U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
CINCINNATI, OHIO 45226

HEALTH HAZARD EVALUATION DETERMINATION
REPORT NO. 76-91-371

SAFEWAY STORES INC. DISTRIBUTION CENTER
LANDOVER, MARYLAND

MARCH 1977

I. TOXICITY DETERMINATION

A National Institute for Occupational Safety and Health Industrial Hygiene Survey was conducted on August 4-5, 1976 for the Warehouse Employees Local Union No. 730 at the frozen foods warehouse of the Safeway Stores Distribution Center. Employees exposure to ammonia from leaking refrigeration systems was evaluated. It was determined that the exposure to ammonia was not hazardous under the conditions observed during this survey. This determination is based on environmental measurements of airborne concentrations, confidential interviews, a review of the pertinent literature, and observations of work practice and exposure controls.

The comments of interviewed workers and management revealed a history of intermittent ammonia leaks and a few instances of major ammonia discharges associated with system failures.

Recently initiated preventive maintenance has apparently eliminated frequent leaks. The body of this report contains further recommendations for protection of personnel during larger system failures.

II. DISTRIBUTION AND AVAILABILITY OF DETERMINATION REPORT

Copies of this Determination Report are currently available upon request from NIOSH, Division of Technical Services, Information and Dissemination Section, 4676 Columbia Parkway, Cincinnati, Ohio 45226. After 90 days the report will be available through the National Technical Information Service (NTIS), Springfield, Virginia. Information regarding its availability through NTIS can be obtained from NIOSH, Publications Office at the Cincinnati address.

Copies of this report have been sent to:

a. Safeway Distribution Center Manager
b. Business Agent - Warehouse Employees Local Union No. 730
c. U.S. Department of Labor - Region III
d. NIOSH - Region III

For the purpose of informing the 54 "affected employees" the employer shall promptly "post" for a period of 30 calendar days the Determination Report in a prominent place near where the affected employees work.

III. INTRODUCTION

Section 20 (a)(6) of the Occupational Safety and Health Act of 1970, 29 U.S.C. 669 (a)(6), authorizes the Secretary of Health, Education, and Welfare, following a written request by any employer or authorized representative of employees, to determine whether any substance normally found in the place of employment has potentially toxic effects in such concentrations as used or found.

The National Institute for Occupational Safety and Health (NIOSH) received such a request from the Warehouse Employees Local Union No. 730 regarding the exposure of workers to ammonia refrigerant.

IV. HEALTH HAZARD EVALUATION

A. Process Description

The frozen foods warehouse of the Safeway Stores Distribution Center employs a total of 54 workers. Forty-five (45) of these workers are routinely working inside the freezer. Reportedly there have been numerous complaints of burning eyes, upset stomachs, headaches and sore throats from ammonia leaks inside the freezer. There have also been problems with ice on the floors, walls and roof. The frozen foods warehouse is more than one acre in size and is maintained below $0^{o}F$, normally between $-4^{o}F$ and $-15^{o}F$. It is part of a large 48 acre Safeway Distribution Center for the East Coast. See Sketch of Area in Figure 1. The older "58" area is approximately 16,300 square feet with a ceiling height of 21 foot. It is refrigerated by three floor mounted units rated at 16 tons and 22,000 CFM each. The newer "66" area is approximately 42,000 square feet with a 28 foot ceiling. It is refrigerated by 11 ceiling mounted units rated at 9.1 tons and 13,200 CFM each. The Truck Dock Area is 8,600 square feet and is maintained at $35^{o}F$ by nine ceiling refrigeration units rated at 1.6 tons and 2,310 CFM each.

Job classifications and duties are as follows:

Title	Number Per Shift	Location
Floor Manager	One on night shift	Office clerical
Fork lift operator	3 nights - 9 days	Freezer
Selectors	1 nights - 3 days	Loading dock
Selectors	31 nights	Freezer
Shipping/Receiving Clerk	1 nights - 1 days	Loading Dock
Receiving Clerk	1 days	Office Clerical
Sanitarians	2 days - 1 nights	Freezer

Fork Lift Operators are used to move bulk shipments from loading docks to warehouse locations during the day and to move supplies at night.

Selectors are primarily used to compile orders from the warehouse stock and deliver them to the truck dock for shipment. A selector usually composits two orders which may take from 20 minutes to an hour averaging about 40 minutes. In addition to the brief pause between order assingments they receive a 10 minute break each hour on day shift and a 20 minute break each 2 hours on night shift. Therefore a selector spends most of his shift traveling on a electric cart throughout the warehouse.

Sanitarians perform janitorial and ice removal duties in the freezer during the shift.

Clerks are in primarily clerical and shipping or receiving activities which do not require their presence in the freezer.

The Refrigeration Units are automatically defrosted for 30 minutes on a staggered 6 hour cycle in the "66" area and manually as needed in the "58" area. The primary cause of leakage in ammonia lines is the loosening of joint and packing due to the changing termperatures. The leaks are noticeable during the defrost cycle when joints thaw out. Therefore the likelihood of a worker encountering a leaking unit during this 30 minute cycle is highly variable. Not all workers would have the same experience.

B. Evaluation Design

Twenty of the workers were given private confidential interviews. Due to the subzero conditions no personal impinger samples were possible for determination of ammonia levels. One was attempted, however, it froze in less than five minutes. Area airborne ammonia samples were set up in heated automatic sequency RAC (Research Appliance Company) samplers in isles 6 & 14. These positions were selected to be in the vicinity of two banks of refrigeration units in the "66" area as shown in Figure 1.

C. Evaluation Method

The air sample locations were chosen to allow accessibility to power outlets on the Truck dock and to detect leaks in the two banks of refrigeration units above. The RAC samplers were timed to automatically sequence the collection of ammonia at an air flow rate of 1 lpm in 12 impingers containing .01N Sulfuric Acid. Each case was equipped with a heating element rated to provide 35^{o}F temperature rise. The

Isle 6 timer was set to provide 15 minute samples once an hour from a quarter past the hour until half past. This sample period was chosen to coincide with the automatic defrost cycle which would be operating during these periods. The other sequential timer was set to run samples continuously changing every sixty minutes. This provided a time weighted average exposure measurement. Samples were collected over a 16 hour period from 2000 hours on August 4th to 1200 hours on August 5th. One of the samplers malfunctioned on the day shift. See Figure 2 for a time sequence sampling chart. The remaining operational sampler was set to run on a continuous basis in the isle 6 location, changing samples every 30 minutes. Analysis was by the Nessler Colorimetric Method, 1.0 ug/ml detection limit.

D. Evaluation Criteria

1. There are a number of criteria available to assess the potential toxicity of ammonia. Those with widest usage are the NIOSH Criteria Recommendations[1], The Threshold Limit Values (TLV) promulgated by the (ACGIH) American Conference of Governmental and Industrial Hygienists,[2,3] and the CFR Title 29 Part 1910.1000 used in enforcement of the Occupational Safety and Health Act.[4] The comparison of these criteria can be made only with an understanding of the differences in methods of measurement and intended degree of protection.

a. The NIOSH recommended criteria for ammonia is a ceiling value of 50 ppm (36 mg/m^3) as measured by a 5 minute impinger breathing zone sample. This value is not to be exceeded during the workday. This ceiling level is intended to restrict the potential for fluctuations to more irritating concentrations, and to ensure that such possibly irritating exposures are brief. This level will minimize discomfort felt by some unacclimatized individuals, however prolonged exposure at this level may become irritating to some.

b. The ACGIH Criteria for Ammonia is 25 ppm (18 mg/m^3) Time Weighted Average (TWA) with a 35 ppm (27 mg/m^3) short term exposure limit (STEL). The time-weighted average concentrations is for a normal 8 hour work day or a 40 hour work week. It represents a condition under which it is believed that nearly all workers may be repeatedly exposed to ammonia and protected against irritation to eyes and the respiratory tract and minimize widespread complaints of discomfort among uninured individuals. The (STEL) is the maximal concentration to which workers can be exposed for a period up to 15 minutes continuously without suffering from intolerable irritation.

The ACGIH (TLV) committee holds to the opinion that limits based on physical irritation should be considered no less binding than those based on physical impairment. There is increasing evidence that physical irritation may initiate, promote, or accelerate physical impairment through interaction with other chemical or biologic agents. In spite of the fact that serious injury is not believed likely as a result of exposure to the threshold limit concentration, the best practice is to maintain concentrations of all atmospheric contaminants as low as is practical.

c. The OSHA Standard for ammonia is contained in the 29 CFR 1910. 1000. Employees exposed shall not exceed the 8-hour time weighted average given in any 8 hour work shift of a 40 hour work week. The ammonia standard of 50 ppm (35 mg/m^3) listed was adopted from the 1968 ACGIH (TLV) listings. The ACGIH has since revised their TLV. (See Par b above) However, the legal standard remains unchanged.

2. The toxic effects of ammonia are discussed at length in reference 1,5, and 6. They are discussed here briefly so that the reader will know and recognize the symptoms and health consequences of overexposure. The specific effects occurring at any given time depend upon a number of factors such as concentration and length of exposure, individual susceptability, and possible synergistic effects of exposure to a combination of substances all at the same time.

The data on odor threshold shows wide variability among individuals ranging from less than one ppm to nearly 50 ppm. The corrosive action of anhydrous ammonia on tissue makes it toxic by any route of entry. Gaseous anhydrous ammonia is a severe irritant to eyes, nose, and throat. Airborne concentrations of 10,000 ppm (1%) are reported fatal to humans. Concentrations between 2,500 and 6,000 ppm are considered dangerous to life. Although the irritating effects are an excellent warning, sudden accidental exposures to high ammonia concentrations can cause adverse respiratory effects including difficulty in breathing, bronchopneumonia, chest pain, pulmonary edema, laryngitis, pharyngitis or rhinitis. Residual reduction in pulmonary function has been reported.[1]

Liquid ammonia in direct contact with the skin causes severe burns not only because it joins the skin moisture, but also because of freezing resulting from its rapid evaporation. High levels of gaseous ammonia can also dissolve in the skins moisture and result in a corrosive action on the skin. The maximum concentration of vapor tolerated by the skin for more than a few seconds is 3.0%.

Ammonia is a severe eye hazard. It can cause serious eye injury very quickly, in a few seconds. Blindness may follow serious eye burns caused by either liquid or gaseous ammonia at 5,000 to 6,000 ppm. Ingestion of ammonia solutions produces corrosive esophagitis and gastritis, ulcerative esophagitis with late resulting stricutres.

E. Evaluation Results and Discussions

Environmental: The NIOSH laboratory report on air samples shown in figure 2 is not believed valid. One reason is inaccuracies and inconsistencies such as positive ammonia finding in several blind banks and in several cases high and non-detected levels in samples taken during the same time period. Secondly the high levels reported should produce highly irritating effects since they were well above the threshold of detection. There was no observed ammonia odors either during the author's frequent visits to the sampling locations or by the workers interviewed throughout the two shifts. The reason for these erroneous measurements obtained by this analytical method has not been resolved, however, clearly no high exposures were experienced during this visit.

The observations of work practices and protective measures show that workers are not being routinely exposed to ammonia. The recently implemented weekly preventive maintenance in the form of inspecting and tightening suspect connections, valves, and packings has apparently reduced the frequency of leaks and hopefully would effectively eliminate this type of exposure. The only protective respirator was a Wilson Gas Mask with a G4 Ammonia Canister with Bureau of Mines approval 14F54 which has not yet been given an expiration date. This mask was located in a case outside the freezer. This type of protective equipment is approved only for limited use in low exposure conditions. These masks with industrial size canisters are suitable for emergency evacuation. There is a potential for very high concentrations in the freezer should a line break as occurred previously when a freezer unit fell from the ceiling. There is also a potential for exposure to liquid ammonia from overhead leaks and pools on warehoused stock.

Emergency eye wash and shower facilities are not adequate. The bottle of Billards^{R} eye wash hanging on the wall in the maintenance area is not sufficient to meet the requirement for a 15 minute flushing. In the event of body exposure a full shower would be required.

Floor icing was noted to be a hazard throughout the freezer. The center manager is aware of the moisture control problem. A roof repair contract is in progress to stop leakage. The additional problem of condensation from frequent openings of loading dock doors requires the alertness of all workers to keep the open door time to a minimum.

A crystallized cloud of moisture is visible each time the warmer 30°F dock air contacts the cold freezer environment. Frost is visible on overhead rafters and above doorways on the walls. Ice control by chipping has not proven adequate. Management is presently considering a new chemical floor cleaning process developed by Environmental Chemical Systems of Nocato, California. The product "Chem-Rel S®" was specifically designed to remove contaminants and ice from floors of freezer warehouses and is claimed to be effective as low as -40°F. The manufacturer recommends that after initial removal of ice buildup and in the absence of roof leaks, this treatment be repeated about once a month to prevent further ice buildup. This may vary with local humidity conditions.

Medical: Twenty workers were interviewed during the two shifts. Their average age and length of employment were 31 years and 6.8 years respectively. For the total work force of 53 ages ranged from 18 to 51. The average length of employment in the freezer warehouse was 5½ years. All but one were male. The employee interviews resulted in a wide range of responses to the intermittent ammonia leaks. They generally agreed that the odor of ammonia was noticeable in the vicinity of leaking freezer units during the defrost cycle. The degree of discomfort ranged from severe nausea and headaches to mild throat and eye irritations. The past instances of serious ammonia leakage due to ruptured lines, etc, have, as would be expected, elicited more serious complaints from all who were exposed. These instances are not considered routine work exposure. The localized and intermittent nature of defrost cycle leaks and the varied nature of individual work activity tend to increase the range of reported responses since on any given day one worker might not find himself in the vicinity of a leaking unit while another might encounter it several times.

It was reported that some leaks are sufficient to cause pooling of ammonia on cases of merchandise below. Rarely the worker may encounter these wet leaks himself. Employees did relate some cases of skin contact irritation. The potential for serious damage to the eyes if liquid contact should occur, prompts a strong recommendation for employee training in first aid.

Discussion: The possibility exists for a serious ammonia leak/spill to occur in the warehouse freezer. In such an enclosed place, high concentrations could build up rather quickly. Therefore, it is necessary to make provisions for protecting workers under these conditions. Reference 1 and 4 contain detailed guidance on work practices including emergency procedures, enclosed space continuous automatic monitoring and alarm requirements, posting requirements, personal protective equipment requirements, and a respiratory protection guide. The basic elements of these references which apply to the freezer warehouse are outlined below. The following measures should be taken to insure workers' safety.

a. A continuous ammonia monitoring alarm system should be installed with several sampling locations throughout the freezer. The alarm should sound both inside and outside the freezer and in the office as well. An alternative is to provide each worker an escape respirator.

b. Workers should be trained in first aid measures and the proper choice and use of protective clothing and respirators for emergencies.

c. Emergency procedures should be revised to show the proper precautions to be taken during repairs of leaks and spills, i.e. evacuation, line blanking, emergency shut down, protective clothing & respirator requirements, etc.

d. A respiratory protection program should be established in accordance with 29 CFR 1910.134 and as outlined in Reference 1. Physical examinations of personnel assigned duties requiring the use of respiratory protection as well as training and maintenance of equipment are required. Respirators should be carried by repair crews and by all workers if no alarm is provided. Self contained breathing equipment should be readily available outside the freezer.

e. Emergency showers and eye wash facilities should be installed near the freezer area. Personal 8 ounce plastic squeeze eye wash bottles should be worn under outer protective clothing for first aid. This will allow the worker a few extra minutes to reach a proper eye wash facility.

f. Repair of roof leakage and chemical floor cleaning should greatly improve floor and overhead icing control.

REFERENCES

1. Criteria for Recommended Standards for Occupational Exposure to Ammonia. (HEW Publication No. (NIOSH) 74-136, Government Printing Office, 1974.)

2. TLV's^{R} Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes for 1976. (American Conference of Governmental Industrial Hygienists, Cincinnati, Ohio, 1976.)

3. Documentation of the Threshold Limit Values for Substance in Workroom Air with supplements for substances added or changed since 1971; 3rd ed 1971, 3rd Printing 1976. (American Conference of Governmental and Industrial Hygienists, Cincinnati, Ohio, 1976.)

4. Title 29 of the Federal Code of Regulations Part 1910.1000. Revised January 1976. (U.S. Department of Labor - OSHA, Government Printing Office, 1976.)

5. Anhydrous Ammonia NH_3 Hygienic Guide (The American Industrial Hygiene Association, Akron, Ohio, 1970.)

6. John Kominsky, rev. Anhydrous Ammonia NH_3 Hygienic Guide by the American Industrial Hygiene Assiciation. (Unpublished, 1977)

VI. AUTHORSHIP AND ACKNOWLEDGMENTS

Report Prepared By:

Bruce A. Hollett
Industrial Hygienist
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Originating Office:

Jerome P. Flesch, Acting Chief
Hazard Evaluation and
Technical Assistance Branch
Cincinnati, Ohio

Figure 1
Safeway Stores Distribution Center
Frozen Foods Warehouse
Landover, Maryland
RHE 76-91
August, 1976

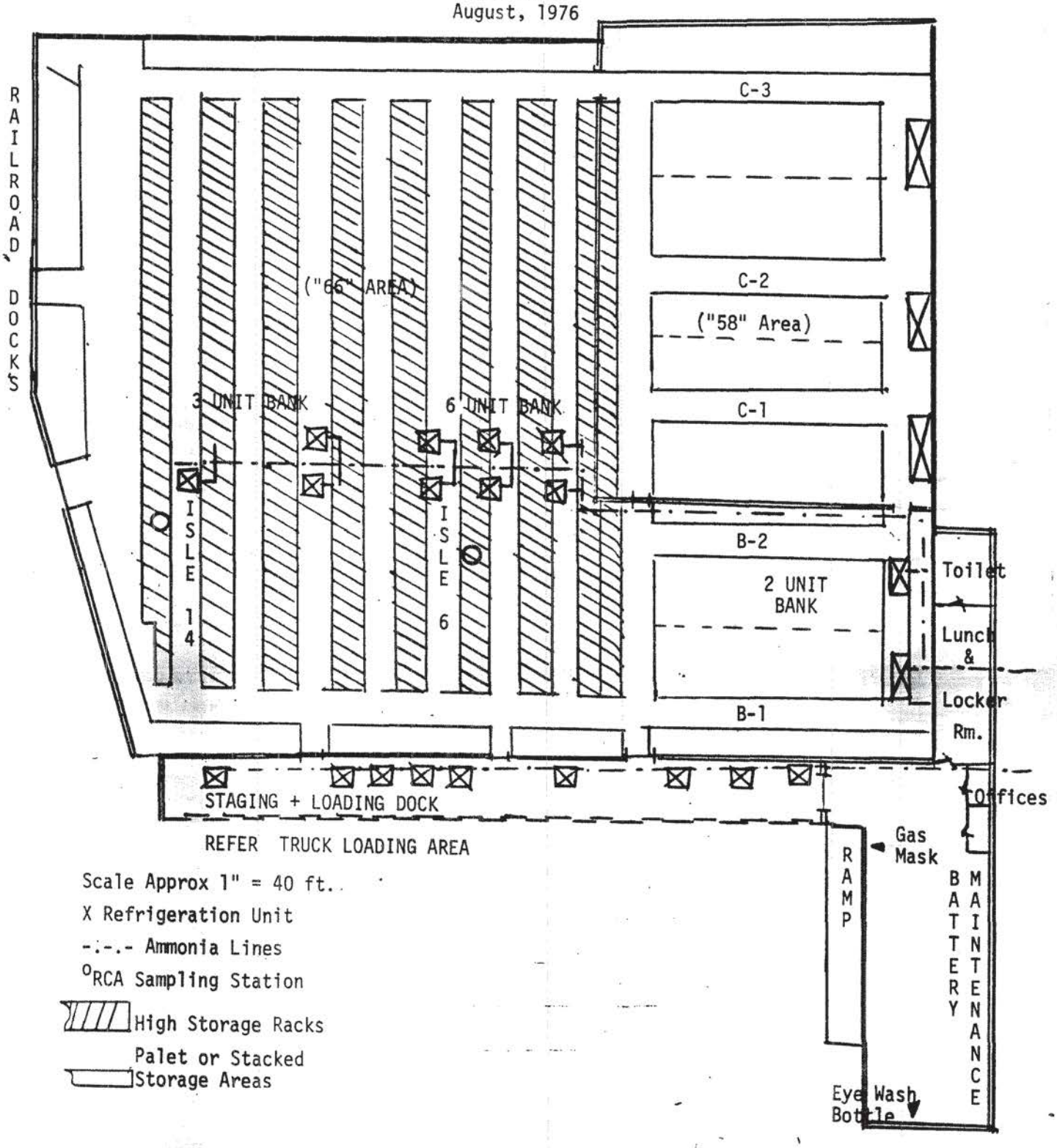

Figure 2

Safeway Stores Inc., Distribution Center RHE 76-91

1501 Cabin Branch Road, Landover, Md.

Time (hr) Aug. 4-5 1976	Defrost Cycle: 3 Unit Bank	2 Unit Bank	6 Unit Bank	Isle 6 Sample Cycle: Sample Number	Ammonia *mg/m³	Sample Period	Isle 14 Sample Cycle: Sample Period	Ammonia *mg/m³	Sample Number
2000			▨	C-1	>110	■			
2100		▨		C-2	>180	■	▨	>27	T-1
2200				C-3	>180	■	▨	<.2	T-2
2300				C-4	>130	■	▨	>50	T-3
2400				C-5	> 88	■	▨	<.2	T-4
0100	▨			C-6	>230	■	▨	>53	T-5
0200			▨	C-7	>170	■	▨	<.2	T-6
0300		▨		C-8	>120	■	▨	>23	T-7
0400				C-9	>88	■	▨	>80	T-8
0500				C-10	>130	■	▨	3.0	T-9
0600				C-11	>130	■			
0700	▨			C-13	>180	■			
0800			▨	C-14	>140	■	▨	<.2	T-13
0900		▨		C-15	>130	■			
				TC-18	<0.33	▨			
1000				TC-19	<0.35	▨			
				TC-20	>75	▨			
1100				TC-21	4.3	▨			
				TC-22	>61	▨			
1200	▨			TC-23	>92	▨			
				TC-24	>92	▨			
				Criteria	36			36	

*CALCULATED CONCENTRATIONS ARE INVALID DUE TO INACCURACIES AND INCONSISTANCIES IN DATA OBTAINED FROM ANALYTICAL METHOD USED

*BLANK SAMPLE DATA

Sample Number	ug/ml	Sample Number	ug/ml
B-1	<1.0	T-10	<1.0
B-2	<1.0	T-11	>400
C-12	>200	T-12	<1.0
P-16	>150	T-14	>200
P-17	<1.0		

GPO: 1971 447-778/88