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

March 21, 1991

Docket No. 50-423
B13781
Re: 10CFR50.54

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

Reference: Permit, NPDES No. CT0003263, Modified, dated September 19, 1986.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 3
Requested Modification to NPDES Permit
Environmental Protection Plan

Pursuant to Section 402(b) of the Federal Water Pollution Control Act, as amended, 33 USC 1251, et seq., and Section 22a-430 of Connecticut General Statutes, Northeast Utilities Service Company (NUSCO), on behalf of Northeast Nuclear Energy Company (NNECO), has requested that the Connecticut Department of Environmental Protection (DEP) issue a modification to NPDES Permit No. CT0003263 (reference).

The requested modification to the permit is concerned with the discharge of biocides and sodium nitrite from Millstone Unit Nos. 1 and 2. Since the requested modification was due to Millstone Unit Nos. 1 and 2, a copy of the request was not submitted as required by Section 3.2 of the Millstone Unit No. 3 Environmental Protection Plan. However, NNECO hereby submits a copy of the request to modify NPDES Permit CT0003263 (reference) to bring your files up to date.

Should you have any questions, please call Mr. Thomas P. Arcari, Generation Facilities Licensing, at (203) 665-3713.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

E. J. Mroczka
Senior Vice President

Enclosure: Letter of Request (D03754) dated June 1, 1990.
cc: T. T. Martin, Region I Administrator
D. H. Jaffe, NRC Project Manager, Millstone Unit Nos. 1 and 3
W. J. Raymond, Senior Resident Inspector, Millstone Unit Nos. 1, 2, and 3

A001

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HARTFORD, CONNECTICUT 06141-0270
(203) 665-5000

June 1, 1990

D03754

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

Reference: (D03156), R. Reckert to A. Freund, dated December 1, 1989.

Dear Mr. Freund:

Millstone Nuclear Power Station
NPDES Permit Renewal Application
Additional Requests

On December 1, 1989, Reference, Northeast Utilities Service Company (NUSCO), on behalf of Northeast Nuclear Energy Company (NNECO), submitted an application for renewal of the NPDES Permit for NNECO's Millstone Nuclear Power Station. Since that application, it has become necessary to request the following additional discharge parameters.

- Enclosure I is a report and safety material requesting the use of alternate biocides in the service water systems.
- Enclosure II is a report and safety material requesting the use of "Proxel EXL" in Discharge Serial Nos. 001A-4 and 001A.
- Enclosure III is a material safety data sheet for Sodium Nitrite. NUSCO hereby requests that sodium nitrite replace chromium in discharge 001A.

Should you have any questions, please call Mr. Thomas T. Arcari, NUSCO Generation Facilities Licensing, at (203) 665-3713.

Very truly yours,

NORTHEAST UTILITIES SERVICE COMPANY
As Agent for Northeast Nuclear Energy Company

R. A. Reckert
Vice President

OS3422 REV. 4-88

Enclosure: 3

cc: Robert Kaliszewski
Department of Environmental Protection
122 Washington Street
Hartford, CT 06106

ENCLOSURE I

(Letter D03754)

ENCLOSURE I

Use of Alternate Biocides
In Service Water Systems

Biofouling is a continuing item of concern at Northeast Utilities system generating stations. Especially troublesome is the problem of macrofouling, or invertebrate growth that causes blockage or flow reduction in condensers, heat exchangers, or safety-related water systems. Historically, biofouling problems have been most severe at marine or brackish-water installations, where Mytilus edulis (Blue Mussel) is the primary fouling organism.

At Millstone Nuclear Power Station, each of the three operating units has developed procedures to control mussel settlement and growth in both circulating and service water systems. Although differing slightly in detail, procedures for each unit are similar. Mussels in the circulating water systems are controlled by periodic thermal backwash, or "mussel cooking"; heated water is recirculated in individual intake bays, with a temperature/duration/frequency regime designed to kill mussels when they are small enough to pass through the system without causing difficulties.

The service water systems cannot be thermally backwashed; there are technical constraints that prohibit elevation of service water temperatures to levels that would kill mussels. Therefore, the Millstone units have relied on continuous low-level chlorination (applied in the form of sodium hypochlorite), to prevent mussel larvae, entrained in the service water, from settling in system piping and components.

The continuous chlorination is adequate to prevent mussel settlement, but will not remove an established population. For example, if the chlorination system is inoperable for a period of time that allows mussel settlement in service water piping, resumption of chlorination will not effect cleanliness of the fouled system. Cleaning of fouled service water systems at Millstone is accomplished primarily by waiting for attrition and mortality of mussels in the service water piping, then manually removing detached shells from the heat exchanger waterboxes. Obviously, this is an inefficient, time-consuming, labor-intensive procedure; Millstone has emphasized prevention of biofouling, rather than remediation, i.e., proactive vs. retroactive measures.

However, Millstone personnel are also investigating the possibility of using one of a number of nonoxidizing biocides, recently marketed by industrial chemical suppliers as molluscides. The most likely candidates at present are:

- Clam-Trol 1 (Betz Laboratories; active ingredients - n-alkyl dimethyl benzyl ammonium chloride and dodecylguanidine hydrochloride),
- H-133A (Calgon; dodecylguanidine hydrochloride),

- Bulab 6002 (Buckman Laboratories; poly[oxyethylene-(dimethylimino) ethylene-(dimethylimino)ethylene dichloride]), and

- Bulab 6009 (Buckman Laboratories; 2-(thiocyano-methylthio) benzothiozole).

Material Safety Data Sheets for each product are attached.

However, since the use of any of these products would be necessary only after existing biofouling control procedures have failed, it is impossible to know a priori where or when such usage would be required, or the requisite application dose or concentration. Ideally, NUSCO would like to receive permission to release a generic biocide from any of the circulating or service water discharges (Discharge Serial Nos. 001A, 001A-5, 001B, 001B5, 001C, 001C-5), at a quantity/concentration to be determined by vendor and NUSCO biologists. The situation would be analogous to a test application, with NUSCO committing to conduct sufficient sampling, analyses, and toxicity testing to ensure environmental protection.

BETZ LABORATORIES, INC.
4636 SOMERTON ROAD, TREVOSE, PA. 19047
BETZ MATERIAL SAFETY DATA SHEET
24 HOUR EMERGENCY TELEPHONE (HEALTH OR ACCIDENT) 215/355-3300

PRODUCT : CLAM-TROL CT-1
EFFECTIVE DATE 05-18-89
PRINTED: 3-Sep-1989
REV: SEC. 3

PRODUCT APPLICATION : WATER-BASED MICROBIAL CONTROL AGENT.

-----SECTION 1----------HAZARDOUS INGREDIENTS----------

INFORMATION ON PHYSICAL HAZARDS, HEALTH HAZARDS, PEL'S AND TLV'S FOR SPECIFIC PRODUCT INGREDIENTS AS REQUIRED BY THE OSHA HAZARD COMMUNICATIONS STANDARD IS LISTED. REFER TO SECTION 4 (PAGE 2) FOR OUR ASSESSMENT OF THE POTENTIAL ACUTE AND CHRONIC HAZARDS OF THIS FORMULATION.

ETHYLENE GLYCOL***CAS#107-21-1; LIVER, KIDNEY AND BLOOD TOXIN; CNS DEPRESSANT; ANIMAL TERATOGEN(HIGH ORAL DOSES); PEL/TLV: 50PPM-C.

ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE***CAS#68424-85-1; CORROSIVE(EYES); PEL: NONE; TLV: NONE.

ISOPROPYL ALCOHOL***(IPA); CAS#67-63-0; FLAMMABLE LIQUID; CHRONIC OVEREXPOSURE MAY CAUSE LIVER AND KIDNEY TOXICITY; PEL/TLV: 400PPM(500PPM-STEL).

DODECYLGUANIDINE HYDROCHLORIDE***(DGH); CAS#13590-97-1; CORROSIVE; PEL: NONE; TLV: NONE.

ETHYL ALCOHOL***(ETHANOL); CAS#64-17-5; FLAMMABLE; MAY CAUSE DEFATTING DERMATITIS, DIZZINESS AND HEADACHE; PEL: 1000PPM; TLV: 1000PPM.

-----SECTION 2----------TYPICAL PHYSICAL DATA----------

PH: AS IS	(APPROX.)	5.3	ODOR: MILD
FL.PT.(DEG.F): 116	SETA(CC)		SP.GR.(70F)OR DENSITY: 1.022
VAPOR PRESSURE(mmHG): 23			VAPOR DENSITY(AIR=1): >1
VISC cps70F: 23			%SOLUBILITY(WATER): 100
EVAP.RATE: <1 ETHER=1			APPEARANCE: COLORLESS
PHYSICAL STATE: LIQUID			FREEZE POINT(DEG.F): <-30

-----SECTION 3----------REACTIVITY DATA----------

STABLE. MAY REACT WITH STRONG OXIDIZERS. DO NOT CONTAMINATE. BETZ TANK CLEAN-OUT CATEGORY 'B'

THERMAL DECOMPOSITION (DESTRUCTIVE FIRES) YIELDS ELEMENTAL OXIDES.

PRODUCT: CLAM-TROL CT-1 EFFECTIVE DATE 05-18-89

-----SECTION 4--- ----- -HEALTH HAZARD EFFECTS- ----------

ACUTE SKIN EFFECTS *** PRIMARY ROUTE OF EXPOSURE
CORROSIVE TO SKIN. POTENTIAL SKIN SENSITIZER

ACUTE EYE EFFECTS ***
CORROSIVE TO THE EYES

ACUTE RESPIRATORY EFFECTS *** PRIMARY ROUTE OF EXPOSURE
VAPORS, GASES, MISTS AND/OR AEROSOLS CAUSE IRRITATION TO UPPER RESPIRATORY TRACT

CHRONIC EFFECTS OF OVEREXPOSURE***
PROLONGED OR REPEATED OVEREXPOSURES MAY CAUSE: TISSUE NECROSIS; BLOOD CELL DAMAGE OR IMPAIR BLOOD CELL FUNCTION; REPRODUCTIVE SYSTEM TOXICITY; SKIN SENSITIZATION.

MEDICAL CONDITIONS AGGRAVATED ***
NOT KNOWN

SYMPTOMS OF EXPOSURE ***
INHALATION OF VAPORS/MISTS/AEROSOLS MAY CAUSE EYE, NOSE, THROAT AND LUNG IRRITATION; SKIN CONTACT MAY CAUSE SEVERE IRRITATION OR BURNS.

PRECAUTIONARY STATEMENT BASED ON TESTING RESULTS ***
MAY BE TOXIC IF ORALLY INGESTED.

-----SECTION 5--------- --FIRST AID INSTRUCTIONS----------

SKIN CONTACT***
REMOVE CLOTHING. WASH AREA WITH LARGE AMOUNTS OF SOAP SOLUTION OR WATER FOR 15 MIN. IMMEDIATELY CONTACT PHYSICIAN

EYE CONTACT***
IMMEDIATELY FLUSH EYES WITH WATER FOR 15 MINUTES. IMMEDIATELY CONTACT A PHYSICIAN FOR ADDITIONAL TREATMENT

INHALATION EXPOSURE***
REMOVE VICTIM FROM CONTAMINATED AREA. APPLY NECESSARY FIRST AID TREATMENT. IMMEDIATELY CONTACT A PHYSICIAN.

INGESTION***
DO NOT FEED ANYTHING BY MOUTH TO AN UNCONSCIOUS OR CONVULSIVE VICTIM
DO NOT INDUCE VOMITING. IMMED. CONTACT PHYSICIAN. DILUTE CONTENTS OF STOMACH USING 3-4 GLASSES MILK OR WATER

-----SECTION 6--------- -SPILL, DISPOSAL AND FIRE INSTRUCTIONS---------

SPILL INSTRUCTIONS***
VENTILATE AREA, USE SPECIFIED PROTECTIVE EQUIPMENT. CONTAIN AND ABSORB ON ABSORBENT MATERIAL. PLACE IN WASTE DISPOSAL CONTAINER. THE CONTAMINATED ABSORBENT SHOULD BE CONSIDERED A PESTICIDE AND DISPOSED OF IN AN APPROVED PESTICIDE LANDFILL. SEE PRODUCT LABEL STORAGE AND DISPOSAL INSTRUCTIONS.
REMOVE IGNITION SOURCES. FLUSH AREA WITH WATER. SPREAD SAND/GRIT.

DISPOSAL INSTRUCTIONS***
WATER CONTAMINATED WITH THIS PRODUCT MAY BE SENT TO A SANITARY SEWER TREATMENT FACILITY, IN ACCORDANCE WITH ANY LOCAL AGREEMENT, A PERMITTED WASTE TREATMENT FACILITY OR DISCHARGED UNDER A NPDES PERMIT
PRODUCT(AS IS)-
DISPOSE OF IN APPROVED PESTICIDE FACILITY OR ACCORDING TO LABEL INSTRUCTIONS

FIRE EXTINGUISHING INSTRUCTIONS***
FIREFIGHTERS SHOULD WEAR POSITIVE PRESSURE SELF-CONTAINED BREATHING APPARATUS(FULL FACE-PIECE TYPE).
DRY CHEMICAL, CARBON DIOXIDE, FOAM OR WATER

PRODUCT: CLAM-TROL CT-1 EFFECTIVE DATE 05-18-89

----SECTION 7----------SPECIAL PROTECTIVE EQUIPMENT----------

USE PROTECTIVE EQUIPMENT IN ACCORDANCE WITH 29CFR SECTION 1910.132-134. USE RESPIRATORS WITHIN USE LIMITATIONS OR ELSE USE SUPPLIED AIR RESPIRATORS.

VENTILATION PROTECTION***

ADEQUATE VENTILATION TO MAINTAIN AIR CONTAMINANTS BELOW EXPOSURE LIMITS

RECOMMENDED RESPIRATORY PROTECTION***

IF VENTILATION IS INADEQUATE OR SIGNIFICANT PRODUCT EXPOSURE IS LIKELY, USE A RESPIRATOR WITH ORGANIC VAPOR CARTRIDGE & DUST/MIST PREFILTER

RECOMMENDED SKIN PROTECTION***

GAUNTLET-TYPE RUBBER GLOVES, CHEMICAL RESISTANT APRON

WASH OFF AFTER EACH USE. REPLACE AS NECESSARY

RECOMMENDED EYE PROTECTION***

SPLASH PROOF CHEMICAL GOGGLES. FACE SHIELD

----SECTION 8----------STORAGE AND HANDLING PRECAUTIONS----------

STORAGE INSTRUCTIONS***

KEEP DRUMS & PAILS CLOSED WHEN NOT IN USE.

STORE IN COOL VENTILATED LOCATION. STORE AWAY FROM OXIDIZERS

HANDLING INSTRUCTIONS***

GENERAL-IMMEDIATELY REMOVE CONTAMINATED CLOTHING. WASH BEFORE REUSE

SPECIFIC- COMBUSTIBLE. DO NOT USE AROUND SPARKS OR FLAMES. BOND CONTAINERS DURING FILLING OR DISCHARGE WHEN PERFORMED AT TEMPERATURES AT OR ABOVE THE PRODUCT FLASH POINT.

****

THIS MSDS COMPLIES WITH THE OSHA HAZARD COMMUNICATION STANDARD

HAROLD M. HERSH (ENVIRONMENTAL INFORMATION COORDINATOR)

****

APPENDIX: REGULATORY INFORMATION

THE CONTENT OF THIS APPENDIX REPRESENTS INFORMATION KNOWN TO BETZ ON THE EFFECTIVE DATE OF THIS MSDS. THIS INFORMATION IS BELIEVED TO BE ACCURATE. ANY CHANGES IN REGULATIONS WILL RESULT IN UPDATED VERSIONS OF THIS DOCUMENT.

...TSCA: ALL COMPONENTS OF THIS PRODUCT ARE LISTED IN THE TSCA INVENTORY

...FIFRA(40CFR): EPA REG NO. 3876- 145

...REPORTABLE QUANTITY(RQ) FOR UNDILUTED PRODUCT:

NOT APPLICABLE

...RCRA: IF THIS PRODUCT IS DISCARDED AS A WASTE, THE RCRA HAZARDOUS WASTE IDENTIFICATION NUMBER IS: D001=IGNITABLE; D002=CORROSIVE

...DOT HAZARD CLASSIFICATION: CORROSIVE TO SKIN. COMBUSTIBLE

...DOT SHIPPING DESIGNATION IS: UN1760 CORROSIVE LIQUID, N.O.S.

...THIS PRODUCT CONTAINS THESE CHEMICALS KNOWN TO THE STATE OF CALIFORNIA TO CAUSE CANCER OR REPRODUCTIVE TOXICITY: NONE PRESENT IN SIGNIFICANT AMOUNTS

...SARA SECTION 302 CHEMICALS: NONE PRESENT IN SIGNIFICANT AMOUNTS

...SARA SECTION 313 CHEMICALS: ETHYLENE GLYCOL(107-21-1) , 21.0-30.0% ;

...SARA SECTION 312 HAZARD CLASS: IMMEDIATE(ACUTE), DELAYED(CHRONIC) AND FIRE

...MICHIGAN CRITICAL MATERIALS: NONE PRESENT IN SIGNIFICANT AMOUNTS

NFPA/HMIS : HEALTH - 3 ; FIRE - 2 ; REACTIVITY - 0 ; SPECIAL - CORR ; PE - D

Betz Industrial

product facts

BETZ CLAM-TROL™ CT-1
MOLLUSCICIDE

- **Effectively controls all life stages of freshwater Asiatic clams**
- **Controls a broad spectrum of microorganisms**
- **Biodegradable—low environmental impact**

DESCRIPTION AND USE

Clam-trol CT-1* is a unique blend of active ingredients that controls mollusc infestations in industrial water systems. Asiatic clams, the most common freshwater mollusc problem, block water lines and damage equipment. The results can be higher production and maintenance costs and plant shutdowns.

A low level of Clam-trol CT-1, applied to a system for a short period, affects all life stages present, including established adult populations. See Figure 1. Thereafter, periodic applications of Clam-trol CT-1 inhibit recolonization of the system by larval and juvenile clams that are carried in with the makeup water.

Clam-trol CT-1 is registered for use against molluscs as well as bacterial, fungal, and algal slimes in:

- recirculating and once-through cooling systems
- influent systems for cooling
- auxiliary water and wastewater systems

Clam-trol CT-1 is a blend of organic biocides and contains no heavy metals or EPA priority pollutants.

TREATMENT AND FEEDING REQUIREMENTS

Adult clams should be physically removed by vacuuming or dredging before the start of a Clam-trol CT-1 program so that dead clams are not carried further into the system.

Your Betz Industrial representative will design a program for your system that controls the infestation problem while minimizing both the cost of the treatment and environmental concerns.

Higher temperatures and longer contact times reduce the amount of Clam-trol CT-1 that is required to achieve effective kills.

Normally, recirculating or closed systems should be laid up for 24–48 hr after the system is charged with an effective amount of product. Typical charge concentrations are 25–50 ppm.

Once-through systems can be effectively treated by 10–30 ppm of product applied continuously over 12–48 hr and repeated two to four times a year. Or, effective control of molluscs and microorganisms can also be achieved in once-through systems using short—0.5–1.0 hr—daily applications of 10–30 ppm.

Figure 1. Asiatic clams growing on the plant side of influent screens. Clam-trol CT-1, unlike halogen or screening methods, controls both larval and adult clams.

**The use of Clam-trol CT-1 for mollusc control is the subject of a pending U.S. patent application.*

Segmenting plant-wide applications of Clam-trol CT-1 reduces the amount of product that appears in plant effluent. Clam-trol CT-1 undergoes neutralization and detoxification by natural routes. But your Betz industrial representative can provide products that accelerate this process. An analytic test procedure is available from Betz that monitors product levels in plant outfall.

Clam-trol CT-1 is compatible with stainless steel, copper alloys, and most common plastics and rubbers. Avoid the use of mild steel, low-density polyethylene, nitrile (Buna N), polyurethane, or Viton in handling the concentrated product. A complete selection of compatible feed equipment is available directly from Betz.

GENERAL PROPERTIES

Appearance	colorless liquid
Density at 70 °F (21 °C)	8.5 lb/gal (1.02 kg/L)
Flash Point (closed cup)	≥116 °F (47 °C)
Freeze Point	< -30 °F (-34 °C)
Initial Crystallization Point	< 0 °F (-18 °C)
pH (undiluted)	5.3
(5% solution)	4.9
Brookfield Viscosity at 70 °F (21 °C)	23 cP
EPA Registration No.	3876-145

SAFETY PRECAUTIONS

A Material Safety Data Sheet containi[illegible]tailed information relative to this product is [illegible]ble upon request.

PACKAGING INFORMATION

Clam-trol CT-1 is blended as a liquid and is supplied in 55-gal (208-L), bung-type, nonreturnable lined steel drums. Approximate net weight is 460 lb (208 kg) per drum. In addition, Clam-trol CT-1 is available under BETZ Point Of Feed® and BETZ Semi-Bulk Control™ programs for contracted quantities in certain geographic areas.

1179 1/85

MATERIAL SAFETY DATA SHEET

DATE June 6, 1989

6N88-10-10-88-862

CALGON CORPORATION
SUBSIDIARY OF MERCK & CO., INC.

PRODUCT NAME H-133A MICROBIOCIDE

SECTION I

MANUFACTURER'S NAME	Calgon Corporation
EMERGENCY TELEPHONE NO.	(412) 777-8000
ADDRESS	P.O. Box 1346, Pittsburgh, Pennsylvania 15230
CHEMICAL NAME AND SYNONYMS	Microbiocide
FORMULA	Multicomponent Liquid

SECTION II - HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT (S)	CAS #	% BY WEIGHT	ORAL LD_{50}	DERMAL LD_{50}	TLV (Units) ACGIH	OSHA	OTHER
Chemical Name Ethylene Glycol Common Name	107-21-1	~ 40	8540 mg/kg	19,530 mg/kg	TWA - 50) ppm ceiling	Not Listed	N/A
Chemical Name Common Name							
Chemical Name Dodecylguanidine HCl Common Name	13590-97-1	~ 12	820 mg/kg	9.2 g/kg	Not Listed	Not Listed	N/A
Chemical Name Isopropanol Common Name	67-63-0	~ 5	5840 mg/kg	13 g/kg	TWA - 400 ppm	PEL - 400 ppm	STEL - 500 ppm
Chemical Name Common Name							

SECTION III - PHYSICAL DATA

BOILING POINT (° F)	> 212	SPECIFIC GRAVITY (H_2O=1)	1.02 - 1.05
VAPOR PRESSURE (mmHg.)	Similar to Water	PERCENT VOLATILE BY VOLUME (%)	8(
VAPOR DENSITY (AIR=1)	Similar to Water	pH	2.4 - 3.0
SOLUBILITY IN WATER	Miscible	OTHER	N/A

APPEARANCE AND ODOR Clear, water white liquid

N/A = Not applicable

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, CALGON CORPORATION MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used)	165°F (T.O.C.); This product is combustible
EXTINGUISHING MEDIA	In case of fire, use dry chemical, foam or CO2.
SPECIAL FIRE FIGHTING PROCEDURES	Exercise caution when fighting any chemical fire. A self-contained breathing apparatus and protective clothing are essential.
UNUSUAL FIRE AND EXPLOSION HAZARDS	None

SECTION V HEALTH HAZARD DATA

EFFECT OF OVEREXPOSURE

A. ACUTE

1. INGESTION — This product may be expected to be harmful or fatal if swallowed. The ethylene glycol in this formulation may cause intoxication, central nervous depression (incoordination, dizziness), respiratory failure, and liver and kidney damage.

2. INHALATION — This product would not be expected to present an inhalation hazard.

3. DERMAL EXPOSURE

a. TOXIC — This product would not be expected to be absorbed through the skin in harmful amounts.

b. IRRITATION — This product is expected to produce severe irritation upon contact with the skin. The primary skin irritation index (rabbit) is 5.08/8.

c. SENSITIZATION — No data were available to suggest that this product may produce an allergic skin reaction.

4. EYE IRRITATION

This product would be e... to produce severe eye damage (chemical burns) upon c... the product produced primary eye irritation scores rang... 63-83/110.

B. SUBCHRONIC, CHRONIC, OTHER

No information was avail... suggest that this product may produce adverse health e... following subchronic or chronic exposure.

Ingestion of as little as 1(... of ethylene glycol has been reported to be fatal in man. Ingest... of a large amount or repeated ingestion of small amounts of ethyl... glycol may produce liver and kidney damage which may result in death.

FIRST AID

A. EYE

In case of contact, immediately flush eyes with water for at least 15 minutes. Seek medical aid.

B. SKIN

In case of skin contact, immediately wash with plenty of soap and water for at least 15 minutes. Remove and wash contaminated clothing before reuse.

C. INGESTION

If swallowed, contact a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger, or if available, by administering syrup of ipecac. Do not induce vomiting or give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate gastric lavage. Measures against circulatory shock, respiratory depression and convulsions may be needed.

D. INHALATION

Not applicable

SECTION VI REACTIVITY DATA

STABILITY	STABLE	X	CONDITIONS TO AVOID	Do not contaminate water, food, or feed by storage or disposal. Keep away from heat and open flame. Keep container closed.
	UNSTABLE			

INCOMPATABILITY (Materials to Avoid): Strong oxidizers

HAZARDOUS DECOMPOSITION PRODUCTS: If involved in a fire, HCl and NH_3 may be evolved.

SECTION VII SPILL OR LEAK PROCEDURES

REPORTABLE QUANTITIES (RQ) IN LBS OF EPA HAZARDOUS SUBSTANCES IN PRODUCT

1. N/A
2. _____
3. _____

NOTIFY EPA OF PRODUCT SPILLS EQUAL TO OR EXCEEDING: N/A LBS.

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED: Spills should be absorbed in sawdust or sand and disposed of in a landfill. This pesticide is toxic to fish. Do not discharge effluent into lakes, streams, ponds, estuaries, oceans, or public waters unless this product is specifically identified in an NPDES permit. Do not discharge effluent to sewer systems without previously notifying the sewage treatment plant authority.

WASTE DISPOSAL METHOD: Pesticide wastes are acutely hazardous. Improper disposal of excess pesticide, spray mixture or rinsate is a violation of Federal law. If these wastes cannot be disposed of by use according to label instructions, contact your State Pesticide or Environmental Control Agency or the Hazardous Waste representative at your EPA Regional Office for guidance.

SECTION VIII HANDLING/STORAGE

PROTECTIVE GLOVES	EYE PROTECTION
Rubber	Chemical splash goggles or face shield

OTHER PROTECTIVE CLOTHING: Not required

RESPIRATORY PROTECTION: Not required, however if the recommended ACGIH-TLV or OSHA-PEL for Isopropanol or Ethylene Glycol are exceeded, then an approved NIOSH/MSHA respirator should be used. (See Section II)

VENTILATION	LOCAL EXHAUST	OTHER
	Not required	Use only in well-ventilated areas that will maintain air levels below limits established by local, state and federal regulations.
	MECHANICAL (General): Recommended	

STORAGE & HANDLING

DANGER!
Corrosive.
Causes eye damage and skin irritation.
May be harmful or fatal if swallowed.
Do not get in eyes, on skin or on clothing.
Wear goggles or face shield and rubber gloves when handling.

OTHER PRECAUTIONS: Container disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning or puncture and dispose of in a landfill, by incineration or if allowed by state and local authorities by burning.
If burned, stay out of smoke.

N/A = Not applicable

PREPARED BY Patricia A. Pacella IMP-0862 6/6/89

CALGON CORPORATION
SUBSIDIARY OF MERCK & CO., INC.

ATER ANAGEMENT VISION

NUCLEAR INDUSTRY PRODUCTS & SERVICES

Bulletin No. 3-25

H-133A MICROBIOCIDE

DESCRIPTION

H-133A Microbiocide is a non-oxidizing liquid, nitrogen-based organic microbiocide for use in industrial systems. H-133A prevents growth of microorganisms encountered in industrial recirculating cooling water systems.

ADVANTAGES

- Effective over a broad pH range and is compatible with most other water treatment additives for scale, deposition and corrosion control.
- Extremely effective for the control of sulfate reducing bacteria.
- H-133A is a non-oxidizing biocide which means that it is available for microbiological control rather than being consumed by inorganic reducing substances in the cooling water.
- Protects cooling tower wood against fungal attack.
- Non-corrosive to cooling tower wood and system metallurgy at use concentrations.

EPA REGISTRATION

H-133A Microbiocide is registered by the Environmental Protection Agency (EPA Registration No. 10445-3) as a biocide for use in industrial recirculating cooling water systems.

DIRECTIONS FOR USE

Badly fouled systems should be cleaned before initiating treatment. Begin treatment when system is in jeopardy of becoming affected or after cleaning systems whose efficiency is already impaired. Slug feed H-133A as received—do not mix with other chemicals. Do not overfeed.

Treatment should be applied at cooling tower sump, suction side of recirculating pump, or any other point that assures good mixing with system water. Slug feeding should be timed so that the entire dose is applied within a one hour period.

Recommended dosages allow for normal water loss due to evaporation, drift, and system blowdown and afford adequate contact time with organisms. Your Calgon Representative will provide technical assistance in determining optimum dosages in relation to specific plant conditions or problems.

Initial Dose

If system is noticeably fouled, slug feed 6.6 to 13.2 fluid ounces of H-133A per 1000 gallons of water in the system (50 to 100 mg/L). Repeat until control is achieved.

Subsequent Dose

After bacterial control is achieved, feed 3.3 to 6.6 fluid ounces of H-133A per 1000 gallons of water in the system (25 to 50 mg/L). Apply treatment two to three times per week, or as needed to maintain control.

CONTROL TESTING

The best indication of the successful application of H-133A is visual inspection of tower surfaces or monitoring changes in heat transfer or metal surfaces of process equipment.

ENV

TYPICAL PROPERTIES

Active Ingredient	12.25% Dodecylguanidine hydrochloride
Appearance	Pale yellow to water white liquid, slightly turbid
pH as supplied	3.0
Specific Gravity @ 77 °F	1.04
Density, pounds per gallon	8.7
Flash Point, °F (TCC)	115
Cloud Point, °F	37

PACKAGING

H-133A is available in 5-gallon pails (40 lbs. net), 55-gallon plastic drums (460 lbs. net), 275-gallon disposable pla[illegible] bins (2275 lbs. net), or delivered to on-site storage facilities via bulk or Calgon Bulk Liquid Service-Plus.℠

SHIPPING

DOT Hazard Class	Combustible Liquid
DOT Proper Shipping Name	Combustible Liquid
NA Number	1993

STORAGE AND HANDLING

H-133A is stable at room temperature. Some haziness may occur in subfreezing weather, but placement in a heated storage area will return it to its original condition with biocidal properties unimpaired. Do not store near heat or open flame. Keep container closed when not in use. Best if used within six (6) months from the time of receipt.

MATERIALS COMPATIBILITY

Recommended materials for:

Bulk Storage Tanks

High density or cross-linked polyethylene, No. 304 stainless steel.

Pump "Liquid Ends" and Piping

Polypropylene, PVC, Kynar, CPVC.

PRECAUTIONARY STATEMENTS

Hazards to Humans and Domestic Animals.

DANGER

CORROSIVE, CAUSES EYE DAMAGE AND SKIN IRRITATION.

MAY BE HARMFUL OR FATAL IF SWALLOWED OR ABSORBED THROUGH THE SKIN.

Do not get in eyes, on skin, or on clothing. Wear goggles or face shield and rubber gloves whe[illegible] handlin[illegible].

STATEMENT OF PRACTICAL TREATMENT

EYE: In case of contact, immediately flush eyes with water for at least 15 minutes. Seek medical aid.

INTERNAL: If swallowed, call a physician or Poison Control Center. Drink 1 or 2 glasses of water and induce vomiting by touching back of throat with finger, or if available, by administering syrup of ipecac. Do not induce vomiting or give anything by mouth to an unconscious person.

NOTE TO PHYSICIAN: Probable mucosal damage may contraindicate the use of gastric lavage. Measures against circulatory shock, respiratory depression, and convulsion may be needed.

ENVIRONMENTAL HAZARDS

This product is toxic to fish. Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or public waters unless this product is specifically addressed in an NPDES permit. Do not discharge effluent containing this product to sewer systems without previously notifying the sewage treatment plant authority. For guidance, contact your State Water Board or Regional Office of the Environmental Protection Agency.

NOTICE: Seller expressly warrants that the product conforms to its chemical description. There are no warranties associated with the sale of this product either expressed or implied, including but not limited to the warranties of fitness for a particular purpose or merchantability.

Information concerning human and environmental exposure may be reviewed on the Material Safety Data Sheet and label for this product.

For additional information regarding incidents involving human and environmental exposure, call (412) 777-8000 and ask for the Health and Environmental Affairs Department.

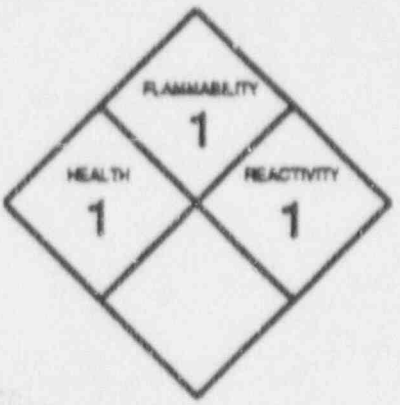
BUCKMAN LABORATORIES, INC.

MATERIAL SAFETY DATA SHEET

BULAB 6002

Buckman Laboratories, Inc.
1256 North McLean Boulevard
Memphis, TN 38108

Phone: (901) 278-0330
24 Hour Emergency: (901) 767-2722



Latest Revision: 4/19/89
Replaces: 2/6/89

SECTION 1 OSHA HAZARD CLASSIFICATIONS

Eye Irritant

SECTION 2 HAZARDOUS COMPONENTS

Chemcial Name	CAS Registry Number	% by Weight	TLV
Poly[oxyethylene-(dimethyliminio)ethylene-(dimethyliminio)ethylene dichloride]	31075-24-8	60.0%	Not applicable

SECTION 3 PRECAUTIONARY LABEL INFORMATION

HAZARDS TO HUMANS AND DOMESTIC ANIMALS

CAUTION: Harmful if swallowed. Avoid breathing vapors. Avoid contact with skin, eyes, or clothing.

FIRST AID: If swallowed, drink promptly a large quantity of milk, egg whites, gelatin solution, or, if these are not available, drink large quantities of water. Avoid alcohol. Call a physician immediately.

ENVIRONMENTAL HAZARDS: This pesticide is toxic to fish. Do not discharge into lakes, streams, ponds, or public waters unless in accordance with an NPDES permit. For guidance, contact the regional office of the Environmental Protection Agency.

SECTION 4 FIRST AID INFORMATION

Eyes: Flush immediately with copious amount of tap water or normal saline (minimum of 15 minutes). Take exposed individual to a health care professional, preferably an optharnologist, for further evaluation.

Skin: Wash exposed area with plenty of soap and water. Repeat washing. Remove contaminated clothing and wash thoroughly before reuse. If irritation persists consult a health care professional.

Inhalation: Move the exposed individual to fresh air. If individual is cyanotic or has difficulty breathing, administer oxygen, if available. Treat symptoms.

Ingestion: DO NOT INDUCE VOMITING. Rinse mouth with copious amounts of water or milk, first. Irrigate the esophagus and dilute stomach contents by slowly giving one (1) to two (2) glasses of water or milk. Avoid giving alcohol or alcohol related products. In cases where the individual is semi-comatose, comatose or convulsing, DO NOT GIVE FLUIDS BY MOUTH. In case of intentional ingestion of the product seek medical assistance immediately; take individual to nearest medical facility.

NOTE TO PHYSICIAN: No specific antidote is known. Treat Symptoms. Medical Consultation is available 24 hours a day. Call the Buckman Center for Product Information at (901) 767-2722.

SECTION 5 PRIMARY ROUTES OF EXPOSURE

Primary Route(s) of Exposure: Eye, Skin, Inhalation, Ingestion

1. Effects from Acute Exposure -

Eye Contact: Possible eye irritant. Minimal ocular irritation is expected. Irritation will depend on length of exposure, solution concentration and first aid measures.

Skin Contact: Non-irritating to the skin

Ingestion: No data is available on human ingestion. Based on information from animal studies, no adverse effects are expected. Inhalation: May cause irritation of mucous membranes and the lungs. Exposed individuals should be monitored for respiratory distress, bronchitis or pneumonia.

2. Effects from Chronic Exposure -

The effects from chronic exposure to Bulab 6002 have not been fully evaluated. Bulab 6002 has tested negative in both animal and human sensitization tests. In vitro mutagenicity tests on Bulab 6002 have been negative. Birth defects are unlikely, animal tests were negative.

SECTION 6 TOXICOLOGICAL INFORMATION

The following toxicity studies have been conducted on Bulab 6002.

Acute Oral LD50 (Rats): male: 3690 mg/kg, female: 1850 mg/kg
Acute Dermal LD50 (Rabbits): Greater than 2000 mg/kg
Eye Irritation (Rabbits): Mild transient irritation.
Acute Inhalation (Rats): No deaths after a 1 hour exposure at 26.4 mg/L.
Skin Sensitization (Guinea Pigs): No evidence of sensitization. (Human): 2% aqueous solution produced no sensitization.
Mutagenicity: Unscheduled DNA Synthesis: Negative at doses up to 1500 mg/kg.

In Vivo Mouse Micronucleus Assay: Negative.
Drosophila Sex-Linked Recessive Lethal Assay: Negative.

90 Day Feeding Study (Rats): No Observable Effect Level of 3,000 ppm in diet. At doses greater than 10,000 ppm mineralization of the kidney tubules was observed.

90 Day Dermal Toxicity Study (Rabbits): No Observable Effect Level for systemic effects is greater than 1,000 mg/kg. No Observable Effect Level for dermal irritation is 10 mg/kg.

Teratology (Rats): Not teratogenic

Two-Generation Reproduction (Rats): No Observable Effect Level for reproductive effects is 6,000 ppm.

Metabolism (Rats): Oral doses of 10 mg/kg for 14 days exhibited no tissue accumulation with most of the radiolabelled compound excreted in the feces. A single dose of 1000 mg/kg resulted in most of the dose excreted by 7 days. Approximately 2% remained in the body, the liver having the greatest amount.

Dermal Absorption (Rats): No absorption through the skin at doses of 2 or 20 mg. Less than 0.2% absorbed at a dose of 200 mg.

SECTION 7 ENVIRONMENTAL TOXICOLOGICAL INFORMATION

1) Toxicity to Fresh Water Organisms:

96 Hr LC50 in Fish: Rainbow Trout - 0.43 ppm in distilled water
Bluegill Sunfish - 0.45 ppm in distilled water - 6.7 ppm in natural river water

48 Hr. EC50 in Invertebrates: Daphnia - 0.162 ppm

Chronic Toxicity / Reproduction Study: Daphnia magna - 16 Day EC50 is greater than 1.0 mg/L. 16 Day LC50 = 1.3 mg/L.
The No Observed Effect Concentration is 1.0 mg/L for mortality and reproduction.

2) Toxicity to Marine Organisms:

96 Hr LC50 in Sheepshead Minnows: greater than 600 ppm
Mysid Shrimp: 13 ppm

48 Hr EC50 in Quahog Clam: 0.23 ppm

3) Toxicity to Birds:

Acute Oral LD50 in Bob White Quail: 1.0 ml/kg

Dietary LC50 in Bob White Quail: greater than 20,000 ppm
Mallard Ducks: greater than 5,620 ppm

SECTION 8 PHYSICAL AND CHEMICAL PROPERTIES

Appearance:	Clear, pale yellow liquid
Odor:	Mild
Density:	1.13 - 1.16 g/ml at 25° C
Flash Point:	None
Freezing Point:	Less than 0° C
Boiling Point:	Above 212° F
Solubility:	Completely miscible in water, insoluble in most organic solvents
pH, neat:	6.0 - 8.0 at 25° C
pH, 100 ppm aqueous:	6 - 7
Vapor Pressure:	N/A
Octanol/water Partition Coefficient:	N/A
Oxidizing or Reducing Properties:	N/A

SECTION 9 FIRE AND EXPLOSION INFORMATION

Extinguishing Media: Dry chemical, water foam or carbon dioxide. Water should be used to cool surrounding containers.

SECTION 10 REACTIVITY INFORMATION

Stability:	Stable
Incompatibility:	None known
Hazardous Decomposition Products:	None known

SECTION 11 HANDLING PRECAUTIONS

Rubber gloves and safety glasses or goggles are recommended.

SECTION 12 MATERIALS OF CONSTRUCTION INFORMATION

Tested Satisfactory Materials:

Teflon	Polyethylene - low density
Polypropylene	PVC - rigid
PVC - flexible	Tygon
Plexiglas	Tygil 880
Neoprene	Gum rubber
Buna-N rubber	Silicone rubber
Viton	Hypalon
EPDM rubber	Aluminum 5052 H34
Fiberglass	

NOTE: The materials listed above have been tested with Bulab 6002. With respect to all other materials not listed above, user should be aware that use of such materials with Bulab 6002 may be hazardous and result in damages to such materials and other property and personal injuries. No data concerning such materials not listed above should be implied by the user.

SECTION 13 SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL AND LEAK RESPONSE GUIDELINES

Important: When responding to a spill or leak of this product, follow recommendations contained in the Handling Precautions section (Section 11) of this MSDS.

Emergency Response Assistance: Emergency technical assistance is available at any time from Buckman Laboratories, Inc., by calling (901) 767-2722.

Initially minimize area effected by the spill or leak. Block any potential routes to water systems (e.g., sewers, streams, lakes, etc.). Based on the products toxicological and chemical properties, and on the size and location of the spill or leak, assess the impact on contaminated environments (e.g., water systems, ground, air, equipment, etc.). Minimize adverse effects on these environments. Determine if federal, state, and/or local release notification is required (see Regulatory Information Section, Section 15). Recover as much of the pure product as possible. Later, determine if this recovered product can be used for its intended purpose. Address clean-up of contaminated environments. Spill or leak residuals may have to be collected and disposed of or flushed to sewer depending on amount of residual and type of sewer system.

DISPOSAL GUIDELINES

Note: Follow federal, state, and local regulations governing the disposal of waste materials.

Neat Product: Contact your Buckman representative or Buckman Laboratories, Inc.,at (901) 278-0330.

Spill or Leak Residuals, Contaminated Materials: Determine if waste containing this product can be handled by available effluent system or other on-site waste management unit (e.g., incinerator, deep well, etc.). If off-site management is required, contact a company experienced in industrial waste management.

Containers: Empty containers of this product are not hazardous wastes. However,insure proper management of any residual left in containers.

SECTION 14 TRANSPORTATION AND SHIPPING INFORMATION

DOT Hazard Class: Nonhazardous

This product may have more than one proper shipping name, depending on packaging, product properties, and mode of shipment. All products shipped from Buckman locations have been properly packaged and labeled according to appropriate hazardous shipping regulations that apply for that particular shipment. If any alteration of packaging, product, or mode of transportation is further intended, different shipping names and labeling may apply. If there are any questions pertaining to hazardous shipping requirements, contact the Buckman transportation department for further details.

SECTION 15 REGULATORY INFORMATION

The following Regulations are known to apply to the use and disposal of this pro[illegible]itional Federal, State and Local regulations may also be applicable.

CERCLA (Comprehensive Environmental Response, Compensation and Liability [illegible]): This product does not contain greater than 0.1% of any 40 CFR 302.4 listed hazardous substance(s).

SARA (Superfund Amendments and Reauthorization Act): This product contains the following toxic chemicals as defined by various regulations under SARA.

SARA Section 302 - Extremely Hazardous Substances List - 40 CFR 300 - No components of this product are listed on the Extremely Hazardous Substances List.

SARA Section 312 - Hazard Category - 40 CFR 327 - Immediate (Acute) Health Hazard

SARA Section 313 - Toxic Chemicals List - 40 CFR 372.45 - This product does not contain greater than 0.1% of any compound listed on the Toxic Chemicals List.

RCRA (Resource Conservation and Recovery Act): This product is not specified as a hazardous waste under 40 CFR 261. However, prior to disposal of the neat product, consideration should be given to disposal information provided on the Bulab 6002 EPA approved label.

CWA (Clean Water Act): This product does not contain components contained in 40 CFR 401.15 at greater than 0.1%.

OSHA Hazard Communication Standard (29 CFR 1910.1200): Based on the Hazard Communication Standard, the following chemicals occur in this product at greater than 1%, are not proprietary and are hazardous. Below are these chemicals and their associated hazards:

Poly[oxyethylene(dimethyliminio)ethylene-(dimethyliminio)ethylene dichloride]	Eye Irritant

ACIGH (American Conference of Governmental Industrial Hygienists): TLV (Threshold Limit Value): This Agency has not established a TLV/TWA/STEL for the hazardous component of Bulab 6002.

FDA (Food and Drug Administration): Not Applicable

TSCA (Toxic Substances Control Act): Bulab 6002 is a registered pesticide. It is not regulated under this Act.

FIFRA (Federal Insecticide, Fungicide and Rodenticide Act): Bulab 6002 is a register pesticide. EPA Registration Number: 1448-42.

HMIS/NPCA Ratings:	Health 1; Flammability 1; Reactivity 1.
NFPA Ratings:	Health 1; Flammability 1; Reactivity 1.

STATE REGULATIONS

California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65): Warning: this product contains a chemical known to the State of California to cause Cancer in laboratory animals.

Massachusetts Hazardous Substances List: Any listed components are shown in Section 2 of this MSDS.

Various State Right to Know Acts: Non-proprietary hazardous chemicals are listed in Section 1 of this MSDS. Should you require further information on specific proprietary chemicals or inerts please contact Buckman Laboratories Regulatory Affairs Department.

The information on this Material Safety Data Sheet reflects the latest information and data that we have on hazards, properties, and handling of this product under the recommended conditions of use. Any use of this product or method of application which is not described in the Product Data Sheet is the responsibility of the user. This Material Safety Data Sheet was prepared to comply with the OSHA Hazard Communication regulations.

BULAB® 6002

W1U

- **Control of algae and bacteria in cooling and process water systems**
- **Control of microbiological slime in industrial air wash systems**
- **Control of Asian Clams *(Corbicula fluminea)* in cooling and process waters**
- **Non-foaming, very low odor**
- **Effective over a wide pH range**
- **Compatible with all Bulab corrosion inhibitors and dispersants**

Application

Bulab 6002 is a polymeric quaternary ammonium compound designed to control bio-fouling in commercial and industrial water systems. It is suggested for use in cooling tower and air wash systems.

Dosage and Feeding

Microbiological Control

Heavy infestation of biological growth, microbiological slime, and other deposits should be mechanically removed before application of Bulab 6002. The specific dosage will vary depending upon system conditions, water chemistry, and severity of fouling. When the system is noticeably fouled, add 0.9-2.2 fl oz per 1000 gal (8-20 ppm) of water in the system. Repeat until control is achieved. When microbial control is evident, add 0.2-2.2 fl oz (2-20 ppm) per 1000 gal of water in the system as needed to maintain control. Your Buckman representative will recommend the most effective dosage for optimum results. To achieve uniform distribution, Bulab 6002 should be fed as received at a point of maximum agitation.

Control of Corbicula fluminea

Corbicula flumines, more commonly known as the Asian clam, is now part of the fauna of most rivers and streams in all but the northern states of the U.S.A. Its rapid growth rate has resulted in its being a major cause of fouling of water lines and heat exchanger tubes at electrical power stations and industrial plants.

Bulab 6002 has effectively prevented fouling by *Corbicula fluminea* when used at concentrations as low as 2 ppm. It is effective with or without the use of chlorine. The exact amount of Bulab 6002 required and the optimum point of addition will vary. Your Buckman representative will survey the system and advise the best parameters of use.

Product Data

Appearance:	Clear, pale yellow liquid
Odor:	Mild
pH (100 ppm):	6-7
Flash point:	None below 212 °F
Freezing point:	Less than 0 °C
Density at 25 °C:	1.13-1.16 g/mL
Approximate volume per kilogram:	870 mL
Approximate volume per pound:	395 mL

Storage and Handling

Bulab 6002 is moderately toxic by ingestion in single doses, but 24-hour patch tests with the concentrated material on both male and female human subjects showed no sign of skin irritation or sensitization. As a general precaution, workers handling the product should avoid contamination of food and observe other precautions shown on the label.

Bulab 6002 is a liquid packed in nonreturnable drums. It can be stored and handled in stainless steel, aluminum, and most plastic materials.

Printed in U.S.A. (9/89)

Buckman Laboratories in Argentina, Australia, Austria, Belgium, Brazil, Canada, Japan, Mexico, Monaco, South Africa, Spain, United Kingdom, U.S.A., and West Germany

MATERIAL SAFETY DATA SHEET

Buckman Laboratories, Inc.
1256 North McLean Boulevard
Memphis, TN 38108
(901) 278-0330

Product Name: Bulab 6009 Date: 5/16/88

Hazard(s) as defined by OSHA Hazard Communication Standard:
Highly toxic by inhalation of mist.
Corrosive to eyes and skin. Sensitizer.
Toxic by ingestion. Combustible.

COMPONENTS

Chemical Name	% by wt	TLV
2-(Thiocyanomethylthio)benzothiazole	30.0	N/A
CAS Registry Number: 21564-17-0		
Aromatic hydrocarbon solvent		100 ppm

PHYSICAL DATA

Appearance: Dark brown liquid
Odor: Slight
Boiling point: Unknown
Solubility: Dispersible in water

Density (g/mL, 25°C): 1.08
pH (neat): N/A
pH (100 ppm in water): 6 - 7

FIRE AND EXPLOSION DATA

Flash point: 123 °F (Tag Closed Cup) Flammable limits: N/A
Extinguishing Media: Water fog, carbon dioxide, foam, dry chemical
Special Firefighting Procedures: None

REACTIVITY DATA

Stability: Stable Incompatibility: None
Hazardous Decomposition Products: Unknown

HEALTH HAZARD DATA

Acute Effects: Acute Dermal LD50: Greater than 2 g/kg.
Irritant Effects: Corrosive to eyes and skin.
Sensitization Effects: Sensitizer.
Carcinogenic Potential: Not listed in any of OSHA Standard, Section 1910.1200 sources as carcinogenic; not tested by Buckman Laboratories, Inc.

Other Health Effects: Inhalation Toxicity was conducted with an 80% technical grade of TCMTB under misting conditions. Normal use of this product under non-misting conditions should not present occupational hazards.

HANDLING PRECAUTIONS

Rubber gloves and safety glasses or goggles are required. Body-protective clothing is strongly recommended. Eye-wash fountains in the work place are recommended. Respiratory protection required for work areas where misting may occur.

EMERGENCY AND FIRST AID INSTRUCTIONS

Eye exposure: Flush with clean, cool water for 15 minutes. See a physician.
Skin exposure: Wash with soap and water. See a physician if irritation occurs. Remove and wash contaminated clothing.
Inhalation: Remove to fresh air.

SPILL, LEAK, AND DISPOSAL PROCEDURES

Large spills: Dam area to prevent spill from entering fish-bearing waters. Pump into appropriate containers. Dispose of as below.
Small spills: Flush liquid to sewer with copious amounts of water.
Product disposal: Product is hazardous waste, EPA Hazard Code (I), EPA Hazardous Waste Number D001 due to flashpoint.
Container disposal: Offer for recycling or triple rinse and dispose of in an approved landfill.

REGULATORY CLASSIFICATIONS

DOT Shipping: Corrosive, Shipping name: Corrosive liquid, N.O.S.
EPA Registration: EPA Reg. No. 1448-55.
TSCA Inventory: Not applicable.
FDA Regulation(s): 21 CFR 176.300.
Calif. Proposition 65: Warning: This product contains aromatic hydrocarbon solvent a chemical known to the state of California to cause cancer.

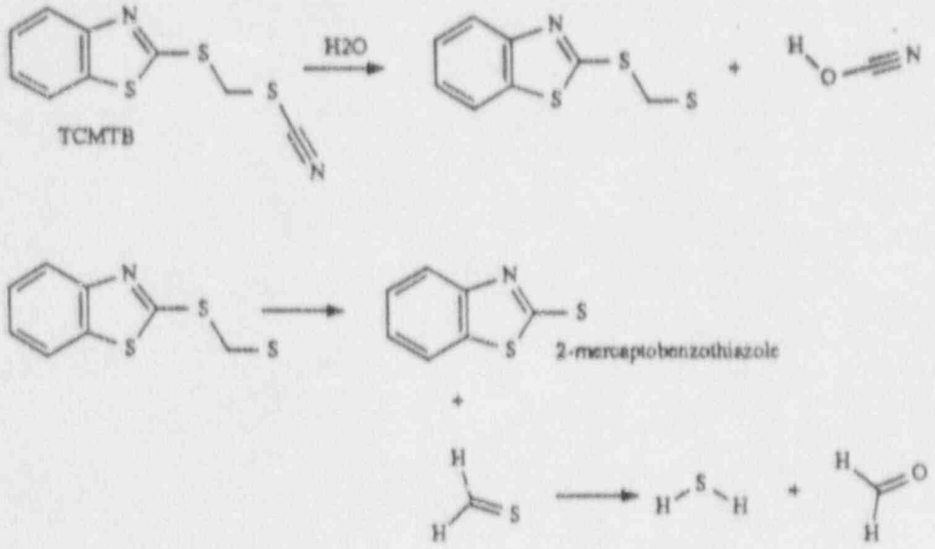
The information on this Material Safety Data Sheet reflects the latest information and data that we have on hazards, properties, and handling of this product under the recommended conditions of use. Any use of this product or method of application which is not described in the Product Data Sheet is the responsibility of the user.

This Material Safety Data Sheet was prepared to comply with the OSHA Hazard Communication regulations.

NPCA/HMIS Rating: Health 3; Flammability 2; Reactivity 1.
NFPA Rating: Health 3; Flammability 2; Reactivity 1.

Bulat 6009
5/16/88

Degradation Products:
The principle degradation product of 2-(Thiocyanomethylthio)benzothiazole in water is 2-mercaptobenzothiazole, with the release of small amounts of hydrogen sulfide and formaldehyde. The postulated degradation mechanism is shown below:[3]



[3]Van Deren, I. M. 1983. Project No. ANA-234 - Hydrolysis of TCMTB, Final Report.

Buckman Laboratories
INDUSTRIAL WATER TREATMENT DIVISION

INDUSTRIAL MICROBICIDES

W4W

BULAB® 6009

- **Broad-spectrum microbicide**
- **For use in severely microbiologically fouled systems**
- **Excellent control of wood-deteriorating fungi**
- **Very effective against Asian clams**
- **Effective over a wide pH range**
- **Compatible with all Bulab corrosion inhibitors and dispersants**

General

Bulab 6009 is used for the control of microorganisms in industrial and commercial cooling water systems. Because of its unique biocidal and physical properties, it is particularly effective for controlling fungi which degrade cooling tower wood. Bulab 6009 can be sprayed on the tower wood surfaces or added to the water on a slug or continuous basis for control of fungi and other microorganisms.

Bulab 6009 is also very effective in controlling the Asian clam, *Corbicula fluminea*. Your Buckman representative can recommend the appropriate procedures for control.

Product Data

Appearance:	Dark brown liquid
Odor:	Slight
pH (100 ppm in water):	6–7
Flash point (Tagliabue closed-cup method):	50 °C (123 °F)
Freezing point:	Less than –40 °C (–40 °F)
Density at 25 °C (77 °F):	1.08 g/mL (9.0 lb/gal)
Approximate volume per kg:	926 mL
Approximate volume per pound:	420 mL

Dosage and Feeding

Microbiological control in cooling water systems

Bulab 6009 is used to control algae, bacteria, and fungi in industrial recirculating cooling water systems. Before treatment is begun, the system should be cleaned thoroughly to remove old algal growth, microbiological slime, and other deposits. The system should then be drained, flushed, refilled with water, and treated.

The frequency of treatment depends on the amount of bleedoff and the severity of the microbiological fouling problem. For uniform distribution, the product should be fed as received at a point of strong agitation.

Your Buckman representative will recommend the most effective dosage for optimum results

Microbiological treatment of cooling tower wood

Cooling tower wood is subject to two types of deterioration—that chemical in nature and that caused by the action of microorganisms. Those microorganisms most generally involved are fungi capable of degrading cellulose. Many cooling water biocides are not effective fungicides. Because of its superior, broad-spectrum activity against cellulytic fungi, Bulab 6009 is the product of choice for maintenance treatment of cooling tower wood.

Your Buckman Laboratories representative will recommend the most effective treatment program for your system.

Storage and Handling

Bulab 6009 is a liquid packed in nonreturnable drums. Materials of construction satisfactory for handling the product include Type 316 stainless steel, molded nylon, Teflon, polyethylene, and polypropylene.

Improper handling of this product can be injurious to workers. Observe all safety precautions shown on the label and in the Material Safety Data Sheet.

Printed in U.S.A. (10/89)

MOLLUSCICIDE

BUCKMAN LABORATORIES

W107W

Bulab 6009

A New Advance in Clam Control

Corbicula fluminea, the Asian clam, continues to cause serious problems for industrial and power generating plants throughout the Western Hemisphere despite all that is being done to provide control. The most significant problems have occurred at plants using water on a once-through basis. The high cost of treatment and lack of products approved by regulatory agencies for once-through applications have placed serious limitations on the affected plants.

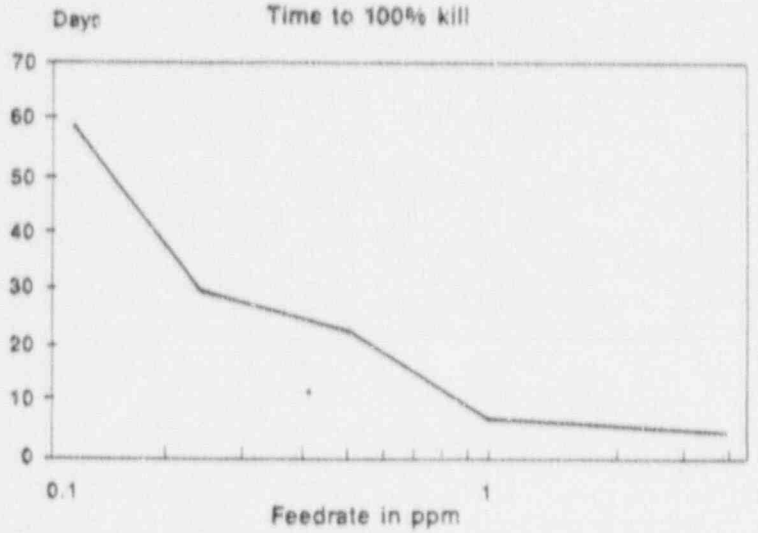
Fortunately, we now have Bulab 6009 the latest weapon in the war against *Corbicula fluminea*. Bulab 6009 is extremely effective against the Asian clam, and it can be applied at very low rates making it environmentally acceptable and economically feasible for once-through plants.

Bulab 6009 was tested at the Center for Corbicula Research, University of Texas-Arlington, to determine the time required to obtain 100% kill of the Asian clam. As shown on the graph Bulab 6009 was effective at levels as low as 0.125 ppm. More rapid kill rates can be achieved using higher dosage rates.

This extreme versatility allows a Bulab 6009 program to be tailored to your plant's configuration and discharge limitations. Since Bulab 6009 is approved by the United States Environmental Protection Agency for application to once-through and recirculating systems, it is the product that can fit into almost any system.

Buckman Laboratories was the first company to offer a truly effective product for control of *Corbicula fluminea*, Bulab 6002. Continuing research and commitment to the science of mollusk control has resulted in Bulab 6009, the second generation of clam control technology.

Bulab 6009 vs. *Corbicula fluminea*



Based on continuous feed

Printed in U.S.A. (5/8/89)

ENCLOSURE II

(Letter D03754)

PROPOSED BIOCIDE TREATMENT AND DISCHARGE

This report addresses the proposed use of a biocide (trade name: Proxel GXL) at Millstone Nuclear Power Station in Waterford, Connecticut. Proxel GXL is a 19% solution of 1,2-Benzisothiazolin-3-one (BIT) in aqueous dipropylene glycol.

Introduction

Millstone is proposing to use Proxel GXL to treat Radwaste Material that has become chemically unstable due to microbial activity. More specifically, Ecodex resin waste (i.e., a predominantly cellulose based material) has been observed generating methane (CH_4) gas. This production of methane gas has rendered the Ecodex waste unsuitable for burial as per 10CFR61.56 requirements. Subsequently, Millstone has had to store Ecodex waste shipping casks on-site for prolonged periods. This is an undesirable practice because of increased personnel exposure, increased costs (shielded storage containers), and potential safety hazards.

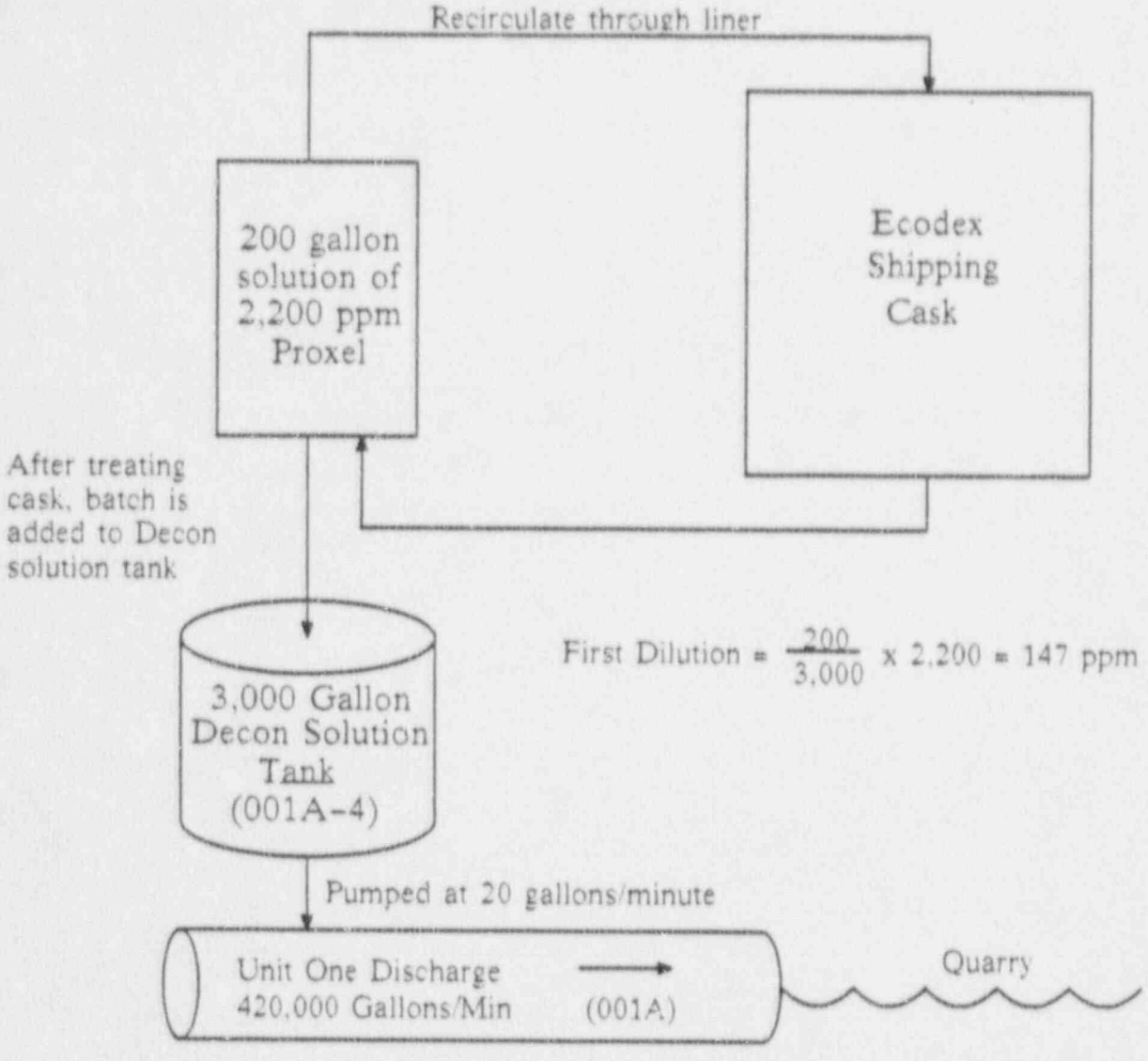
Proxel GXL was chosen as the administered biocide for the following reasons.

- Low toxicity and minimal environmental impact.
- It is non-oxidizing and should be chemically compatible with all system components.
- It can kill both aerobic and anaerobic bacteria.
- It is used as a preservative and will provide sustained protection.

Testing/Discharge Path

The Millstone Chemistry Department, working in conjunction with a professor from the University of Connecticut, has recently completed some initial experimentation concerning the effectiveness of the Proxel GXL biocide/biostat. This experimentation, although not conclusive, does indicate that the Proxel GXL biocide at a concentration of 2,200 ppm (W/V) will significantly reduce the microbiological activity in an Ecodex waste liner.

The following is a flow diagram for the disposition of the Proxel GXL. The concentration of 2200 pprn Proxel GXL and the initial volume of 200 gallons are conservative values. Subsequently the final concentration of 7.02 µg/L Proxel noted in the Unit #1 discharge water should not be exceeded. This will <u>not</u> be a one-time occurrence as it is anticipated to treat all future shipping casks containing Ecodex waste material (maximum of four shipping casks per year).



First Dilution = $\frac{200}{3,000}$ x 2,200 = 147 ppm

Concentration of Proxel as it enters the Quarry water =

147 ppm x $\frac{20}{420,000}$ = 7.02(-3) ppm or ' ' ppb

or $\frac{7.02\ \mu g}{L}$

The final concentration of 7.02 µg/L in the Unit 1 Discharge water should pose no risk to the aquatic life in the quarry water based on Toxicity Studies.

Acute Toxicity LC_{50} (mg/L) 96 Hours

Product	Rainbow Trout	Bluegill Sunfish
Proxel GXL	7.0	30.0

Regulatory clearances

EPA

PROXEL® CRL (EPA Reg. No. 10182-3) and PROXEL GXL (EPA Reg. No. 10182-30) are registered for use as preservatives for aqueous compositions such as oil-in-water emulsions, latices, emulsion paints, water-based adhesives, casein/rosin dispersions, textile spin-finish solutions, etc.

PROXEL GXL also has specific clearance for use as a preservative for pesticide formulations. The clearance is:

40 CFR 180.1001 (d)
For use as a preservative/stabilizer in pesticide formulations. And is exempted from the requirement of tolerance when used in accordance with good agricultural practice as an inert.

Limitation: Not more than 0.1% of the formulation. Not more than 0.02 lbs. to be applied per acre.

FDA

The active agent in PROXEL CRL and PROXEL GXL, 1,2-Benzisothiazolin-3-one (BIT), has a wide spectrum of clearances applicable to preservatives used in paper, paper-coating and adhesive applications.

These are:

21 CFR 175.105; c(5)
For use as a preservative in adhesives.

21 CFR 176.170; a(5)
For use as a preservative in paper-coating compositions in contact with aqueous and fatty foods.

Limitation: 0.01 mg/in² (0.0016 mg/cm²) of the finisned paper and paperboard.

21 CFR 176.180,b(2)
For use as a preservative in paper-coating compositions in contact with dry-food.

Limitation: 0.02 mg/in² (0.0031 mg/cm²) of finished paper and paperboard.

21 CFR 176.300 (c)
For use as a slimicide in the manufacture of paper and paperboard that contact food.

Limitation: 0.06 lbs./ton of dry weight fiber.

USDA

PROXEL CRL and PROXEL GXL are considered acceptable for use as ingredients in paints used in Federally inspected plants. They are also considered acceptable for use as components for packaging adhesives having minimal contact with meat or poultry food products prepared under Federal inspection.

Health Considerations

Skin and Eye Contact

Both PROXEL CRL and PROXEL GXL are severe skin and eye irritants. Repeated skin contact may result in sensitization in some cases. Take precautions to avoid skin and eye contact by wearing suitable protective clothing including goggles and gloves.

Remove eye contamination promptly by copious irrigation with clean water. Continue rinsing for at least 15 minutes. Seek medical attention.

Remove skin contamination promptly by thorough washing with water.

Ingestion

Ingestion of PROXEL antimicrobials will irritate the mouth and gastric tract but the toxic effect will be slight unless large amounts are swallowed.

Oral LD_{50} (Rat) mg/kg body weight	
PROXEL CRL	667
PROXEL GXL	885

Avoid ingestion. However, in the [illegible]nt of it taking place, the perso[illegible]ted should swallow liberal amounts of water or milk immediately. Seek medical attention as soon as possible. Do not induce vomiting.

Effluent Tests

Fish Toxicity

Results of acute toxicity tests on two species of fresh water fish using the flow-through technique are given below.

Acute Toxicity LC_{50} (mg/l) 96 hour		
Product	Rainbow Trout	Bluegill Sunfish
PROXEL CRL	3.6	17.4
PROXEL GXL	7.0	30.0

Sewage Systems

Laboratory evidence demonstrates that five parts of BIT per million can be degraded by settled sewage organisms (Bunch and Chambers test) into harmless metabolites.

Activated sludge-aerobic oxidation

Laboratory tests indicate that a shock spillage of [illegible] of BIT into a sewage system servi[illegible]0,000 people will suppress respiration of the sludge by only 20%. A continuous dose of up to 10ppm of the feed shows only minor effects.

Anaerobic digestion

A shock spillage of one ton of BIT into the digester of a sewage system serving 100,000 people will show only small effects on efficiency. A continuous feed up to 2ppm could be permitted by the same digester system.

The Preservation Problem

Microorganisms are found throughout the environment. They will grow under a wide variety of conditions including those which exist in most water-based industrial products.

For example, aqueous formulations of binders, thickeners, dispersants, surfactants and other organic and inorganic ingredients will almost certainly be susceptible to microbial attack. Such attacks may result in physical changes which render the product unusable, e.g., viscosity losses, phase separation, discoloration, or unpleasant odors.

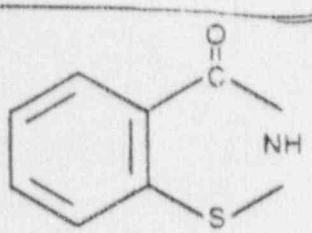
The financial effect of microbially induced spoilage may be serious in terms of loss of both product and time.

The Solution—PROXEL®

PROXEL antimicrobial agents protect your investment by preventing the growth of microorganisms throughout the manufacture and storage of your product.

PROXEL antimicrobials are highly effective and economical formulations based on the unique active agent:

1,2-Benzisothiazolin-3-one (BIT)



PROXEL CRL is a 30% solution of BIT in aqueous ethylene diamine.

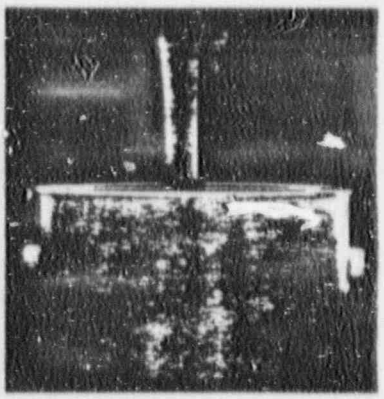
PROXEL GXL is a 19% solution of BIT in aqueous dipropylene glycol.

Benefits

- **Broad spectrum of activity:** effective against microorganisms causing spoilage of industrial products
- **No formaldehyde:** not dependent on the release of formaldehyde for antimicrobial activity
- **Heat stability:** nonvolatile and stable at the elevated temperatures often encountered during product manufacture and storage
- **Broad pH compatability:** effective over a pH range of 4 to 12, allowing use in almost all substrates
- **Liquid:** easily incorporated into products by liquid measure or direct metering
- **Low toxicity:** minimal toxic hazard in use
- **Low environmental impact:** readily degraded in the environment to materials less toxic than the original compound

Effectiveness

Organism	Minimum Inhibitory Concentration (M.I.C.) (ppm) PROXEL CRL	PROXEL GXL
Bacteria		
Bacillus subtilis	25	40
Staphylococcus aureus	25	40
Streptococcus faecalis	25	40
Streptococcus lactis	10	15
Enterobacter cloacae	50	80
Escherichia coli	25	40
Proteus vulgaris	75	125
Pseudomonas aeruginosa	150	250
Pseudomonas fluorescens	100	150
Rhodopseudomonas capsulata	10	15
Serratia marcescens	50	80
Yeast		
Saccharomyces cerevisiae	150	240
Saccharomyces turbidans	150	240
Fungi		
Aspergillus niger	200	350
Aureobasidium pullulans	200	350
Cladosporium herbarum	50	80
Penicillium notatum	75	125



Applications

PROXEL® antimicrobials find use in numerous applications, thanks to their unique properties. Some of these areas include:

- **Synthetic polymer emulsions:** SBR, PVA and acrylics used in paints, adhesives, paper coatings and carpet backings
- **Latex paint:** trade sales and industrial
- **Aqueous slurries:** clay, titanium dioxide, etc.
- **Adhesives:** starch, PVA, dextrin casein and others.

Numerous other aqueous-based products require a preservative. PROXEL antimicrobials are used in many of these and may be an ideal product for your application. Contact the Technical Service Laboratory of ICI Americas with your inquiries.

Usage

Amount to Add

Several factors affect the amount of PROXEL antimicrobial to add to your product. These include:

- the susceptibility of the formulation to microbiological attack
- the extent to which microorganisms can gain access
- the number and type of organisms present
- the pH of the formulation
- [illegible] temperature and duration for [illegible] protection is required.

Our experience indicates the use levels in Table 1 give excellent protection.

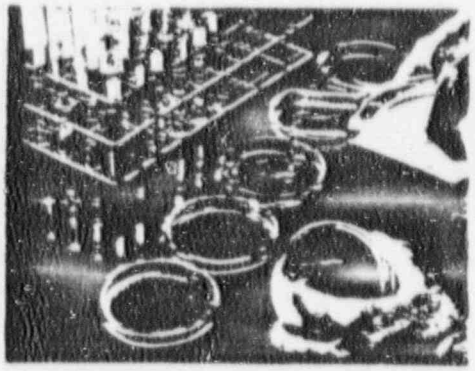
When to add

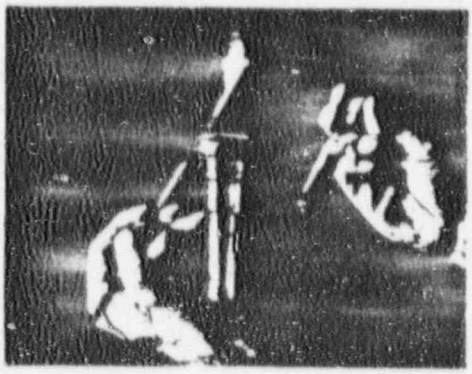
PROXEL antimicrobials may be incorporated into the formulation at any convenient stage during manufacture since they are readily soluble in aqueous-based products at use concentrations. However, it is strongly recommended that PROXEL antimicrobials be added as early as possible during the manufacturing process to eliminate contamination which often arises from water, raw materials, or the manufacturing process.

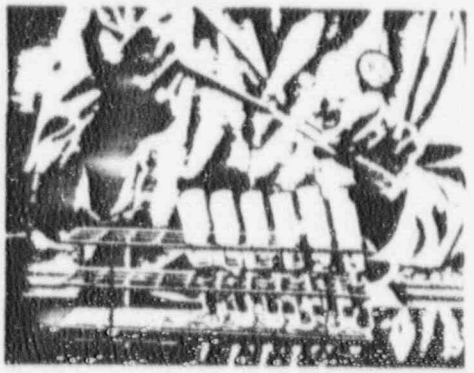
Long-term storage of a high strength aqueous dilution (1-10%) of PROXEL CRL or PROXEL GXL is not recommended.

Table I Typical use levels for PROXEL (%)
(based on total weight of formulation requiring protection)

Product	PROXEL CRL	PROXEL GX
Synthetic polymer emulsions	0.020-0.050	0.035-0.080
Latex paint	0.025-0.100	0.040-0.125
Aqueous slurries	0.025-0.075	0.040-0.125
Adhesives	0.030-0.120	0.050-0.200







Method of Addition

As liquids, PROXEL antimicrobials are incorporated easily into your formulation by liquid measure or direct metering. Details on recommended metering systems are available.

Plant Hygiene

Preservative use should be complemented by a good standard of plant hygiene to reduce potential spoilage problems. Production equipment, storage tanks and pipelines should all be cleaned regularly.

After physically cleaning away adherent debris, plant sanitation may be achieved by circulating a 0.2% aqueous solution of formalin (37% formaldehyde) or hypochlorite (15-20 ppm free available chlorine) through process equipment. For maximum effectiveness, a pH between 5 and 7 should be maintained. If possible, allow the sanitizing solution to circulate overnight.

After hypochlorite circulation, it is essential to thoroughly rinse your manufacturing equipment with good quality water before reintroducing the product treated with PROXEL antimicrobial in your process equipment.

Properties*

Characteristics	PROXEL CRL	PROXEL GXL
Composition	a solution of BIT (30%) in aqueous ethylene diamine	a solution of BIT (19%) in aqueous dipropylene glycol
Physical Form	dark brown liquid	dark brown liquid
Viscosity (25°C)	15 centipoise	350 centipoise
Specific Gravity (25°C)	1.13	1.14
pH (25°C)	10.8	12.0
Boiling Point	180°C	100°C
Flash Point (Pensky Martin closed cup method)	>108°C	>200°C
Stability	Stable under all normal storage conditions. The active agent is heat stable and nonvolatile. Protect from frost.	

*Properties represent typical values and do not constitute a specification.

PRESSURE POINT ANALYSIS ™
EFA, INC.'S PPA

What's News ——

* * *

TOO GOOD TO BE TRUE?

Industry and government's concern about leak detection is now addressed. EFA, Inc.'s patented breakthrough, Pressure Point Analysis performs as well or better than the most expensive and exotic alternatives yet is inexpensive and simple to apply.

* * *

High performance has been demonstrated at each installation. Detecting 1/4 inch and 1/8 inch holes within seconds to a few minutes is commonplace. False alarming can usually be eliminated.

* * *

Liquids, gases and some two-phase flow situations are compatible to PPA. The PPA technique eliminates most fluid properties problems.

* * *

Special instruments are not required. PPA was designed to work with ordinary process control instruments (most field testing was done with Rosemont 1151 GP pressure transmitters).

* * *

Flexible, versatile system configuration is achieved with insightful, modular design. PPA interfaces to a SCADA system on a local area network or as a printer would thus achieving a simple, economical data connection. PPA can also connect directly into instrument loops, eliminating the need for SCADA.

* * *

Low cost is achieved through use of top quality components (Compaq computers, for example) configured as a product (as opposed to a custom system).

* * *

SCADA capability is built-in for users that need to do leak detection but do not have a SCADA system. This saves hundreds of thousands of dollars.

* * *

Fast, easy installation and start-up are assured by sound system design, simple interfacing to instruments or host computer, and a tightly integrated package. Typical start-up takes less than two hours.

* * *

Simple operation results from suggestions by dozens of industry people. The displays and operator control features incorporate what operators say they want implemented in ways they say "make sense."

* * *

Everything you need for success comes with the package including software, computer, complete user's manual, and our help. We provide training so that successful operation is assured and so you can confidently configure new points and modify old ones, all without extra help.

* * *

You can't fail with PPA. You get a proven system and all the support necessary for great success.

* * *

* 1611 20TH STREET * SACRAMENTO, CALIFORNIA 95814 *
* (916) 443-8842 * TELEX 820906 *

WHAT IS PRESSURE POINT ANALYSIS?

Pressure Point Analysis (PPA) is a procedure in which a series of pressure readings taken at a point on a pipeline are analyzed for evidence of a leak. Raw data from pressure instruments are processed to extract actual trends from normal fluctuations. The result is then analyzed using a breakthrough statistical procedure patented by EFA, Inc. PPA computes the probability that the series of readings indicate there is a leak in the pipeline.

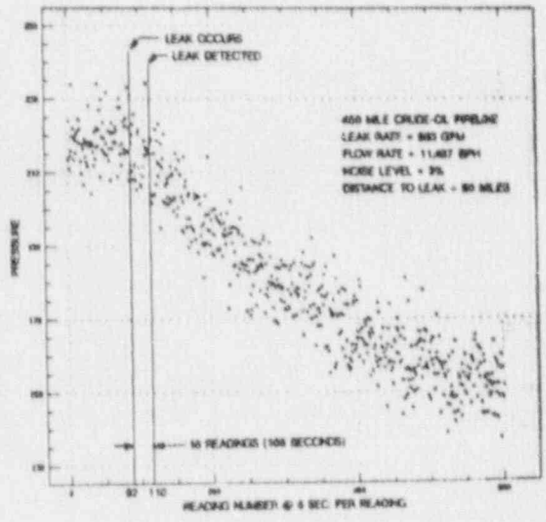
HOW DOES PPA FIND LEAKS?

Point analysis technology is a method rooted in statistics. It is based on the realization that the statistical properties of a series of pressure or velocity measurements taken on a pipeline are different before and after a leak occurs.

When fluid escapes from a pipeline there is a decrease in density at the leak as it develops. This causes a change in local pressure which in turn causes fluid above and below the leak to migrate into this region of decreased density. The process by which the fluid moves creates a wave of low pressure (an expansion wave) that travels up and down the pipeline at nearly the speed of sound in fluid. The front of this wave is the first evidence of a leak but it is very difficult to reliably detect. It is the behavior of the pressure behind this wavefront, or the changes in velocity associated with it, that PPA analyzes.

Each PPA point analyzer continually accumulates measurements, discarding the oldest and adding the newest each time new data are available. PPA automatically learns from these data what current normal operation looks like. It then assumes a leak occurred a few measurements ago and performs a series of statistical tests to prove or disprove that assumption. If the analysis indicates a leak may have occurred, tests are made to see if the leak-like event has resulted from known or usual events. If no such events are known to PPA, the probability a leak has occurred is reported to the operator as a percentage.

Since there is no way to predict what size leak you will need to detect, all PPA point analyzers contain five filters which are each optimized for a different size leak. Acting together, they form a "net" which catches leaks of all sizes within the system's capability. Normal events that "look like" leaks, such as opening a valve, can be suppressed automatically or manually through the filters.



PPA PERFORMS

An extensive testing program involving on-line performance of a variety of pipelines carrying fluids ranging from natural gas, to NGLs, to fuel oils has been conducted. Many transient simulations have also been used to investigate performance under unusual or otherwise difficult to create conditions. Performance has been consistently beyond expectations.

HOW LONG DOES PPA TAKE TO FIND LEAKS?

PPA is fast. How fast depends on the speed of sound in the fluid, the rate at which new data are available, the size of the leak, and the particular pipeline and control system configuration.

Large leaks are detected in seconds. Small leaks generally take a few seconds to a few minutes. The following tables show some examples from actual field operation. All of the test results were obtained with existing process control instruments:

RESIDUAL FUEL OIL PIPELINE
LENGTH: 8.2 MILES
DIAMETER: 10 INCHES
VOLUME: 69,000 GALLONS

PIPELINE PRESSURE (PSIG)	LEAK RATE (GPM)	DETECTION TIME (SEC)	VOLUME LOST @DETECTION (GAL)
82.6	4.0	7.0	0.5
233.0	7.6	16.0	2.0
10.7	11.6	11.0	2.1
20.2	40.4	16.0	10.8
4.06	7.7	36.0	4.6

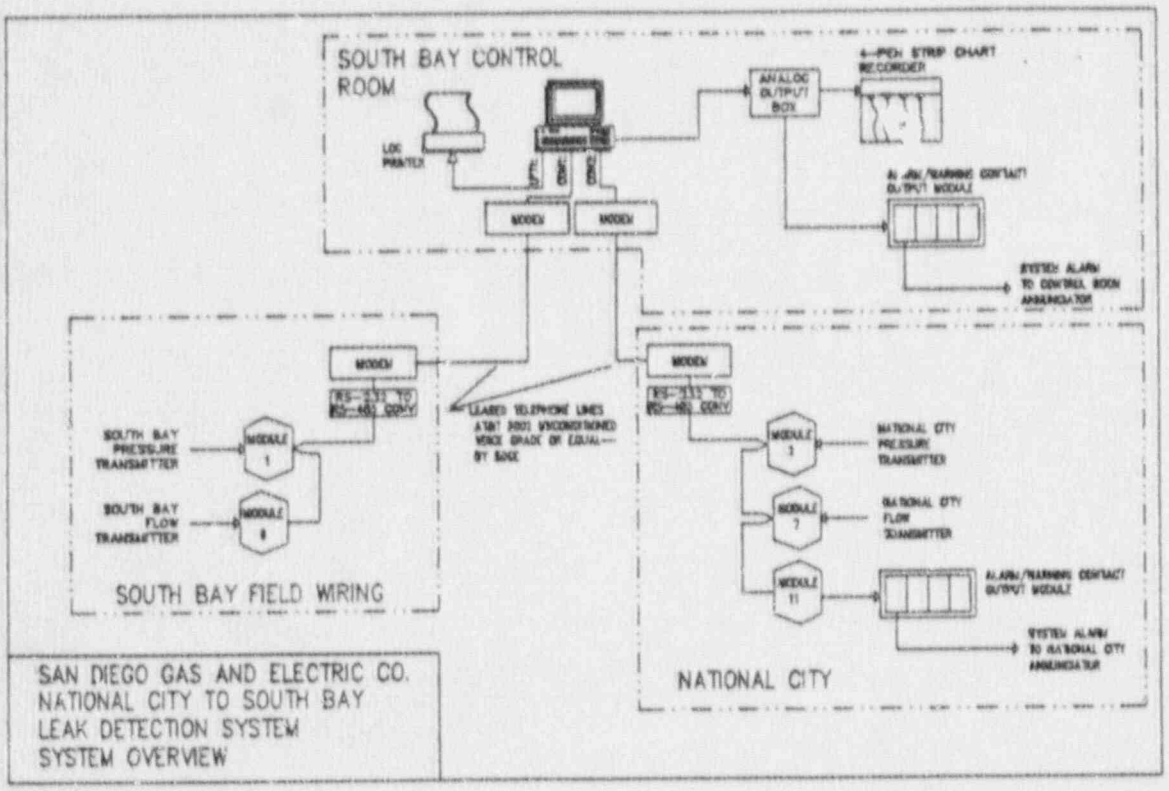
NATURAL GAS PIPELINE
LENGTH: 26 MILES
DIAMETER: 20 INCHES

LEAK SIZE (IN.)	FLOW RATE (SCFH)	PIPELINE PRESSURE (PSIG)	DETECTION TIME (MIN.)
1"	75,000	580	2
1/2"	75,000	580	5
1/4"	75,000	580	15

PPA USERS

PPA currently operates in the field in many configurations and on various fluids. PPA users at the end of 1988 include:

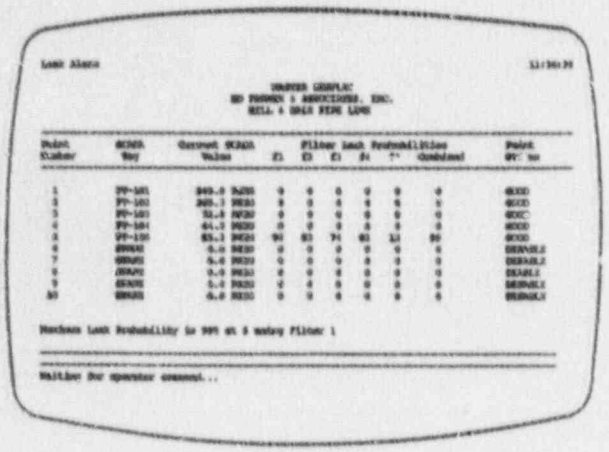
* Chevron Pipe Line Company
* San Diego Gas & Electric Company
* Shell Western E & P (not yet in service)
* Union Pacific Pipe Line Company
* Union Pacific Resources
* Pacific Gas & Electric Company (Gas System Design Department)
* Pacific Gas & Electric Company (Pittsburg Power Plant)
* El Paso Natural Gas



DISPLAYS

Five types of displays are available to the operator by a keystroke at any time. Alarm and warning signals operate at all displays in both audible and silent mode.

PPA MASTER DISPLAY



THE PPA PACKAGE

PPA is a simple yet high performance system designed to meet industry's needs in leak detection.

Each system is delivered completely integrated on state of the art equipment and ready for installation directly into instrument loops or interfacing to a SCADA system. EFA, Inc. supplies complete start-up as well as operator training

PPA can be packaged synergistically with other EFA, Inc. leak detection products including Over/Short Accounting, Mass Balance with Line Pack Correction, and our Transient Model.

PPA is a new solution to an old leak detection problem. Call or write Ed Farmer and Associates, Inc. for more detailed information about your PPA solution.

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PIPELINE CONFERENCE

Loews Anatole Hotel, Dallas, Texas

A new approach to pipe line leak detection

Edward J. Farmer, P.E., Ed Farmer & Associates, Inc.

ED FARMER & ASSOCIATES, INC.
Consulting Engineers & Scientists
1611-20th STREET
SACRAMENTO, CALIFORNIA 95814
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A new approach to pipe line leak detection

Edward J. Farmer, P.E., Ed Farmer & Associates, Inc.

PRESSURE POINT analysis (PPA) is a method for detecting leaks on gas, liquid and some two-phase flow pipe lines that relies on analyzing data taken, in the simplest implementation, at a single measurement point. Additional points improve performance but are not essential to the technique. PPA was developed to provide leak detection on a sour gas pipe line with many unusual hydraulic problems. In 1988, PPA detected leaks of as little as ⅛-in. diameter on that line.

Methodology. PPA is based on a great deal of research in the behavior of the energy and momentum balance on a pipe line (as represented by pressure and velocity measurements) before and after a leak occurs.

When state-of-the-art signal processing techniques are applied to these data, one finds a tremendous amount of information in them. Before exploring the application of PPA's methodology to leak detection it is useful to consider briefly what happens on a pipe line when a leak occurs.

When a pipe line is at steady state its velocity, pressure and density profiles are time invarient. In between devices that can add or extract energy (such as pumps or compressors) these profiles are also continuous. When steady state is disturbed by an event, a transition toward a new steady state begins. This transition becomes complete some time later when the fluid has changed its velocity and pressure such that mass, energy and momentum are conserved.

If an event occurs at some point along a line, the first evidence of it will arrive at the ends (or any other monitored location) in an amount of time determined by the distance from the event to the monitored point and the speed of sound in the fluid as constrained by the pipe. Since the speed of sound is fairly high, 3,000 to 4,500 ft/sec for most petroleum liquids and perhaps one-tenth that amount for most gases, evidence of the event is available in a few seconds to a few minutes. This wave propagation time determines the minimum time in which a leak or any other event can be detected.

Loss of mass. When the event is a leak there is an immediate loss in mass at its location. This causes a local decrease in density and consequently a decrease in pressure. Since the fluid in the pipe line cannot change velocity instantly, there is a difference in pressure between fluid at the location of the leak and that in the fluid on either side of it. This difference in pressure causes flow from above and below the leak into the region of low pressure at the leak.

This flow deprives the regions immediately adjacent to the leak of mass which in turn causes a decrease in density and therefore pressure. There is now a difference in pressure between these regions adjacent to the leak and those immediately upstream and downstream of them. This, similarly, causes flow to occur toward the leak. The effect of this chain of events is that a pressure trough travels up and down the pipe line away from the leak. This wave of low pressure is called an "expansion wave" and travels at the speed of sound in the fluid as restrained by the pipe. It contains the first evidence of a leak and, in fact, leak detection systems have been based (with mixed

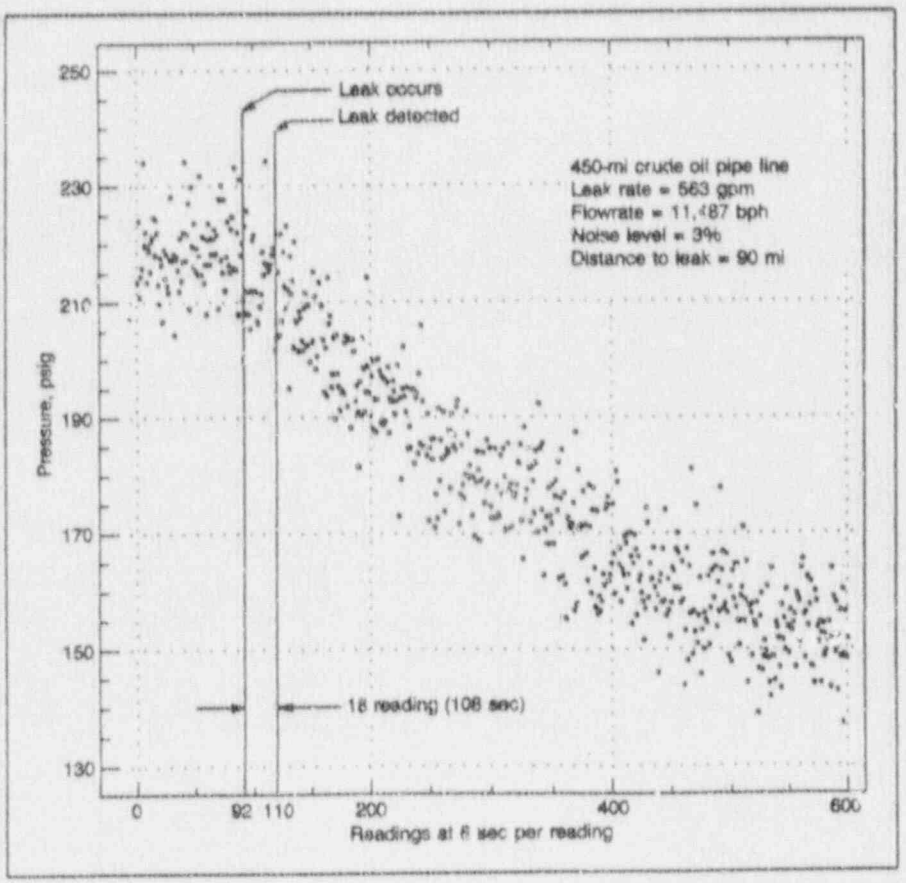

Fig. 1—Pressure data scatterplot.

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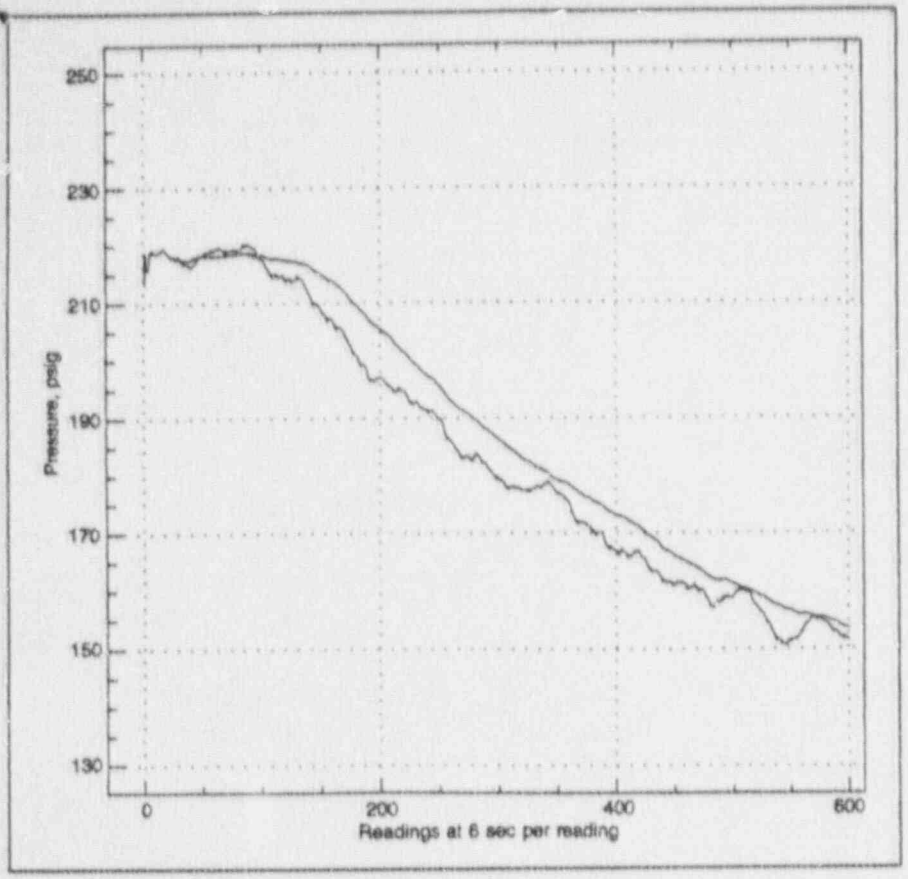

Fig. 2—Population and sample trend after filtering.

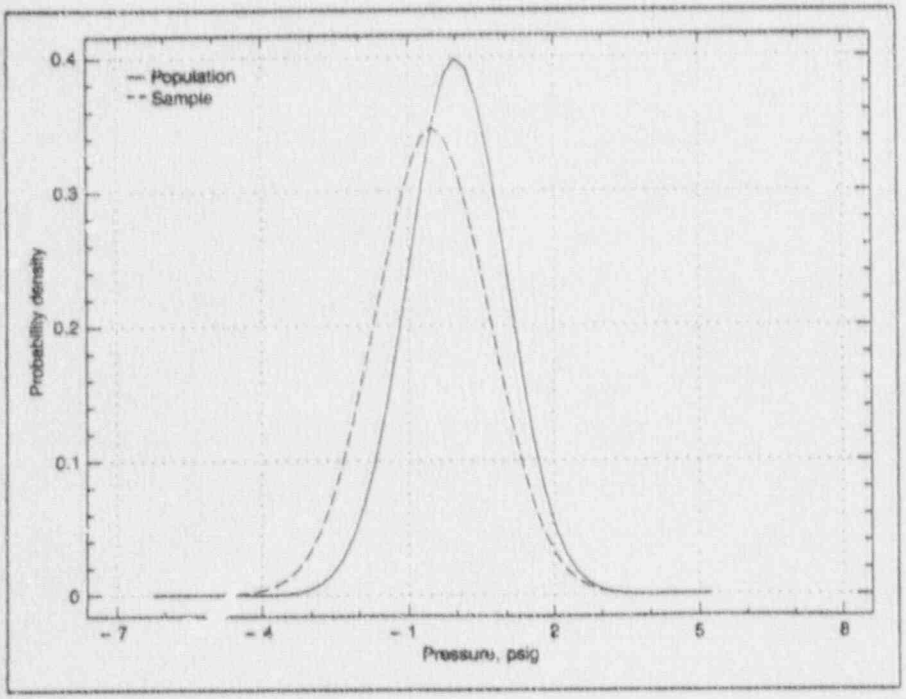

Fig. 3—Pressure data characteristics.

success) on detecting the front of this wave.

Some time after an event occurs, the pipe line will complete its transition to a new steady state. The time required to do this can be determined from the principle of impulse-and-momentum which basically says that the application of a force (e.g., a change in pressure acting on the cross-sectional area of the fluid) for an amount of time will produce a corresponding change in velocity of the mass in the line. The time required for this change to become complete is typically several minutes to tens of minutes.

Avoids special instrumentation. In order to avoid the special instrumentation and noise-related reliability problems associated with attempting to detect the expansion wavefront, PPA looks at the behavior of the pressure or velocity of the fluid in the line at a monitored point as it transitions from one steady state to another.

Actually, steady state is a more restrictive term then necessary in describing this situation. PPA's analytical procedure does not require transitions between stable steady states—it adapts to current operation of the pipe line. A more accurate way of stating the initial and final conditions would be at steady state or in smooth transition.

PPA detects leaks by:

- Extracting signals representative of current operation and the most recent trends from data taken at a point along the line
- Determining if the behavior of these two signals contains evidence of a leak
- Determining if evidence of a leak from Step 2 is the result of events of the line known to PPA to produce leak-like signatures
- Reporting the results of this procedure to the operator.

Fig. 1 is a scatterplot of data taken at a point approximately 90 mi from a leak on a large pipe line. This plot shows the time (corrected from wave propagation time) at which the leak occurred and the time at which PPA detected it. Note that it would be very difficult to infer any event had occurred at the time of detection even if the data were closely examined by a highly trained observer.

Fig. 2 shows the trends in the data as extracted by PPA's signal processing system. The smoother of the two lines indicates PPA's assessment of normal operation. By overlaying the two figures, one can see how PPA tracks normal operation changes. The rougher line is PPA's assessment of the current trend in the data. When these curves diverge in characteristic ways, as they do in Fig. 2, there is evidence a leak could have occurred.

When there is evidence of a leak, PPA

compares certain statistical parameters of the set of data used to define current operation with the same parameters of the set of data used to define the current trend. Fig. 3 illustrates the differences between data sets collected before and after a leak. The solid line is a frequency diagram of readings taken before a leak, while the dashed line is the corresponding diagram after the leak occurs. Some of the differences are immediately obvious. Others require some level of analysis to discern. When this analysis is done, PPA determines the probability it has found a leak. PPA also checks to determine if this could be the result of known events in progress. If the probable leak cannot be explained in that way, PPA reports the data to the operator.

Another way of looking at this process is shown in Fig. 4. While this discussion is in terms of pressure, a similar behavior can be seen if one monitors velocity instead.

Leak occurence. When a leak occurs, the first evidence of it travels from the location of the leak to the point of measurement. The first evidence a leak has occurred is usually a pressure trough after which the pressure (or velocity) signature displays one of three characteristics.

Pattern 1 leaks are characterized by essentially complete pressure recovery. Only very small leaks, usually on gas pipe lines, exhibit this pattern. They are fairly difficult to detect since evidence exists only for a few minutes.

Pattern 2 leaks are the most common small leaks. In this situation, pressure recovers to some new steady state value that reflects the change in the hydraulic losses on the line as a result of having to supply fluid to the leak. These leaks are easy to detect because even when the difference between the initial and final pressure is small it persists for many minutes.

Pattern 3 is common to large holes or line breaks in which the line unpacks. These are extremely simple to detect.

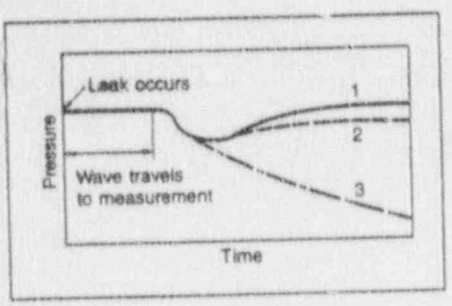

Fig. 4—Probable leak location.

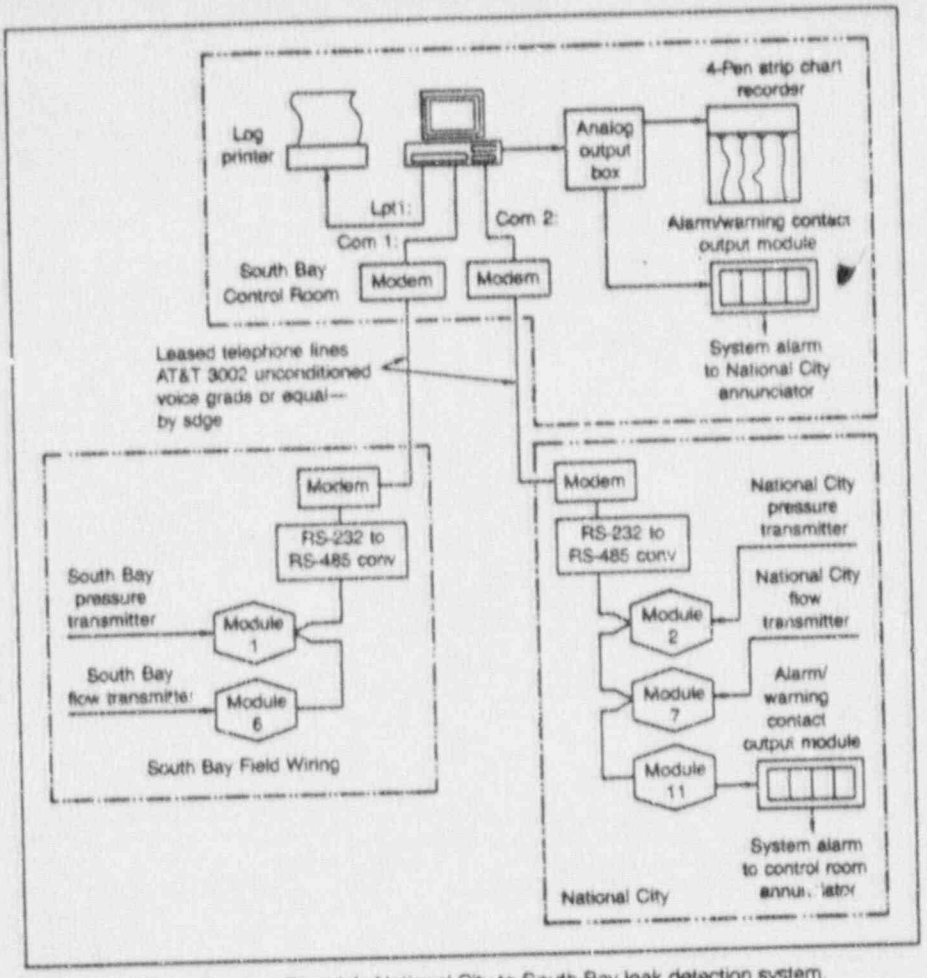

Fig. 5—San Diego Gas and Electric's National City to South Bay leak detection system.

PPA looks for a pattern that could indicate a leak has occurred by comparing its short-term signal with its current operation signal. Leaks of different sizes produce perturbations in patterns that make them difficult to find if only one estimate of the current trend is used. Consequently, PPA incorporates five statistical filters, each of which makes its own assessment of the current trend according to easily modifiable user criteria.

Since PPA's method of analysis is closely tied to the physics of the events that inescapably accompany leaks, it is capable of very high levels of performance. Detecting ¼ to ⅛-in. holes is commonplace in many applications. Since the leak detection process occurs rapidly, detection times are quite short—generally a few seconds to a few minutes.

The PPA package. PPA is an integrated product that includes the computer, the software, and all peripheral devices necessary to interface to an existing SCADA system or directly to field instruments. PPA includes full user support capability including a comprehensive fill-in-the-blanks configuration editor that allows a user to be completely self-supporting. Fig. 5 shows a PPA system configured to connect directly to instruments.

With PPA the user does not have to become an expert on leak detection, instrumentation, measurement, signal processing, computer interfacing or any of the associated fields. All components connect together or plug together in simple, obvious ways and in accordance with detailed drawings provided with each unit. Set-up is easily accomplished by means of a fill-in-the-blanks editor that requires only simple, easily understood information. Making adjustments to optimize PPA for a particular pipe line is simply done by changing a few values in easily understood ways.

A PPA installation typically takes less than a day. A complete training program takes no more than a day and typically only a few hours. ■

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