.O. (mg/l) | | pH | | Hardness |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 48h | 96h | 0h | 96h | 0h | 96h | 0h (ppt) |
| Control | 1 | 10 | 10 | 9 | 8.6 | 8.5 | 7.2 | 7.0 | 50 |
| | 2 | 10 | 10 | 9 | 8.6 | 8.2 | 7.2 | 6.9 | 50 |
| 6.25% | 1 | 10 | 10 | 10 | 8.6 | 8.0 | 7.3 | 7.0 | |
| (0.16ppm) | 2 | 10 | 10 | 10 | 8.6 | 7.8 | 7.3 | 7.0 | |
| 12.5% | 1 | 10 | 10 | 10 | 8.5 | 8.2 | 7.4 | 7.0 | |
| (0.31ppm) | 2 | 10 | 10 | 9 | 8.5 | 8.0 | 7.4 | 7.0 | |
| 25% | 1 | 10 | 10 | 10 | 8.6 | 7.9 | 7.5 | 7.0 | |
| (0.63ppm) | 2 | 10 | 10 | 10 | 8.6 | 7.8 | 7.5 | 7.1 | |
| 50% | 1 | 10 | 10 | 10 | 8.6 | 7.8 | 7.6 | 7.1 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 8.6 | 7.8 | 7.6 | 7.1 | |
| 100% | 1 | 10 | 10 | 9 | 8.6 | 8.4 | 7.9 | 7.1 | |
| (2.5ppm) | 2 | 10 | 10 | 9 | 8.6 | 8.0 | 7.9 | 7.1 | |
| 200% | 1 | 10 | 10 | 10 | 8.6 | 7.7 | 8.5 | 7.1 | 48 |
| (5.0ppm) | 2 | 10 | 10 | 10 | 8.6 | 7.5 | 8.5 | 7.1 | 48 |

Mr. Adrian Freund, Chief
Bureau of Water Management
Department of Environmental Protection
122 Washington Street
Hartford, Connecticut 06106

January 21, 1992

DDXXXX

Dear Mr. Freund;

Two chemical compounds have been proposed for controlling corrosion in the new Millstone Unit 2 steam generator. These are diaminoethane and monoethanolamine. These amines would replace hydrazine and ammonium hydroxide, which are currently being used.

Aquatic toxicity testing was requested by DEP for these two compounds, using two test species (mysid shrimp Mysidopsis bahia, and sheepshead minnow, Cyprinodon variegatus) at the proposed discharge concentration (2.5 ppm). Testing was conducted from January 13-17, at replicated concentrations ranging from 5.0 ppm (200% of the proposed discharge concentration) to 0.17 ppm (6.25% of the proposed discharge concentration), plus controls. A maximum concentration of 5 ppm was used for both compounds; this level is twice that of the proposed discharge concentration. Results of the testing are presented in Tables 1-5 (Attachment 1). There were no mortalities of the minnows with either compound at any concentration. A total of six mysids (out of 280) died at some of the lower concentrations. Since survival was high, even at the highest concentration tested, it was not possible to generate an LC50 for either compound or species. Reference toxicant LC50 values (Copper nitrate) were 313 ppb(212-459) for the mysids and 1490 ppb (1135-1983) for the sheepshead minnow.

If there are any questions related to these results, please call Mr. Ray Heller, Northeast Utilities Environmental Laboratory at (203) 447-1791 ext 5054.

Very truly yours;

Northeast Utilities Service Company
As agent for Northeast Nuclear Energy Company

Table 1. Results of Monoethanolamine toxicity test (January 13-15,1992) with *Mysidopsis bahia*.

| Monoethanolamine | | Number Surviving | | | D.O. (mg/l) | | pH | | Salinity |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.8 | 6.5 | 8.0 | 7.8 | 26 |
| | 2 | 10 | 10 | 10 | 7.8 | 6.3 | 8.0 | 7.8 | 26 |
| 6.25% | 1 | 10 | 10 | 10 | 7.6 | 6.0 | 7.9 | 7.7 | |
| (0.17ppm) | 2 | 10 | 10 | 10 | 7.6 | 6.0 | 7.9 | 7.7 | |
| 12.5% | 1 | 10 | 10 | 10 | 7.6 | 6.0 | 7.9 | 7.6 | |
| (0.33ppm) | 2 | 10 | 10 | 10 | 7.6 | 6.1 | 7.9 | 7.6 | |
| 25% | 1 | 10 | 10 | 10 | 7.6 | 5.3 | 8.0 | 7.6 | |
| (0.67ppm) | 2 | 10 | 10 | 9 | 7.6 | 5.3 | 8.0 | 7.6 | |
| 50% | 1 | 10 | 10 | 10 | 7.6 | 5.5 | 8.0 | 7.7 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 7.6 | 5.4 | 8.0 | 7.7 | |
| 100% | 1 | 10 | 10 | 10 | 7.6 | 5.0 | 8.0 | 7.6 | |
| (2.5ppm) | 2 | 10 | 10 | 9 | 7.6 | 5.0 | 8.0 | 7.6 | |
| 200% | 1 | 10 | 10 | 10 | 7.5 | 4.4 | 8.0 | 7.7 | |
| (5.0ppm) | 2 | 10 | 10 | 10 | 7.5 | 4.8 | 8.0 | 7.7 | |

Table 2. Results of Diaminoethane toxicity test (January 13-15, 1992) with *Mysidopsis bahia*.

| Diaminoethane | | Number Surviving | | | D.O. (mg/l) | | pH | | Salinity |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 24h | 48h | 0h | 48h | 0h | 48h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.6 | 5.6 | 8.0 | 7.9 | 28 |
| | 2 | 10 | 10 | 10 | 7.6 | 5.7 | 8.0 | 7.9 | 28 |
| 6.25% | 1 | 10 | 10 | 10 | 7.4 | 5.6 | 8.0 | 7.9 | |
| (0.17ppm) | 2 | 10 | 10 | 10 | 7.4 | 5.4 | 8.0 | 7.8 | |
| 12.5% | 1 | 10 | 10 | 9 | 7.4 | 5.6 | 8.0 | 7.8 | |
| (0.33ppm) | 2 | 10 | 10 | 10 | 7.4 | 5.5 | 8.0 | 7.9 | |
| 25% | 1 | 10 | 10 | 10 | 7.5 | 5.4 | 8.0 | 7.8 | |
| (0.67ppm) | 2 | 10 | 10 | 10 | 7.5 | 5.5 | 8.0 | 7.9 | |
| 50% | 1 | 10 | 8 | 8 | 7.5 | 5.5 | 8.1 | 7.8 | |
| (1.25ppm) | 2 | 10 | 9 | 9 | 7.5 | 5.5 | 8.1 | 7.9 | |
| 100% | 1 | 10 | 10 | 10 | 7.4 | 5.6 | 8.1 | 7.8 | |
| (2.5ppm) | 2 | 10 | 10 | 10 | 7.4 | 5.7 | 8.1 | 7.9 | |
| 200% | 1 | 10 | 10 | 10 | 7.5 | 5.4 | 8.1 | 7.8 | |
| (5.0ppm) | 2 | 10 | 10 | 10 | 7.5 | 5.5 | 8.1 | 7.9 | |

Table 3. Results of Monoethanolamine toxicity test (January 13-17,1992) with *Cyprinodon variegatus*

| Monoethanolamine | | Number Surviving | | | D.O. (mg/l) | | pH | | Salinity |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 48h | 96h | 0h | 96h | 0h | 96h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.8 | 6.9 | 8.0 | 7.8 | 26 |
| | 2 | 10 | 10 | 10 | 7.8 | 6.8 | 8.0 | 7.9 | 26 |
| 6.25% | 1 | 10 | 10 | 10 | 7.6 | 6.9 | 7.9 | 7.9 | |
| (0.17ppm) | 2 | 10 | 10 | 10 | 7.6 | 7.0 | 7.9 | 7.9 | |
| 12.5% | 1 | 10 | 10 | 10 | 7.6 | 7.2 | 7.9 | 7.9 | |
| (0.33ppm) | 2 | 10 | 10 | 10 | 7.6 | 7.1 | 7.9 | 7.9 | |
| 25% | 1 | 10 | 10 | 10 | 7.6 | 6.9 | 8.0 | 7.9 | |
| (0.67ppm) | 2 | 10 | 10 | 10 | 7.6 | 6.8 | 8.0 | 7.9 | |
| 50% | 1 | 10 | 10 | 10 | 7.6 | 7.0 | 8.0 | 7.9 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 7.6 | 7.0 | 8.0 | 7.9 | |
| 100% | 1 | 10 | 10 | 10 | 7.6 | 7.0 | 8.0 | 7.9 | |
| (2.5ppm) | 2 | 10 | 10 | 10 | 7.6 | 6.7 | 8.0 | 7.9 | |
| 200% | 1 | 10 | 10 | 10 | 7.5 | 7.0 | 8.0 | 7.8 | |
| (5.0ppm) | 2 | 10 | 10 | 10 | 7.5 | 6.6 | 8.0 | 7.8 | |

*Table 4.* Results of Diaminoethane toxicity test (January 13-17,1992) with Cyprinodon variegatus.

| Diaminoethane | | Number Surviving | | | D.O. (mg/l) | | pH | | Salinity |
|---|---|---|---|---|---|---|---|---|---|
| (mg/l) | Rep | 0h | 48h | 96h | 0h | 96h | 0h | 96h | 0h (ppt) |
| Control | 1 | 10 | 10 | 10 | 7.6 | 7.0 | 8.0 | 7.9 | 28 |
| | 2 | 10 | 10 | 10 | 7.6 | 6.9 | 8.0 | 7.9 | 28 |
| 6.25% | 1 | 10 | 10 | 10 | 7.4 | 6.8 | 8.0 | 7.9 | |
| (0.17ppm) | 2 | 10 | 10 | 10 | 7.4 | 6.9 | 8.0 | 7.9 | |
| 12.5% | 1 | 10 | 10 | 10 | 7.4 | 7.2 | 8.0 | 7.9 | |
| (0.33ppm) | 2 | 10 | 10 | 10 | 7.4 | 6.9 | 8.0 | 7.9 | |
| 25% | 1 | 10 | 10 | 10 | 7.5 | 6.9 | 8.0 | 7.9 | |
| (0.67ppm) | 2 | 10 | 10 | 10 | 7.5 | 6.9 | 8.1 | 7.9 | |
| 50% | 1 | 10 | 10 | 10 | 7.5 | 7.0 | 8.1 | 7.9 | |
| (1.25ppm) | 2 | 10 | 10 | 10 | 7.5 | 6.7 | 8.1 | 7.9 | |
| 100% | 1 | 10 | 10 | 10 | 7.4 | 6.9 | 8.1 | 7.9 | |
| (2.5ppm) | 2 | 10 | 10 | 10 | 7.4 | 6.8 | 8.1 | 7.9 | |
| 200% | 1 | 10 | 10 | 10 | 7.5 | 6.9 | 8.1 | 7.9 | |
| (5.0ppm) | 2 | 10 | 10 | 10 | 7.5 | 6.8 | 8.1 | 7.9 | |

Memo to : Parker Downing

Date: 18 November 1991

Subject: Ethanolamine Toxicity Test Results

## EXECUTIVE SUMMARY

**Ethanolamine displayed neither acute nor chronic toxicity to *Ceriodaphnia dubia* at concentrations up to 40 mg/L, even when 100% effluent from Catawba Nuclear Station Outfall 002 was used to dilute the exposure treatments.**

Several toxicity tests have been conducted in support of your efforts to have Pre-Tect 7000® (ethanolamine) approved for use at Catawba Nuclear Station (CNS). Our lab is certified by South Carolina Department of Health and Environmental Control (SCDHEC) and we have purposely employed their methods and protocol to the extent possible, hoping to maximize the likelihood that they will find this information acceptable. The organism tested was, in all instances, *Ceriodaphnia dubia* from our lab cultures maintained as specified by SCDHEC.

Upon receipt of the research sample of Pre-Tect 7000® (40% monoethanolamine) from Calgon Corp., a 24-hour static acute range-finding test was conducted. The purpose of a range-finding test is to expose test organisms to a wide range of toxicant concentrations, and "zero in" on the specific portion of that wide range where acute (lethal) effects are anticipated to occur. From that information, we estimate the expected chronic (sublethal) effect range. *C. dubia* exposures were extended approximately one more day (beyond the customary 24-h test duration) to document additional or delayed mortalities.

After a test range was established, two seperate and distinct exposures of *C. dubia* to ethanolamine were undertaken. We followed standard three-brood survival and reproduction protocol as suggested by USEPA and SCDHEC. *C. dubia* were exposed individually in 10 replicate cups per control and treatment such that 60 organisms were used to initiate these tests of a control and five different treatments. The exposures were static-renewal, with solutions renewed every 24 hours. For these tests, the renewal solutions were prepared fresh from a refrigerated stock ethanolamine solution and refrigerated dilution waters every other day (48-hour intervals). Each time new solutions were prepared, analyses for dissolved oxygen, pH, and conductivity were made. Additionally, the "old" solutions (i.e., those prepared and used the previous 48 hours) were analyzed for the same variables after being held in surrogate containers and subjected to the same temperature and photoperiod regime as the tests.

The difference in the two tests was the source of dilution water. Lake Wylie water amended with 7 % Perrier Mineral Water (to adjust mineral content to a level defined by

USEPA as "soft") served as one diluent. This water is collected from the tail-race of Mt. Island Hydroelectric Station, and is used (where applicable) in our routine laboratory culture and testing activities. The other dilution water was 100% effluent from CNS Outfall 002. Outfall 002 serves the basin in which waste ethanolamine would be collected at CNS and through which it would ultimately be discharged. The latter test is intended to represent a "worst case" evaluation of ethanolamine toxicity as part of the proposed complex effluent from CNS Outfall 002 and before mixing with receiving water. We felt that these two exposure regimes best represented the site-specific concerns that needed to be evaluated for ethanolamine use and discharge at CNS.

All raw data and supporting documents are attached. Please note that in all instances, the given ethanolamine concentrations are nominal, not measured. They were calculated based on the 40% ethanolamine formulation of Pre-Tect 7000® and the specific gravity of ethanolamine (1.018 g/mL). The results are summarized below:

**Acute Range-finding Test**

| Ethanolamine Concentration | # *C.dubia* Exposed | # Surviving @ 24 Hours | # Surviving @ 46 Hours |
|---|---|---|---|
| 0 (Control) | 10 | 10 | 10 |
| 4.07 mg/L | 10 | 10 | 10 |
| 40.7 mg/L | 10 | 10 | 10 |
| 407.2 mg/L | 10 | 0 | 0 |
| 4072 mg/L | 10 | 0 | 0 |
| 40720 mg/L | 10 | 0 | 0 |

The range for acute toxicity of ethanolamine to *C. dubia* fell between 407.2 and 40.7 mg/L. We chose to proceed at the lower end of that range for two reasons. First, the endpoint of concern for our definitive tests was chronic (not acute) toxicity, and second, it was suggested that discharge concentrations of ethanolamine at CNS would not exceed 10 mg/L (M.E. Kowalewski, personal communication).

**Chronic Definitive Test 1 -- Lake Wylie Diluent**

| Ethanolamine Concentration | # *C. dubia* Exposed | # of Morts. | # of Males | Total Young Produced | Mean Young Per Female |
|---|---|---|---|---|---|
| 0 (Control) | 10 | 0 | 1 | 245 | 27.2 |
| 2.5 mg/L | 10 | 0 | 1 | 243 | 27.0 |
| 5.0 mg/L | 10 | 3 | 0 | 186 | 18.6 |
| 10 mg/L | 10 | 0 | 1 | 268 | 29.8 |
| 20 mg/L | 10 | 1 | 2 | 210 | 26.2 |
| 40 mg/L | 10 | 1 | 1 | 231 | 25.7 |

There was no significant mortality (i.e., mortality was not significantly different from the control in any of the treatments) as determined by Fisher's Exact Test. The data were normally distributed according to a Shapiro-Wilks Test, and displayed homogeneity of variance as determined by Bartlett's Test. The data contained unequal numbers of replicates, so Bonferroni's T-Test was used to compare young per female means for each treatment with the control young per female mean to determine if significant difference existed between any two means.

No significant differences ($\alpha = 0.05$) in young production between the control and any treatment were demonstrated. Consequently, no adverse effects on survival or reproduction were observed among *C. dubia* exposed at or below 40 mg ethanolamine/L when tested in Lake Wylie water reconstituted to USEPA "soft" water by the addition of 7% Perrier Mineral Water.

**Chronic Definitive Test 2 -- 100% CNS Outfall 002 Diluent**

| Ethanolamine Concentration | # *C. dubia* Exposed | # of Morts. | # of Males | Total Young Produced | Mean Young Per Female |
|---|---|---|---|---|---|
| 0 (Control) | 10 | 2 | 2 | 127 | 15.9 |
| 2.5 mg/L | 10 | 1 | 1 | 126 | 14.0 |
| 5.0 mg/L | 10 | 0 | 2 | 171 | 21.4 |
| 10 mg/L | 10 | 0 | 2 | 187 | 23.4 |
| 20 mg/L | 10 | 0 | 2 | 283 | 35.4 ** |
| 40 mg/L | 10 | 1 | 1 | 305 | 33.9 ** |

** Significantly ($\alpha = 0.05$) greater than control

There was no significant mortality (i.e., mortality was not significantly different from the control in any of the treatments) as determined by Fisher's Exact Test. The data were normally distributed according to a Shapiro-Wilks Test, only after a $Log_{10}$ transformation was applied to the data. Transformed data displayed homogeneity of variance as determined by Bartlett's Test. The data contained unequal numbers of replicates, so Bonferroni's T-Test (with the $Log_{10}$ transformation) was used to compare young per female means for each treatment with the control young per female mean to determine if significant difference existed between any two means.

Significant differences ($\alpha = 0.05$) between the control and the 20- and 40-mg/L treatments were demonstrated by Bonferroni's T-Test on $log_{10}$-transformed data. The *C.dubia* replicates in those treatments produced significantly **more** young per female than did the control replicates. Consequently, no adverse effects on survival or reproduction were observed among *C. dubia* exposed at or below 40 mg ethanolamine/L when tested in undiluted CNS Outfall 002 effluent.

**Discussion**

The results observed in Definitive Chronic Test 1 are typical for three-brood chronic *C.dubia* tests in which no effect is observed. We aimed for the anticipated discharge range, and simply did not test a high enough concentration in that study to determine a Low Observed Effect Concentration (LOEC) or the true No Observed Effect Concentration (NOEC). From this data we can only conclude that under the given test conditions, *C. dubia* are not adversely affected by as much as 40 mg ethanolamine /L.

Routine measures of dissolved oxygen, pH, and conductivity offered some interesting clues about the behavior of ethanolamine. In both definitive chronic tests, pH was consistently observed to decline and conductivity to increase in the treatments after 48 hours at 25 ° C (see raw data for chemistry results, both chronic tests). Again, it is unlikely that the test organisms experienced a comparable wide swing in water chemistry because test solutions were replaced daily and were refrigerated otherwise. The chemistry variables may suggest, however, that ethanolamine dissociated relatively quickly under the given test conditions. These remarks are speculative in that our data do not provide information on the rate of ethanolamine dissociation.

The results of Definitive Chronic Test 2 are more difficult to interpret. It is important to recognize that this test was unconventional in the choice of an industrial effluent as dilution water. Water from CNS Outfall 002 certainly would not meet the normal requirements of a typical dilution water, even if toxicity is not apparent (which this test showed). Significantly increased young production at higher ethanolamine exposures suggests that some beneficial effect was realized by the *C. dubia* in those treatments. Potential explainations are that ethanolamine caused chemical modifications in CNS Outfall 002 water which resulted in water quality or nutritional characteristics that significantly increased the productivity of *C. dubia* . Again, the range of ethanolamine exposures was not high enough to demonstrate chronic toxicity nor to determine NOEC and LOEC values. Accordingly, the conclusion is that under the given test conditions, 40 mg ethanolamine/L of CNS Outfall 002 water was not detrimental to *C. dubia* .

Please let me know if you need further clarification of this information or if additional testing is warranted. My telephone number is (704) 875-5237.

J. S. Velte

J.S. Velte, Scientist
Environmental Services

xc: M.E. Kowalewski (attachments)
P.A. Hull (attachments)
R.W. Eaker (w/o attachments)
G.E. Vaughan (w/o attachments)
Staff (route; w/o attachments)

Form 35437 (7-87)

ACUTE RANGE-FINDING

# TOXICITY TEST DATA

PRETECT 7000

Industry/Toxicant: ~~MONOETHANOLAMINE (90%)~~ Test Conducted By: J.S. Velte

Address: NA Testing Laboratory: DPC/ BIOASSAY

NPDES Permit No.: NA Beginning Date: 10 / 11 / 91 Time: 1452

Effluent Serial No.: NA Ending Date: 10 / 13 / 91 Time: ____

Dilution water: 22% PERRIER IN MILLI-Q Test Organism: CERIODAPHNIA DUBIA

Carrier Solvent: ☐ Yes ☒ No ____ Organism Age: < 24 h

Test criterion: ☐ Mortality ☒ Immobility Organism Source: DPC BIOASSAY CULTURES

____ (Other)

Test Type: ☒ Static
☐ Static with renewal at: ____
☐ Continuous flow

Sample Type: ☐ Grab Collected: ___ / ___ / ___ Time: ____
NA ___ / ___ / ___ Time: ____
☐ Composite
Collected From: / / Time: ____
To: / / Time: ____

| Concentration ( Or ~~Product~~ % ~~Effluent~~ ) | Test Container Number | Number of Surviving Organisms | | | | | | | | | | Temperature (°C) (ELENV- 30809 ) | | | | | | | | | | ~~Dissolved Oxygen (mg/L)~~ | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 0h | 24 | ~~48~~ | ~46 | | | | | | | 0h | 24 | ~~48~~ | ~46 | | | | | | | | | | | | |
| CONTROL | - | 10 | 10 | | 10 | | | | | | | 24.6 | 24.9 | | 25.3 | | | | | | | | | | | | |
| 0.001 | - | 10 | 10 | | 10 | | | | | | | 24.6 | 24.5 | | 24.6 | | | | | | | | | | | | |
| 0.01 | - | 10 | 10 | | 10 | | | | | | | 24.8 | 25.1 | | 24.8 | | | | | | | | | | | | |
| 0.1 | - | 10 | 0 | | 0 | | | | | | | 24.3 | 24.8 | | 24.1 | | | | | | | | | | | | |
| 1.0 | - | 10 | 0 | | 0 | | | | | | | 24.3 | 24.9 | | 24.8 | | | | | | | | | | | | |
| 10 | - | 10 | 0 | | 0 | | | | | | | 24.7 | 25.0 | | 24.8 | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
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| | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Analyst Initials: | | JSV | JSV | | DSC | | | | | | | JSV | JSV | | DSC | | | | | | | | | | | | |

~~Chemistry Data~~

Date: / / Time: ____

| | Control | High Conc. |
|---|---|---|
| pH | | |
| Spec. Cond. (uS/cm) | | |
| TRC (mg/L) | | |
| Total Alk. (mg/L) | | |
| Total Hardness (mg/L) | | |

Procedure Numbers

BIO- 200.0 (Temperature)
BIO- (Dissolved O2)
BIO- (pH)
(Spec. Cond.)
(TRC)
(Total Alk.)
(Total Hardness)

~~Organism Length (mm)~~: 0 Mean: ____ S.D.: ____

~~Organism Weight (g)~~: 0 Mean: ____ S.D.: ____

Test vessel capacity: 100 mL (glass) ____ L

Test solution volume: 50 mL ____ L

Feeding: ☒ No ☐ Yes: ____

Aeration: ☒ No ☐ Yes: ____

Condition of surviving organisms at end of test:

Comments: Incubator D, Shelf D2
10/13/91 observation time = 1240 PM, DSC

SP1091J1

## CERIODAPHNIA DUBIA CHRONIC TOXICITY TEST DATA SHEET

Industry/Toxicant: Ethanolamine
Address: NA
NPDES Permit No: NA
Effluent Serial No: NA
Effluent Filtration: NA µm mesh
Diluent: 7.5% Perrier in Lake Wylie H2O
Carrier Solvent: (No) Yes
Test Vessel Composition: Polystyrene-Arcnor Hoaring PI-1
Test Vessel Capacity: 30 mL
Test Solution Volume: 15 mL
Renewal Frequency: (Daily) Days 0,2,4,+5 #A
#A: Test vessels renewed daily
Solutions renewed days 0,2,4,+6

Beginning Date 10/15/91 Time: 0940
Ending Date 10/22/91 Time: 0942
Test Conducted by: J.S. Velte
Location of Test: DPC-ASC-Bioassay
Incubator ID: D
Shelf ID: D1
Organism Age: less than 24 hours
Organism Source: DPC cultures (Tray D)
Diet: #1 YTC Amount 100 µL
#2 S. capricornutum Amount 100 µL

### CERIODAPHNIA DUBIA YOUNG PRODUCTION

Dilution Water for Adults 22.5% Perrier in Milli-Q Plus H2O: PER-76
Adults segregated at: Date 10-14-91 Time 0950 Initials BGN
Check adults eight hours or less after the segregation time for third or later broods of eight or more neonates.
Adults checked for neonates at: Date 10-14-91 Time 12 Initials BGN
Number of acceptable broods 6 Number of neonates 85
RETAIN EXTRA NEONATES UNTIL AFTER THE ONE HOUR POST-INITIATION MORTALITY CHECK HAS BEEN COMPLETED.

### PROCEDURE NUMBERS

BIO-200.0 Temperature
Temp. Device: ELENV-30809
BIO-214.0 (Dissolved $O_2$)
BIO-210.0 (pH)
BIO-217.0 (Spec. Cond.)
BIO-~~NA~~ (TRC)
BIO-215.0 (Total Alk.)
BIO-216.0 (Total Hard.)
BIO-

### CHEMISTRY DATA → see additional data sheet

| | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D.O. | | | | | | | | | | | | |
| pH | | | | | | | | | | | | |
| Spec. Cond. (µS/cm) | | | | | | | | | | | | |
| TRC (mg/L) | | | | | | | | | | | | |
| Total Alk. (mg/L) | | | | | | | | | | | | |
| Total Hard. (mg/L) | | | | | | | | | | | | |
| Date: | / / | / / | / / | / / | / / | / / | / / | / / | / / | / / | / / | / / |
| Time: | | | | | | | | | | | | |
| Initials: | | | | | | | | | | | | |

SP1091J1

CHESAPEAKE BIOA ASSOC
PROCEDURE NUMBER EPA-2021.0

TEST: Ethanolamine Toxicity - L. Wylie $H_2O$ Diluent

| Conc. or % Effluent | Day | Replicate 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Total | ♀ | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONTROL | Init. | | | | | | | | | | | | | | 24.8 | #7 is ♂ |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.4 | KAF 10-22-91 |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.2 | |
| | 3 | S,0 | S,0 | S,0 | S,3 | S,0 | S,0 | S,2 | S,0 | S,0 | S,4 | | | 7 | 25.1 | |
| | 4 | S,5 | S,4 | S,4 | S,0 | S,3 | S,0 | S,0 | S,2 | S,3 | S,6 | | | 27 | 24.7 | |
| | 5 | S,7 | S,6 | S,8 | S,6 | S,0 | S,5 | S,0 | S,8 | S,0 | S,0 | | | 40 | 24.1 | |
| | 6 | S,8 | S,0 | S,0 | S,12 | S,0 | S,12 | S,0 | S,0 | S,12 | S,14 | | | 58 | 24.6 | |
| | 7 | S,0 | S,15 | S,8 | S,15 | S,15 | S,10 | S,0 | S,14 | S,16 | S,14 | | | 107 | 25.3 | |
| | 8 | | | | | | | | | | | | | | | $\bar{x}$ = 27.2 |
| | Total | 20 | 25 | 20 | 36 | 24 | 27 | 0 | 24 | 31 | 38 | | | 245 | | |
| 2.5 mg/L | Init. | | | | | | | | | | | | | | 24.7 | #4 is ♂ |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.5 | KAF 10-22- |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.0 | |
| | 3 | S,4 | S,2 | S,2 | S,0 | S,0 | S,0 | S,2 | S,0 | S,0 | S,1 | | | 11 | 25.2 | |
| | 4 | S,8 | S,8 | S,2 | S,0 | S,1 | S,3 | S,0 | S,0 | S,5 | S,0 | | | 27 | 25.0 | |
| | 5 | S,0 | S,0 | S,0 | S,0 | S,6 | S,0 | S,0 | S,8 | S,8 | S,7 | | | 29 | 25.0 | |
| | 6 | S,12 | S,14 | S,10 | S,0 | S,0 | S,10 | S,2 | S,0 | S,0 | S,15 | | | 103 | 24.7 | |
| | 7 | S,15 | S,17 | S,14 | S,0 | S,6 | S,13 | S,13 | S,10 | S,11 | S,14 | | | 113 | 25.6 | |
| | 8 | | | | | | | | | | | | | | | $\bar{x}$ = 27.0 |
| | Total | 34 | 41 | 28 | 0 | 13 | 26 | 17 | 18 | 24 | 37 | | | 243 | | |
| 5.0 mg/L | Init. | | | | | | | | | | | | | | 24.7 | Note: found adult ♀ in |
| | 1 | S,0 | D,0 | D,0 | S,0 | D,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.1 | |
| | 2 | S,0 | | | S,0 | | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 24.9 | #1 - KAF |
| | 3 | S,3 | | | S,0 | | S,0 | S,0 | S,0 | S,2 | S,0 | | | 4 | 24.8 | ↑ Inadvertently |
| | 4 | S,4 | | | S,5 | | S,4 | S,3 | S,5 | S,4 | S,5 | | | 35 | 25.1 | |
| | 5 | S,0 | | | S,9 | | S,6 | S,0 | S,5 | S,0 | S,6 | | | 26 | 25.0 | |
| | 6 | S,14 | | | S,0 | | S,0 | S,4 | S,0 | S,14 | S,0 | | | 32 | 24.7 | |
| | 7 | S,8,14 | | | S,15 | | S,13 | S,10 | S,14 | S,11 | S,12 | | | 89 | 25.1 | |
| | 8 | KAF 10-22-91 | | | | | | | | | | | | | | $\bar{x}$ = 18.6 KAF 10 |
| | Total | 34 | 0 | 0 | 29 | 0 | 23 | 17 | 24 | 30 | 23 | | | 180 | | |
| 10 mg/L | Init. | | | | | | | | | | | | | | 24.4 | #2 is ♂ |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.2 | KAF 10-22- |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,6 | S,0 | | | 0 | 25.1 | |
| | 3 | S,0 | S,0 | S,1 | S,0 | S,3 | S,0 | S,1 | S,0 | S,0 | S,3 | | | 8 | 25.0 | |
| | 4 | S,5 | S,0 | S,5 | S,6 | S,5 | S,9 | S,8 | S,5 | S,5 | S,8 | | | 47 | 25.3 | |
| | 5 | S,9 | S,0 | S,0 | S,9 | S,0 | S,2 | S,0 | S,0 | S,11 | S,0 | | | 31 | 25.2 | |
| | 6 | S,0 | S,0 | S,11 | S,0 | S,11 | S,7 | S,15 | S,7 | S,0 | S,13 | | | 64 | 25.0 | |
| | 7 | S,14 | S,0 | S,15 | S,11 | S,14 | S,9 | S,18 | S,7 | S,12 | S,18 | | | 118 | 25.2 | |
| | 8 | | | | | | | | | | | | | | | $\bar{x}$ = 29.3 |
| | Total | 28 | 0 | 32 | 26 | 33 | 18 | 42 | 19 | 28 | 42 | | | 268 | | |
| 20 mg/L | Init. | | | | | | | | | | | | | | 24.3 | #2 is ♂ |
| | 1 | S,0 | S,0 | S,0 | S,0 | D,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 24.8 | #7 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 24.7 | |
| | 3 | S,2 | S,0 | S,0 | S,0 | | S,6 | S,0 | S,5 | S,4 | S,0 | | | 6 | 24.9 | KAF 10-22- |
| | 4 | S,8 | S,0 | S,5 | S,3 | | S,6 | S,0 | S,5 | S,8 | S,0 | | | 35 | 25.3 | |
| | 5 | S,0 | S,0 | S,6 | S,4 | | S,8 | S,0 | S,8 | S,0 | S,8 | | | 34 | 24.8 | |
| | 6 | S,15 | S,0 | S,0 | S,8 | | S,0 | S,0 | S,0 | S,16 | S,13 | | | 52 | 24.6 | |
| | 7 | S,16 | S,0 | S,13 | S,10 | | S,7 | S,0 | S,6 | S,16 | S,15 | | | 83 | 25.4 | |
| | 8 | | | | | | | | | | | | | | | $\bar{x}$ = 26.2 |
| | Total | 41 | 0 | 24 | 25 | 0 | 21 | 0 | 19 | 44 | 36 | | | 210 | | |
| 40 mg/L | Init. | | | | | | | | | | | | | | 24.1 | # 1 is ♂ |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | D,0 | | | 0 | 24.5 | KAF 10-22- |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | | 0 | 24.9 | |
| | 3 | S,0 | S,0 | S,0 | S,3 | S,2 | S,4 | S,0 | S,0 | S,4 | | | | 13 | 25.1 | |
| | 4 | S,0 | S,7 | S,0 | S,0 | S,4 | S,0 | S,3 | S,0 | S,9 | | | | 22 | 24.6 | |
| | 5 | S,0 | S,11 | S,6 | S,6 | S,0 | S,8 | S,9 | S,0 | S,0 | | | | 40 | 24.8 | |
| | 6 | S,0 | S,0 | S,12 | S,14 | S,3 | S,12[20] | S,0 | S,9 | S,12 | | | | 92 | 24.5 | |
| | 7 | S,0 | S,16 | S,10 | S,12 | S,3 | S,12 | S,13 | S,11 | S,17 | | | | 94 | 25.2 | |
| | 8 | | | | | | | | | | | | | | | $\bar{x}$ = 25.7 |
| | Total | 0 | 38[20] | 28 | 35 | 12 | 36 | 25 | 20 | 41 | 0 | | | 230 | | |

(13) (13) (16) (16) (16) (16) (14) (14) (14) (12) (—) (—) (231) BGW

* * * *

Numbers in parentheses indicate the originating brood sizes.
All organisms in a replicate are from the same adult.
* One brood used to initiate two replicates.

Record in order given:

a) S = Alive, D = Dead  b) 0 - 30 = Number of live young, (0 - 30) = Number of dead young (if present)  c) E = Aborted embryos observed

BGW 10-15-91 CHECKED BY: J.S. Vetter 10-25-91

SP1091J1

ETHANOL AMINE TOXICITY TEST
~~NOEM PERFORMANCE SAMPLES~~ GW

LAKE WYLIE H2O DILLUENT

WATER QUALITY DATA SHEET

| | | | DAY 2 | | DAY 4 | | DAY 6 | | |
|---|---|---|---|---|---|---|---|---|---|
| | | INITIATION | OLD | NEW | OLD | NEW | OLD | NEW | TERMINATI |
| CONTROL A | DO | 7.8 | 7.8 | 8.9 | 7.9 | 8.7 | 7.8 | 9.6 | 7.9 |
| | pH | 7.8 | 7.9 | 7.9 | 7.9 | 7.9 | 8.0 | 7.9 | 7.9 |
| | Cond. | 118 | 122 | 114 | 123 | 115 | 131 | 115 | 122 |
| 2.5 mg/L B | DO | 7.9 | 7.9 | 8.3 | 7.8 | 8.6 | 7.7 | 9.5 | 7.8 |
| | pH | 8.2 | 8.0 | 8.2 | 8.0 | 8.2 | 8.0 | 8.3 | 8.0 |
| | Cond. | 117 | 142 | 117 | 127 | 117 | 121 | 117 | 124 |
| 5.0 mg/L C | DO | 7.9 | 7.9 | 8.3 | 7.8 | 8.5 | 7.8 | 9.2 | 7.9 |
| | pH | 8.5 | 8.0 | 8.6 | 8.0 | 8.5 | 8.1 | 8.6 | 8.0 |
| | Cond. | 119 | 148 | 119 | 127 | 121 | 132 | 120 | 133 |
| 10 mg/L D | DO | 7.9 | 7.8 | 8.7 | 7.8 | 8.8 | 7.7 | 9.4 | 7.8 |
| | pH | 8.9 | 8.1 | 8.9 | 8.1 | 8.8 | 8.1 | 8.9 | 8.2 |
| | Cond. | 124 | 143 | 124 | 142 | 125 | 132 | 124 | 133 |
| 20 mg/L E | DO | 7.9 | 7.8 | 8.8 | 7.8 | 8.7 | 7.7 | 9.5 | 7.8 |
| | pH | 9.2 | 8.2 | 9.2 | 8.2 | 9.1 | 8.3 | 9.2 | 8.6 |
| | Cond. | 130 | 146 | 131 | 148 | 133 | 144 | 131 | 143 |
| 40 mg/L F | DO | 8.0 | 7.8 | 8.8 | 7.8 | 8.8 | 7.7 | 9.5 | 7.8 |
| | pH | 9.4 | 8.4 | 9.4 | 8.4 | 9.4 | 8.5 | 9.5 | 8.9 |
| | Cond. | 142 | 180 | 142 | 170 | 144 | 170 | 141 | 161 |
| DILUENT | HARDNESS | 39.4 | — | — | — | — | — | — | — |
| | ALKALINITY | 30.0 | — | — | — | — | — | — | — |
| | DATE | 10-15-91 | 10-17-91 | 10-17-91 | 10-19-91 | 10-19-91 | 10-21-91 | 10-21-91 | 10-22-91 |
| | TIME | 1340 | 1105 | 1100 | 1305 | 1305 | 1025 | 1110 | 0910 |
| | INITIALS | JSW | JSW | JSW | BGN | BGN | JSW | JSW* | KAF |

SP1091J2

## CERIODAPHNIA DUBIA CHRONIC TOXICITY TEST DATA SHEET

Industry/Toxicant: Catawba Nuclear Station / Ethanolamine

Address: —

NPDES Permit No: —

Effluent Serial No: —

Effluent/Diluent Filtration: 60 µm mesh

Diluent: Catawba NS 002 Discharge H2O

Carrier Solvent: (No) Yes

Test Vessel Composition: Polystyrene-Anchor Hocking PI-1

Test Vessel Capacity: 30 mL

Test Solution Volume: 15 mL

Renewal Frequency: Daily/(Days) 0,2,4,&6 *A

*A: Test vessels renewed daily
Solutions renewed days 0,2,4,&6

Beginning Date 10/19/91 Time: 1304

Ending Date 10/23/91 Time: 1357

Test Conducted by: J.S. Velte

Location of Test: DEC-ASC-Bioassay

Incubator ID: D

Shelf ID: D3

Organism Age: less than 25 hours

Organism Source: DEC cultures (Tray D)

Diet: #1 YTC Amount 100µl

#2 S. Capricornutum Amount 100µl

## CERIODAPHNIA DUBIA YOUNG PRODUCTION

Dilution Water for Adults 22‰ Perrier in Milli-Q Plus H2O: PER-76

Adults segregated at: Date 10-14-91 Time 1243 Initials BGN

Check adults eight hours or less after the segregation time for third or later broods of eight or more neonates.

Adults checked for neonates at: Date 10-14-91 Time 1608 Initials BGN

Number of acceptable broods 7 Number of neonates 84

RETAIN EXTRA NEONATES UNTIL AFTER THE ONE HOUR POST-INITIATION MORTALITY CHECK HAS BEEN COMPLETED.

## PROCEDURE NUMBERS

BIO- 200.0 Temperature

Temp. Device: ELENV- 30809

BIO- 214.0 (Dissolved $O_2$)

BIO- 210.0 (pH)

BIO- 217.0 (Spec. Cond.)

BIO- — (TRC)

BIO- 215.0 (Total Alk.)

BIO- 216.0 (Total Hard.)

BIO- —

## CHEMISTRY DATA → see additional sheet

| | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. | Control | High Conc. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| D.O. | — | — | — | — | — | — | — | — | — | — | — | — |
| pH | — | — | — | — | — | — | — | — | — | — | — | — |
| Spec. Cond. (µS/cm) | — | — | — | — | — | — | — | — | — | — | — | — |
| TRC (mg/L) | — | — | — | — | — | — | — | — | — | — | — | — |
| Total Alk. (mg/L) | — | — | — | — | — | — | — | — | — | — | — | — |
| Total Hard. (mg/L) | — | — | — | — | — | — | — | — | — | — | — | — |
| Date: | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— | —/—/— |
| Time: | — | — | — | — | — | — | — | — | — | — | — | — |
| Initials: | — | — | — | — | — | — | — | — | — | — | — | — |

SP1091.12

CHRONIC FISH TEST
PROCEDURE MANUAL EPA-600/4-89-001

TEST: Ethanolamine Toxicity - CNS 002 Diluent

| Conc. or % Effluent | Day | Replicate 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | Σ F | Σ Y | Comments |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CONTROL | Init. | | | | | | | | | | | | | | 24.7 | $\bar{x}$ = 25.5 |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | D,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.6 | Rep #2 is ♂ |
| | 2 | D,0 | S,0 | S,0 | S,0 | S,0 | ↓ | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.3 | #3 is ♂ |
| | 3 | ↓ | S,0 | S,0 | S,4 | S,2 | | S,0 | S,4 | S,0 | S,3 | | | 13 | 25.5 | KAF 10-23-91 |
| | 4 | | S,0 | S,0 | S,0 | S,0 | | S,0 | S,0 | S,0 | S,0 | | | 6 | 25.3 | |
| | 5 | | S,0 | S,0 | S,5 | S,6 | | S,4 | S,6 | S,8 | S,6 | | | 35 | 24.8 | |
| | 6 | | S,0 | S,0 | S,7 | S,10 | | S,0 | S,5 | S,0 | S,7 | | | 29 | 25.3 | |
| | 7 | | S,0 | S,0 | S,0 | S,7 | | S,3 | S,10 | S,6 | S,8 | | | 34 | 25.5 | |
| | 8 | ↓ | S,0 | S,0 | S,0 | S,0 | ↓ | S,1 | S,0 | S,9 | S,0 | | | 10 | 24.9 | |
| | Total | 0 | 0 | 0 | 16 | 25 | 0 | 8 | 25 | 29 | 24 | | | 137 | | $\bar{x}$ = 15.9 |
| 2.5 mg/L | Init. | | | | | | | | | | | | | | 24.2 | $\bar{x}$ = 24.5 |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.6 | Rep #4 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | D,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.7 | KAF 10-23 |
| | 3 | S,0 | S,3 | S,4 | S,0 | ↓ | S,2 | S,0 | S,4 | S,0 | S,0 | | | 11 | 25.4 | |
| | 4 | S,9 | S,0 | S,0 | S,0 | | S,2 | S,0 | S,0 | S,3 | S,0 | | | 10 | 26.4 | |
| | 5 | S,7 | S,3 | S,6 | S,0 | | S,3 | S,8 | S,0 | S,0 | S,7 | | | 34 | 25.6 | |
| | 6 | S,0 | S,3 | S,2 | S,0 | | S,5 | S,0 | S,0 | S,4 | S,6 | | | 20 | 25.9 | |
| | 7 | S,3 | S,0 | S,8 | S,0 | | S,3 | S,2 | S,9 | S,4 | S,0 | | | 29 | 25.6 | |
| | 8 | S,5 | S,1 | S,0 | S,0 | ↓ | S,7 | S,10 | S,0 | S,7 | S,10 | | | 22 | 25.8 | |
| | Total | 20 | 10 | 20 | 0 | 0 | 20 | 11 | 13 | 18 | 14 | | | 126 | | $\bar{x}$ = 14.0 |
| 5.0 mg/L | Init. | | | | | | | | | | | | | | 24.9 | |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.5 | Rep #1 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.5 | #2 is ♂ |
| | 3 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,4 | S,0 | S,3 | | | 7 | 25.2 | KAF 10-23 |
| | 4 | S,0 | S,0 | S,0 | S,2 | S,2 | S,2 | S,3 | S,0 | S,5 | S,0 | | | 14 | 25.3 | |
| | 5 | S,0 | S,0 | S,9 | S,9 | S,8 | S,1 | S,0 | S,6 | S,0 | S,3 | | | 35 | 24.9 | |
| | 6 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,1 | S,5 | S,7 | S,0 | | | 19 | 25.7 | |
| | 7 | S,0 | S,0 | S,4 | S,6 | S,10 | S,14 | S,15 | S,11 | S,14 | S,1 | (KAF) | | 45 | 25.1 | |
| | 8 | S,0 | S,0 | S,0 | S,4 | S,16 | S,9 | S,10 | S,0 | S,6 | S,6 | | | 51 | 25.3 | |
| | Total | 0 | 0 | 12 | 21 | 36 | 16 | 25 | 26 | 33 | 13 | | | 171 | | $\bar{x}$ = 21.4 |
| 10 mg/L | Init. | | | | | | | | | | | | | | 24.4 | |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.4 | Rep #2 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.4 | #3 is ♂ |
| | 3 | S,0 | S,0 | S,0 | S,4 | S,2 | S,0 | S,0 | S,2 | S,2 | S,4 | | | 14 | 25.3 | KAF 10-23 |
| | 4 | S,1 | S,0 | S,0 | S,0 | S,0 | S,4 | S,7 | S,0 | S,0 | S,0 | | | 12 | 25.3 | |
| | 5 | S,12 | S,0 | S,0 | S,5 | S,6 | S,11 | S,7 | S,7 | S,8 | S,5 | | | 55 | 25.2 | |
| | 6 | S,0 | S,0 | S,0 | S,0 | S,6 | S,0 | S,7 | S,8 | S,0 | S,0 | | | 21 | 25.7 | |
| | 7 | S,5 | S,0 | S,0 | S,10 | S,12 | S,2 | S,9 | S,10 | S,9 | S,6 | | | 63 | 25.3 | |
| | 8 | S,11 | S,0 | S,0 | S,0 | S,0 | S,11 | S,0 | S,0 | S,0 | S,0 | | | 23 | 25.3 | |
| | Total | 29 | 0 | 0 | 19 | 26 | 28 | 24 | 27 | 19 | 15 | | | 187 | | $\bar{x}$ = 23.4 |
| 20 mg/L | Init. | | | | | | | | | | | | | | 24.0 | |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.3 | Rep #1 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | | | 0 | 25.4 | #4 is ♂ |
| | 3 | S,0 | S,1 | S,0 | S,0 | S,0 | S,0 | S,4 | S,2 | S,1 | S,4 | | | 12 | 25.3 | KAF 10-23 |
| | 4 | S,0 | S,0 | S,4 | S,0 | S,3 | S,0 | S,0 | S,0 | S,1 | S,0 | | | 8 | 25.5 | |
| | 5 | S,0 | S,7 | S,9 | S,0 | S,8 | S,0 | S,7 | S,6 | S,6 | S,8 | | | 51 | 25.3 | |
| | 6 | S,0 | S,10 | S,0 | S,0 | S,0 | S,10 | S,9 | S,10 | S,5 | S,14 | | | 58 | 25.2 | |
| | 7 | S,0 | S,15 | S,11 | S,0 | S,13 | S,12 | S,11 | S,16 | S,13 | S,0 | | | 91 | 25.3 | |
| | 8 | S,0 | S,9 | S,12 | S,0 | S,10 | S,16 | S,9 | S,0 | S,0 | S,16 | | | 63 | 25.2 | |
| | Total | 0 | 33 | 36 | 0 | 34 | 38 | 40 | 34 | 26 | 42 | | | 283 | | $\bar{x}$ = 35.4 |
| 40 mg/L | Init. | | | | | | | | | | | | | | 24.1 | |
| | 1 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | D,0 | | | 0 | 25.2 | Rep #4 is ♂ |
| | 2 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | S,0 | ↓ | | | 0 | 25.4 | KAF 10-23 |
| | 3 | S,4 | S,0 | S,4 | S,0 | S,0 | S,0 | S,0 | S,2 | S,0 | | | | 10 | 25.3 | |
| | 4 | S,0 | S,6 | S,7 | S,0 | S,4 | S,1 | S,4 | S,0 | S,5 | | | | 27 | 25.5 | |
| | 5 | S,8 | S,9 | S,0 | S,0 | S,8 | S,0 | S,2 | S,8 | S,7 | | | | 42 | 25.0 | |
| | 6 | S,8 | S,0 | S,12 | S,0 | S,0 | S,8 | S,3 | S,15 | S,0 | | | | 46 | 25.2 | |
| | 7 | S,9 | S,13 | S,18 | S,0 | S,14 | S,13 | S,13 | S,16 | S,15 | | | | 111 | 25.2 | |
| | 8 | S,10 | S,12 | S,0 | S,0 | S,15 | S,14 | S,13 | S,16 | S,10 | ↓ | (KW) | | 69 | 25.1 | |
| | Total | 29 | 40 | 41 | 0 | 41 | 36 | 35 | 41 | 42 | 0 | | | 305 | | $\bar{x}$ = 33.9 |
| | | (13) | (13) | (17) | (17) | (15) | (15) | (15) | (12) | (12) | (11) | (—) | (—) | | | |

* * *

Numbers in parentheses indicate the originating brood sizes.
All organisms in a replicate are from the same adult.
* - Same brood initiated two replicates.

CHECKED BY: J.S. Velte 10-25-91

Record in order given:

a) S = Alive, D = Dead  b) 0 - 30 = Number of live young, (0 - 30) = Number of dead young (if present)  c) E = Aborted embryos observed

SP1091J2

ETHANOLAMINE TOXICITY TEST

~~NEDEM PERFORMANCE SAMPLE~~

CATAWBA NS (002) DILUENT

WATER QUALITY DATA SHEET

| | | INITIATION | DAY 2 OLD | DAY 2 NEW | DAY 4 OLD | DAY 4 NEW | DAY 6 OLD TERMINATION | DAY 6 NEW TERMINATION | TERMINATI |
|---|---|---|---|---|---|---|---|---|---|
| CONTROL A | DO | 9.2 | 7.9 | 9.5 | 7.8 | 9.1 | 7.8 | 9.6 | 7.9 |
| | pH | 7.4 | 7.0 | 7.3 | 7.1 | 7.3 | 7.1 | 7.2 | 7.0 |
| | Cond. | 312 | 333 | 314 | 329 | 316 | 325 ~~131~~ JSN | 316 | 314 |
| 2.5 mg/L B | DO | 8.5 | NA* | 9.5 | 7.8 | 8.6 | 7.8 | 9.2 | 7.7 |
| | pH | 7.8 | NA* | 7.8 | 7.1 | 7.5 | 7.1 | 7.7 | 7.0 |
| | Cond. | 315 | NA* | 317 | 339 | 324 | 364 | 319 | 322 |
| 5.0 mg/L C | DO | 8.9 | 7.4 | 9.5 | 7.8 | 8.8 | 7.7 | 9.2 | 7.1 |
| | pH | 8.3 | 7.0 | 8.1 | 7.2 | 7.9 | 7.2 | 8.1 | 7.0 |
| | Cond. | 317 | 342 | 321 | 351 | 323 | 341 | 320 | 322 |
| 10.0 mg/L D | DO | 9.0 | 6.0 | 9.5 | 7.6 | 8.8 | 7.6 | 9.3 | 6.5 |
| | pH | 8.6 | 6.9 | 8.6 | 7.3 | 8.4 | 7.3 | 8.6 | 7.0 |
| | Cond. | 320 | 335 | 322 | 338 | 326 | 343 | 324 | 338 |
| 20 mg/L E | DO | 8.8 | 4.0 | 9.4 | 7.6 | 8.8 | 7.4 | 9.3 | 6.6 |
| | pH | 9.0 | 6.9 | 9.0 | 7.5 | 8.8 | 7.5 | 9.0 | 7.3 |
| | Cond. | 326 | 354 | 329 | 365 | 332 | 351 | 329 | 343 |
| 40 mg/L F | DO | 9.0 | 5.8 | 9.4 | 6.8 | 8.8 | 7.3 | 9.3 | 6.2 |
| | pH | 9.3 | 6.8 | 9.3 | 7.6 | 9.2 | 7.8 | 9.3 | 7.5 |
| | Cond. | 338 | 417 | 338 | 385 | 343 | 368 | 340 | 375 |
| DILLENT: | HARDNESS | 19.8 | — | — | — | — | — | — | |
| | ALKALINITY | 5.5 | — | — | — | — | — | — | |
| | DATE | 10-15-91 | 10-17-91 | 10-17-91 | 10-19-91 | 10-19-91 | 10-21-91 | 10-21-91 | 10-23-91 |
| | TIME | 1410 | 1120 | 1205 | 1305 | 1305 | 1050 | 1125 | 1330 |
| | INITIALS | JSN | JSN | JSN | BSN | BSN | JSN | JSN* | JSN |

* SAMPLE SPILLED JSN 10-17-91

# ATTACHMENT II

OHS15200

## SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 110-91-8
RTECS NUMBER: QD6475000

SUBSTANCE: MORPHOLINE

TRADE NAMES/SYNONYMS:
DIETHYLENEIMIDE OXIDE; TETRAHYDRO-1,4-OXAZINE; BASF 238; DIETHYLENIMIDE OXIDE; 1-OXA-4-AZACYCLOHEXANE; TETRAHYDRO-1,4-ISOXAZINE; TETRA-HYDRO-2H-1,4-OXAZINE; DIETHYLENE OXIMIDE; DIETHYLENE IMIDOXIDE; STCC 4907846; UN 2054; M-263; OHS15200

CHEMICAL FAMILY:
Heterocyclic

CREATION DATE: 12/14/84 REVISION DATE: 06/30/94

## SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : MORPHOLINE
CAS NUMBER: 110-91-8
PERCENTAGE: 100.0

OTHER CONTAMINANTS: NONE

## SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=3 REACTIVITY=1 PERSISTENCE=1
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=3 REACTIVITY=0

EMERGENCY OVERVIEW:
Colorless, hygroscopic, oily mobile liquid with a weak, characteristic, fishy, amine-like odor.
Harmful if absorbed through skin. Causes severe burns to mucous membranes. Causes respiratory tract and eye burns. Causes skin irritation, possibly severe.
Flammable liquid and vapor. May cause flash fire. May react with water. Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep away from all ignition sources. Do not allow water to get in container. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause burns. Additional effects may include tearing, low blood pressure, headache, dizziness, lung congestion and kidney damage.
LONG TERM EFFECTS: Same effects as short term exposure.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include tearing, low blood pressure, headache, dizziness and twitching. May also cause death.
LONG TERM EFFECTS: In addition to effects from short term exposure, kidney damage may occur.
EYE CONTACT:
SHORT TERM EFFECTS: May cause burns. Additional effects may include eye damage.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause gastrointestinal irritation. May cause burns. Additional effects may include tearing, vomiting, digestive disorders, low blood pressure, headache, dizziness and twitching.
LONG TERM EFFECTS: May cause effects as in short term exposure. Additional effects may include liver and kidney damage.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

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## SECTION 4 FIRST AID MEASURES

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INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

INGESTION:

FIRST AID- If the person is conscious and not convulsing, induce emesis by giving syrup of ipecac followed by water. (If vomiting occurs keep the head below the hips to prevent aspiration). Repeat in 20 minutes if not effective initially. Give activated charcoal. In patients with depressed respiration or if emesis is not produced, perform gastric lavage cautiously (Dreisbach, Handbook of Poisoning, 12th Ed.). Treat symptomatically and supportively. Gastric lavage should be performed by qualified medical personnel. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

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SECTION 5 FIRE FIGHTING MEASURES

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FIRE AND EXPLOSION HAZARD:
Dangerous fire hazard when exposed to heat or flame.

Vapor-air mixtures are explosive above flash point.

Vapors are heavier than air and may travel a considerable distance to a source of ignition and flash back.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or regular foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

Alcohol foam
(NFPA 325M, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, 1991).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Do not get water inside container. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks. Withdraw immediately in case of rising sound from venting safety device or any discoloration of tank due to fire. Isolate for 1/2 mile in all directions if tank, rail car or tank truck is involved in fire (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 29).

Extinguish using agents indicated; do not use water directly on material. If large amounts of combustible materials are involved, use water spray or fog in flooding amounts. Use water spray to absorb corrosive vapors. Cool containers with flooding amounts of water from as far a distance as possible. Avoid breathing corrosive vapors; keep upwind.

FLASH POINT: 100 F (38 C) (OC)
LOWER FLAMMABLE LIMIT: 1.4%
UPPER FLAMMABLE LIMIT: 11.2%
AUTOIGNITION: 550 F (290 C)

FLAMMABILITY CLASS(OSHA): II

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon and nitrogen.

## SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Shut off ignition sources. Do not touch spilled material. Stop leak if you can do it without risk. Use water spray to reduce vapors. Do not get water inside container. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For larger spills, dike far ahead of spill for later disposal. No smoking, flames or flares in hazard area. Keep unnecessary people away; isolate hazard area and deny entry.

## SECTION 7 HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Protect against physical damage. Outside or detached storage is preferable. Inside storage should be in a standard flammable liquids storage room or cabinet. Separate from oxidizing materials (NFPA 49, hazardous chemicals data, 1975).

## SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
MORPHOLINE:
20 ppm (71 mg/m3) OSHA TWA (skin); 30 ppm (107 mg/m3) OSHA STEL
20 ppm (71 mg/m3) ACGIH TWA (skin)
20 ppm (71 mg/m3) NIOSH recommended TWA (skin);
30 ppm (107 mg/m3) NIOSH recommended STEL
20 ppm (71 mg/m3) DFG MAK TWA (skin);
40 ppm (142 mg/m3) DFG MAK 5 minute peak, momentary value, 8 times/shift

Measurement method: Silica gel tube; sulfuric acid/sodium hydroxide; gas chromatography with flame ionization detection; (NIOSH Vol. II(3) # S150).

**OSHA revoked the final rule limits of January 19, 1989 in response to the 11th Circuit Court of Appeals decision (AFL-CIO v. OSHA) effective June 30, 1993. See 29 CFR 1910.1000 (58 FR 35338)**

VENTILATION:
Provide local exhaust or process enclosure ventilation to meet the published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment to prevent any possibility of skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

MORPHOLINE:
550 ppm- Any supplied-air respirator operated in a continuous flow mode.
Any powered air-purifying respirator with organic vapor cartridge(s).

1000 ppm- Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.
Any chemical cartridge respirator with a full facepiece and organic vapor cartridge(s).

8000 ppm- Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode.

Escape- Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted organic vapor canister.
Any appropriate escape-type self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

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## SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

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DESCRIPTION: Colorless, hygroscopic, oily mobile liquid with a weak, characteristic, fishy, amine-like odor.
MOLECULAR WEIGHT: 87.14
MOLECULAR FORMULA: C4-H9-N-O
BOILING POINT: 263 F (128 C)
FREEZING POINT: 24 F (-5 C)
VAPOR PRESSURE: 10 mmHg @ 23 C
VAPOR DENSITY: 3.00
SPECIFIC GRAVITY: 1.0005
WATER SOLUBILITY: very soluble
VOLATILITY: 100.0%
PH: 11.0 (25% solution)
ODOR THRESHOLD: 0.1 ppm
EVAPORATION RATE: (butyl acetate=1) <1
SOLVENT SOLUBILITY: Soluble in ethanol, methanol, ether, acetone, benzene, ethylene glycol, linseed oil, castor oil, pine oil, turpentine, 2-hexanone, organic solvents; insoluble in concentrated sodium hydroxide solutions

VISCOSITY: 2.23 cP @ 20 C

decomposes at 489 F (250 C)

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## SECTION 10 STABILITY AND REACTIVITY

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REACTIVITY:
Contact with water may result in evolution of some heat.

CONDITIONS TO AVOID:
Avoid contact with heat, sparks, flames or other ignition sources. Vapors may be explosive. Material is corrosive; avoid contact with skin or eyes. Do not allow contamination of water sources.

INCOMPATIBILITIES:
MORPHOLINE:
ACIDS (STRONG): Violent reaction and violent spattering.
ALUMINUM: Corrosive.
CELLULOSE NITRATE: Spontaneous ignition.
COPPER: Attacks.
COPPER COMPOUNDS: Attacks.
METALS: Corrosive.
NITROMETHANE: Plus acids or bases; susceptible to initiation by detonator.
OXIDIZERS (STRONG): Fire and explosion hazard.
PLASTICS: Attacks.
RESINS: Dissolves.
RUBBER: Attacks.
ZINC: Corrosive.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon and nitrogen.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal

temperatures and pressures.

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SECTION 11 TOXICOLOGICAL INFORMATION

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MORPHOLINE:
IRRITATION DATA: 995 mg/24 hours skin-rabbit severe; 500 mg open skin-rabbit moderate; 2 mg eye-rabbit severe.
TOXICITY DATA: 8000 ppm/8 hours inhalation-rat LC50; 1320 mg/m3/2 hours inhalation-mouse LC50; 12,000 mg/m3 inhalation-mammal LC50; 500 mg/kg skin-rabbit LD50; 1050 mg/kg oral-rat LD50; 525 mg/kg oral-mouse LD50; 100 mg/kg oral-guinea pig LDLo; 1220 mg/kg oral-mammal LD50; 413 mg/kg intraperitoneal-mouse LD50; 1600 mg/kg unreported-rat LDLo; mutagenic data (RTECS); tumorigenic data (RTECS).
CARCINOGEN STATUS: Animal Inadequate Evidence (IARC Group-3).
LOCAL EFFECTS: Corrosive- inhalation, skin, eye, ingestion.
ACUTE TOXICITY LEVEL: Toxic by dermal absorption; moderately toxic by ingestion; slightly toxic by inhalation.
TARGET EFFECTS: Poisoning may affect the liver, kidney, and lungs.
AT INCREASED RISK FROM EXPOSURE: Persons with chronic respiratory, liver, kidney, eye, or skin diseases.

HEALTH EFFECTS
INHALATION:
MORPHOLINE:
CORROSIVE. 8000 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- A human exposed to 12,000 ppm for 1.5 minutes experienced nasal irritation and cough. More severe exposure may cause lacrimation, sore throat, rhinitis, headache, shallow respiration, respiratory irritation, dizziness, hypotension and lethargy. In rats pulmonary edema, liver necrosis, and renal tubular degeneration may occur but only at concentrations which are intensely irritating.
CHRONIC EXPOSURE- Damage to lungs, liver and kidneys occurred in rats dying within 3-5 days from daily exposure to 18,000 ppm.

SKIN CONTACT:
MORPHOLINE:
CORROSIVE/TOXIC.
ACUTE EXPOSURE- Vapors may cause severe irritation. Liquid contact may cause severe irritation or skin necrosis and may be readily absorbed to produce systemic affects similar to inhalation: Headache, dizziness, lethargy, shallow respiration and hypotension. Application to rabbit skin caused hypoactivity, tremors, lacrimation and salivation.
CHRONIC EXPOSURE- Repeated or prolonged exposure may cause dermatitis and symptoms similar to acute exposure. Repeated exposures may induce hypersensitivity. In rabbits and guinea pigs, from 1-13 applications to shaven skin caused skin burns, necrosis, inflammation, edematous dermatitis, congestion of liver and spleen, fatty degeneration and necrosis of the liver, renal tubular necrosis and death.

EYE CONTACT:
MORPHOLINE:
CORROSIVE.
ACUTE EXPOSURE- Vapors may cause redness and irritation, foggy vision, rings

temperatures and pressures.

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SECTION 11 TOXICOLOGICAL INFORMATION

---

MORPHOLINE:
IRRITATION DATA: 995 mg/24 hours skin-rabbit severe; 500 mg open skin-rabbit moderate; 2 mg eye-rabbit severe.
TOXICITY DATA: 8000 ppm/8 hours inhalation-rat LC50; 1320 mg/m3/2 hours inhalation-mouse LC50; 12,000 mg/m3 inhalation-mammal LC50; 500 mg/kg skin-rabbit LD50; 1050 mg/kg oral-rat LD50; 525 mg/kg oral-mouse LD50; 100 mg/kg oral-guinea pig LDLo; 1220 mg/kg oral-mammal LD50; 413 mg/kg intraperitoneal-mouse LD50; 1600 mg/kg unreported-rat LDLo; mutagenic data (RTECS); tumorigenic data (RTECS).
CARCINOGEN STATUS: Animal Inadequate Evidence (IARC Group-3).
LOCAL EFFECTS: Corrosive- inhalation, skin, eye, ingestion.
ACUTE TOXICITY LEVEL: Toxic by dermal absorption; moderately toxic by ingestion; slightly toxic by inhalation.
TARGET EFFECTS: Poisoning may affect the liver, kidney, and lungs.
AT INCREASED RISK FROM EXPOSURE: Persons with chronic respiratory, liver, kidney, eye, or skin diseases.

HEALTH EFFECTS
INHALATION:
MORPHOLINE:
CORROSIVE. 8000 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- A human exposed to 12,000 ppm for 1.5 minutes experienced nasal irritation and cough. More severe exposure may cause lacrimation, sore throat, rhinitis, headache, shallow respiration, respiratory irritation, dizziness, hypotension and lethargy. In rats pulmonary edema, liver necrosis, and renal tubular degeneration may occur but only at concentrations which are intensely irritating.
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SKIN CONTACT:
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CORROSIVE/TOXIC.
ACUTE EXPOSURE- Vapors may cause severe irritation. Liquid contact may cause severe irritation or skin necrosis and may be readily absorbed to produce systemic affects similar to inhalation: Headache, dizziness, lethargy, shallow respiration and hypotension. Application to rabbit skin caused hypoactivity, tremors, lacrimation and salivation.
CHRONIC EXPOSURE- Repeated or prolonged exposure may cause dermatitis and symptoms similar to acute exposure. Repeated exposures may induce hypersensitivity. In rabbits and guinea pigs, from 1-13 applications to shaven skin caused skin burns, necrosis, inflammation, edematous dermatitis, congestion of liver and spleen, fatty degeneration and necrosis of the liver, renal tubular necrosis and death.

EYE CONTACT:
MORPHOLINE:
CORROSIVE.
ACUTE EXPOSURE- Vapors may cause redness and irritation, foggy vision, rings

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101
AND SUBPART E:
Flammable liquid

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.150
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.242

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 60 L
CARGO AIRCRAFT ONLY: 220 L

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## SECTION 15 REGULATORY INFORMATION

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TSCA STATUS: Y

| | |
|---|---|
| CERCLA SECTION 103 (40CFR302.4): | N |
| SARA SECTION 302 (40CFR355.30): | N |
| SARA SECTION 304 (40CFR355.40): | N |
| SARA SECTION 313 (40CFR372.65): | N |
| OSHA PROCESS SAFETY (29CFR1910.119): | N |
| CALIFORNIA PROPOSITION 65: | N |

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)

| | |
|---|---|
| ACUTE HAZARD: | Y |
| CHRONIC HAZARD: | N |
| FIRE HAZARD: | Y |
| REACTIVITY HAZARD: | Y |
| SUDDEN RELEASE HAZARD: | N |

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## SECTION 16 OTHER INFORMATION

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OHS08710

## SECTION 1 CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

MDL INFORMATION SYSTEMS, INC.
14600 CATALINA STREET
SAN LEANDRO, CA 94577
1-800-635-0064 OR
1-510-895-1313

FOR EMERGENCY SOURCE INFORMATION
CONTACT: 1-615-366-2000 USA

CAS NUMBER: 141-43-5
RTECS NUMBER: KJ5775000

SUBSTANCE: ETHANOLAMINE

TRADE NAMES/SYNONYMS:
ETHANOL, 2-AMINO-; AMINOETHANOL; BETA-AMINOETHANOL; 2-AMINOETHANOL; BETA-AMINOETHYL ALCOHOL; COLAMINE; BETA-ETHANOLAMINE; 2-ETHANOLAMINE; ETHYLOLAMINE; GLYCINOL; 2-HYDROXYETHANAMINE; BETA-HYDROXYETHYLAMINE; 2-HYDROXYETHYLAMINE; MEA; MONOETHANOLAMINE; M-251; C2H7NO; UN 2491; STCC 4935665; OHS08710

CHEMICAL FAMILY:
Alcohol, aliphatic

Amine

CREATION DATE: 09/10/84 REVISION DATE: 09/28/94

## SECTION 2 COMPOSITION, INFORMATION ON INGREDIENTS

COMPONENT : ETHANOLAMINE
CAS NUMBER: 141-43-5
PERCENTAGE: 100

OTHER CONTAMINANTS: NONE

## SECTION 3 HAZARDS IDENTIFICATION

CERCLA RATINGS (SCALE 0-3): HEALTH=3 FIRE=2 REACTIVITY=0 PERSISTENCE=0
NFPA RATINGS (SCALE 0-4): HEALTH=2 FIRE=2 REACTIVITY=0

EMERGENCY OVERVIEW:
Colorless, viscous, hygroscopic liquid with an ammonia-like odor.
Harmful if absorbed through skin. Causes severe burns to mucous membranes. Causes respiratory tract and skin burns. Causes eye irritation, possibly severe.
Combustible liquid and vapor.
Do not breathe vapor or mist. Do not get in eyes, on skin, or on clothing. Keep away from all ignition sources. Keep container tightly closed. Wash thoroughly after handling. Use only with adequate ventilation.

POTENTIAL HEALTH EFFECTS:
INHALATION:
SHORT TERM EFFECTS: May cause burns. Additional effects may include difficulty breathing, low blood pressure, headache, dizziness, bluish skin color, lung congestion and liver and kidney damage.
LONG TERM EFFECTS: In addition to effects from short term exposure, digestive disorders may occur.
SKIN CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe. Additional effects may include blisters. May also cause death.
LONG TERM EFFECTS: Same effects as short term exposure.
EYE CONTACT:
SHORT TERM EFFECTS: May cause irritation, possibly severe.
LONG TERM EFFECTS: Same effects as short term exposure.
INGESTION:
SHORT TERM EFFECTS: May cause burns. Additional effects may include nausea, vomiting, stomach pain and shock.
LONG TERM EFFECTS: In addition to effects from short term exposure, may cause reproductive effects.

CARCINOGEN STATUS:
OSHA: N
NTP: N
IARC: N

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## SECTION 4 FIRST AID MEASURES

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INHALATION:
FIRST AID- Remove from exposure area to fresh air immediately. Perform artificial respiration if necessary. Maintain airway, blood pressure and respiration. Keep warm and at rest. Treat symptomatically and supportively. Get medical attention immediately. Qualified medical personnel should consider administering oxygen.

SKIN CONTACT:
FIRST AID- Remove contaminated clothing and shoes immediately. Wash with soap or mild detergent and large amounts of water until no evidence of chemical remains (at least 15-20 minutes). If burns occur, proceed with the following: Cover affected area securely with sterile, dry, loose-fitting dressing. Treat symptomatically and supportively. Get medical attention immediately.

EYE CONTACT:
FIRST AID- Wash eyes immediately with large amounts of water, occasionally lifting upper and lower lids, until no evidence of chemical remains (at least 15-20 minutes). Continue irrigating with normal saline until the pH has returned to normal (30-60 minutes). Cover with sterile bandages. Get medical attention immediately.

INGESTION:
FIRST AID- Give large amounts of water or milk immediately. Allow vomiting to

occur. Do not perform gastric lavage or induce emesis. Esophagoscopy is the only way to exclude th possibility of corrosion in the upper gastro-intestinal tract; if corrosion is suspected, esophagoscopy should usually be performed within 24 hours. (Dreisbach & Robertson; Handbook of Poisoning; 12th Ed.). Do not give anything by mouth if person is unconscious or otherwise unable to swallow. If vomiting occurs, keep head lower than hips to help prevent aspiration. Maintain airway and respiration. Treat symptomatically and supportively. Get medical attention immediately.

NOTE TO PHYSICIAN
ANTIDOTE:
No specific antidote. Treat symptomatically and supportively.

## SECTION 5 FIRE FIGHTING MEASURES

FIRE AND EXPLOSION HAZARD:
Moderate fire hazard when exposed to heat or flame.

EXTINGUISHING MEDIA:
Dry chemical, carbon dioxide, water spray or alcohol-resistant foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

For larger fires, use water spray, fog or alcohol-resistant foam (1993 Emergency Response Guidebook, RSPA P 5800.6).

Alcohol foam
(NFPA 325M, Fire Hazard Properties of Flammable Liquids, Gases, and Volatile Solids, 1991).

FIREFIGHTING:
Move container from fire area if you can do it without risk. Apply cooling water to sides of containers that are exposed to flames until well after fire is out. Stay away from ends of tanks (1993 Emergency Response Guidebook, RSPA P 5800.6, Guide Page 60).

Extinguish only if flow can be stopped; use flooding amounts of water as fog, solid streams may not be effective. Cool containers with flooding amounts of water, apply from as far a distance as possible. Avoid breathing corrosive vapors, keep upwind.

FLASH POINT: 186 F (86 C) (CC)
LOWER FLAMMABLE LIMIT: 3.0%
UPPER FLAMMABLE LIMIT: 23.5% @ 140 C
AUTOIGNITION: 1436 F (780 C)
FLAMMABILITY CLASS(OSHA): IIIA

HAZARDOUS COMBUSTION PRODUCTS:
Thermal decomposition products may include toxic oxides of carbon and nitrogen.

## SECTION 6 ACCIDENTAL RELEASE MEASURES

OCCUPATIONAL SPILL:
Do not touch spilled material. Stop leak if you can do it without risk. For small spills, take up with sand or other absorbent material and place into containers for later disposal. For small dry spills, with clean shovel place material into clean, dry container and cover. Move containers from spill area. For larger spills, dike far ahead of spill for later disposal. Keep unnecessary people away. Isolate hazard area and deny entry.

## SECTION 7 HANDLING AND STORAGE

Observe all federal, state and local regulations when storing this substance.

Protect against physical damage. Store in well-ventilated area free of sources of ignition. Separate from oxidizing materials (NFPA 49, hazardous chemicals data).

Store away from incompatible substances.

## SECTION 8 EXPOSURE CONTROLS, PERSONAL PROTECTION

EXPOSURE LIMITS:
ETHANOLAMINE:
3 ppm (8 mg/m3) OSHA TWA; 6 ppm (15 mg/m3) OSHA STEL
3 ppm (8 mg/m3) ACGIH TWA; 6 ppm (15 mg/m3) ACGIH STEL
3 ppm (8 mg/m3) NIOSH recommended TWA;
6 ppm (15 mg/m3) NIOSH recommended STEL
3 ppm (8 mg/m3) DFG MAK TWA;
15 ppm (40 mg/m3) DFG MAK 30 minute peak, average value, 2 times/shift

Measurement method: Silica gel tube; methanol/water; gas chromatography with flame ionization detection; (NIOSH Vol. III # 2007, Aminoethanol Compounds).

**OSHA revoked the final rule limits of January 19, 1989 in response to the 11th Circuit Court of Appeals decision (AFL-CIO v. OSHA) effective June 30, 1993. See 29 CFR 1910.1000 (58 FR 35338)**

VENTILATION:
Provide local exhaust or process enclosure ventilation to meet the published exposure limits. Ventilation equipment should be explosion-proof if explosive concentrations of dust, vapor or fume are present.

EYE PROTECTION:
Employee must wear splash-proof or dust-resistant safety goggles and a faceshield to prevent contact with this substance.

Emergency wash facilities:
Where there is any possibility that an employee's eyes and/or skin may be exposed to this substance, the employer should provide an eye wash fountain and quick drench shower within the immediate work area for emergency use.

CLOTHING:
Employee must wear appropriate protective (impervious) clothing and equipment

to prevent any possibility of skin contact with this substance.

GLOVES:
Employee must wear appropriate protective gloves to prevent contact with this substance.

RESPIRATOR:
The following respirators and maximum use concentrations are recommendations by the U.S. Department of Health and Human Services, NIOSH Pocket Guide to Chemical Hazards; NIOSH criteria documents or by the U.S. Department of Labor, 29 CFR 1910 Subpart Z.
The specific respirator selected must be based on contamination levels found in the work place, must not exceed the working limits of the respirator and be jointly approved by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration (NIOSH-MSHA).

ETHANOLAMINE:

30 ppm- Any supplied-air respirator.
Any self-contained breathing apparatus.
Any chemical cartridge respirator with cartridge(s) providing protection against ethanolamine.

75 ppm- Any supplied-air respirator operated in a continuous flow mode.
Any powered, air-purifying respirator with cartridge(s) providing protection against ethanolamine.

150 ppm- Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against ethanolamine.
Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against ethanolamine.
Any self-contained breathing apparatus with a full facepiece.
Any supplied-air respirator with a full facepiece.

1000 ppm- Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Escape- Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against ethanolamine.
Any appropriate escape-type, self-contained breathing apparatus.

FOR FIREFIGHTING AND OTHER IMMEDIATELY DANGEROUS TO LIFE OR HEALTH CONDITIONS:

Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

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## SECTION 9 PHYSICAL AND CHEMICAL PROPERTIES

DESCRIPTION: Colorless, viscous, hygroscopic liquid with an ammonia-like odor.
MOLECULAR WEIGHT: 61.08
MOLECULAR FORMULA: H2-N-C-H2-C-H2-O-H
BOILING POINT: 338 F (170 C)
FREEZING POINT: 51 F (10 C)
VAPOR PRESSURE: 0.48 mmHg @ 20 C
VAPOR DENSITY: 2.1
SPECIFIC GRAVITY: 1.0180
WATER SOLUBILITY: complete
VOLATILITY: 0%
PH: 11.5 @ 1% solution
ODOR THRESHOLD: 3 ppm
EVAPORATION RATE: (butyl acetate=1) >1
SOLVENT SOLUBILITY: Soluble in alcohol, chloroform, acetone and methanol; slightly soluble in benzene, ether; almost insoluble in carbon tetrachloride, n-heptane.

VISCOSITY: 19 cP @ 20 C

## SECTION 10 STABILITY AND REACTIVITY

REACTIVITY:
Stable under normal temperatures and pressures.

CONDITIONS TO AVOID:
May burn but does not ignite readily. Flammable, poisonous gases may accumulate in tanks and hopper cars. May ignite combustibles (wood, paper, oil, etc.).

INCOMPATIBILITIES:
ETHANOLAMINE:
ACETIC ACID: Temperature and pressure increase in closed container.
ACETIC ANHYDRIDE: Temperature and pressure increase in closed container.
ACIDS: Temperature and pressure increase in closed container.
ACROLEIN: Temperature and pressure increase in closed container.
ACRYLIC ACID: Temperature and pressure increase in closed container.
ACRYLONITRILE: Temperature and pressure increase in closed container.
ALUMINUM: Corrodes above 100 C.
CELLULOSE NITRATE: Ignites on contact.
CHLOROSULFONIC ACID: Temperature and pressure increase in closed container.
COPPER, COPPER COMPOUNDS, COPPER ALLOYS: Corrodes.
N,N'-DIMETHYL-N,N'DINITROSOTEREPTHALAMIDE: Ignition.
EPICHLOROHYDRIN: Temperature and pressure increase in closed container.
HYDROCHLORIC ACID: Temperature and pressure increase in closed container.
HYDROFLUORIC ACID: Temperature and pressure increase in closed container.
IRON (GALVANIZED): Corrodes.
MESITYL OXIDE: Temperature and pressure increase in closed container.
NITRIC ACID: Temperature and pressure increase in closed container.
OLEUM: Temperature and pressure increase in closed container.
OXIDIZERS: Fire and explosion hazard.
PLASTICS: Corrodes.

BETA-PROPIOLACTONE: Temperature and pressure increase in closed container.
RUBBER: Corrodes.
SULFURIC ACID: Temperature and pressure increase in closed container.
VINYL ACETATE: Temperature and pressure increase in closed container.
See also amines.

AMINES:
ACROLEIN: Exothermic polymerization.
CALCIUM HYPOCHLORITE: Formation of explosive chloroamine.
MALEIC ANHYDRIDE: Explosive decomposition.
NITROSYL PERCHLORATE: Explosive reaction.
SODIUM HYPOCHLORITE: Formation of explosive chloroamine.
TRI-ISO-BUTYL ALUMINUM: Violent reaction.

HAZARDOUS DECOMPOSITION:
Thermal decomposition products may include toxic oxides of carbon and nitrogen.

POLYMERIZATION:
Hazardous polymerization has not been reported to occur under normal temperatures and pressures.

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## SECTION 11 TOXICOLOGICAL INFORMATION

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ETHANOLAMINE:
IRRITATION DATA: 505 mg open skin-rabbit moderate; 250 ug eye-rabbit severe.
TOXICITY DATA: >2420 mg/m3/2 hours inhalation-mouse LC; >2420 mg/m3/2 hours inhalation-cat LC; 0.58 mg/L/1 hour (580 mg/m3) inhalation-guinea pig LCLo (38MKAJ); 1000 mg/kg skin-rabbit LD50; 1720 mg/kg oral-rat LD50; 700 mg/kg oral-mouse LD50; 620 mg/kg oral-guinea pig LD50; 1000 mg/kg oral-rabbit LD50; 105 mg/kg/30 weeks intermittent oral-rat TDLo; 1500 mg/kg subcutaneous-rat LD50; 225 mg/kg intravenous-rat LD50; 67 mg/kg intraperitoneal-rat LD50; 50 mg/kg intraperitoneal-mouse LD50; 1750 mg/kg intramuscular-rat LD50; mutagenic data (RTECS); reproductive effects data (RTECS).
CARCINOGEN STATUS: None.
LOCAL EFFECTS: Corrosive- inhalation, skin, eye, ingestion.
ACUTE TOXICITY LEVEL: Toxic by dermal absorption; moderately toxic by ingestion.
TARGET EFFECTS: Poisoning may affect the central nervous system, liver, and kidneys.
AT INCREASED RISK FROM EXPOSURE: Persons with pre-existing liver, kidney, skin or respiratory disease.

HEALTH EFFECTS
INHALATION:
ETHANOLAMINE:
CORROSIVE. 1000 ppm Immediately Dangerous to Life or Health.
ACUTE EXPOSURE- May cause severe respiratory tract irritation possibly including coughing, sore throat, choking, shortness of breath, headache, pain in the nose, mouth and throat and burns of the mucous membranes. If sufficient quantities of a corrosive substance are inhaled, pulmonary edema may develop, often with a latent period of 5-72 hours. The symptoms

may include tightness in the chest, dyspnea, frothy sputum, cyanosis, and dizziness. Physical findings may include weak, rapid pulse, hypotension, hemoconcentration and moist rales. Animal exposure resulted in central nervous system stimulation and depression. Four out of six guinea pigs died after being exposed to 0.58 mg/k for 1 hour. Pathologic findings included pulmonary irritation, and degenerative liver and kidney damage.

CHRONIC EXPOSURE- Depending on the concentration and duration of exposure, repeated or prolonged exposure to corrosive substances may cause inflammatory and ulcerative changes in the mouth and possibly bronchial and gastrointestinal disturbances. Chronic exposure of animals resulted in lethargy, apathy, poor appetite, decreased alertness and changes in the lungs, liver and kidneys.

SKIN CONTACT:
ETHANOLAMINE:
CORROSIVE/TOXIC.

ACUTE EXPOSURE- The vapor may be irritating. Contact with the undiluted material may cause severe irritation with erythema and blistering. When applied to human skin for 1.5 hours redness and infiltration of the skin occurred. 1000 mg/kg was lethal to animals tested but symptoms were not reported.

CHRONIC EXPOSURE- Effects depend on concentration and duration of exposure. Repeated or prolonged contact with corrosive substances may result in dermatitis or effects similar to acute exposure.

EYE CONTACT:
ETHANOLAMINE:
CORROSIVE.

ACUTE EXPOSURE- Direct contact with corrosive substances may cause severe irritation, pain, and burns, possibly severe. The degree of injury depends on the concentration and duration of contact. The full extent of the injury may not be immediately apparent.

CHRONIC EXPOSURE- Effects depend on concentration and duration of exposure. Repeated or prolonged contact with corrosive substances may result in conjunctivitis or effects as in acute exposure.

INGESTION:
ETHANOLAMINE:
CORROSIVE.

ACUTE EXPOSURE- May cause abdominal pain, nausea, vomiting and mucosal burns of the mouth and esophagus. There may be discoloration of the tissues. Swallowing and speech may be difficult at first and then almost impossible. The effects on the esophagus and gastrointestinal tract may range from irritation to severe corrosion. Edema of the epiglottis and shock may occur.

CHRONIC EXPOSURE- Depending on the concentration, repeated ingestion of corrosive substances may result in effects as with acute ingestion. Dose dependent increases in embryotoxicity and lethality (malformation, intrauterine deaths, and intrauterine growth retardation) occurred when pregnant rats were given 500, 300, or 50 mg/kg per day of organogenesis.

## SECTION 12 ECOLOGICAL INFORMATION

ENVIRONMENTAL IMPACT RATING (0-4): no data available

ACUTE AQUATIC TOXICITY: no data available

DEGRADABILITY: no data available

LOG BIOCONCENTRATION FACTOR (BCF): no data available

LOG OCTANOL/WATER PARTITION COEFFICIENT: no data available

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## SECTION 13 DISPOSAL CONSIDERATIONS

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Observe all federal, state and local regulations when disposing of this substance.

Disposal must be in accordance with standards applicable to generators of hazardous waste, 40 CFR 262. EPA Hazardous Waste Number D002.
100 pound CERCLA Section 103 Reportable Quantity.

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## SECTION 14 TRANSPORT INFORMATION

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U.S. DEPARTMENT OF TRANSPORTATION SHIPPING NAME-ID NUMBER, 49 CFR 172.101:
Ethanolamine-UN 2491

U.S. DEPARTMENT OF TRANSPORTATION HAZARD CLASS OR DIVISION, 49 CFR 172.101:
8 - Corrosive material

U.S. DEPARTMENT OF TRANSPORTATION PACKING GROUP, 49 CFR 172.101:
PG III

U.S. DEPARTMENT OF TRANSPORTATION LABELING REQUIREMENTS, 49 CFR 172.101 AND SUBPART E:
Corrosive

U.S. DEPARTMENT OF TRANSPORTATION PACKAGING AUTHORIZATIONS:
EXCEPTIONS: 49 CFR 173.154
NON-BULK PACKAGING: 49 CFR 173.203
BULK PACKAGING: 49 CFR 173.243

U.S. DEPARTMENT OF TRANSPORTATION QUANTITY LIMITATIONS 49 CFR 172.101:
PASSENGER AIRCRAFT OR RAILCAR: 5 L
CARGO AIRCRAFT ONLY: 60 L

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## SECTION 15 REGULATORY INFORMATION

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TSCA STATUS: Y

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|---|---|
| CERCLA SECTION 103 (40CFR302.4): | N |
| SARA SECTION 302 (40CFR355.30): | N |
| SARA SECTION 304 (40CFR355.40): | N |
| SARA SECTION 313 (40CFR372.65): | N |

OSHA PROCESS SAFETY (29CFR1910.119): N
CALIFORNIA PROPOSITION 65: N

SARA HAZARD CATEGORIES, SARA SECTIONS 311/312 (40 CFR 370.21)
ACUTE HAZARD: Y
CHRONIC HAZARD: N
FIRE HAZARD: Y
REACTIVITY HAZARD: N
SUDDEN RELEASE HAZARD: N

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SECTION 16 OTHER INFORMATION

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