DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVY ENVIRONMENTAL HEALTH CENTER
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From: Commanding Officer, Navy Environmental Health Center
To: Commanding Officer, U.S. Naval Air Facility Atsugi

Subj: HUMAN HEALTH RISK EVALUATION FOR NAVAL AIR FACILITY, ATSUGI, JAPAN

Encl: (1) Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility, Atsugi, Japan
(2) Executive Summary

1. As you requested, we conducted a human health risk evaluation for the Naval Air Facility, Atsugi, Japan. The evaluation was based on data and documents forwarded to us by the Naval Facilities Engineering Services Center (NFESC), Port Hueneme, CA. Our risk evaluation is provided as enclosure (1). This report is to be incorporated as Part B of a combined report that will include the emissions study conducted by NFESC as Part A.

2. The Executive Summary for the combined report is forwarded as enclosure (2). Please insert the Executive Summary at the beginning of the report.

3. We are available to discuss the enclosed information by telephone with you. If you require additional assistance, please call Ms. Vera Wang, CIH, or Ms. Yvonne P. Walker, CIH, Deputy Director, Environmental Programs Directorate, at (804) 363-5560 and (804) 363-5555, or DSN 564-5560 and DSN 564-5555, respectively.

YPWalker
Y. P. WALKER
By direction

HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY ATSUGI, JAPAN

COMPLETED BY:
The Navy Environmental Health Center
2510 Walmer Avenue
Norfolk, VA 23513
October 1995

Enclosure (1)

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Air pollution resulting from the Japanese owned and operated Jinkanpo Incineration Complex, Atsugi, Japan was investigated to determine its impact on human health for neighboring U.S. Naval Air Facility (NAF) Atsugi and off-base residents.

This investigation was conducted in two parts. Part A is a report on the emissions inventory, an emission rate analysis, ambient air sampling data, and a comparison with air emission standards and guidelines for diagnosing potential health impacts due to the emissions from the incineration complex. This investigation was conducted by the Navy Engineering Facilities Services Center. Part B is the Preliminary Health Risk Evaluation conducted by the Navy Environmental Health Center.

The conclusion of this investigation is that there is a significant degradation in air quality at the sites sampled at NAF Atsugi. The results provide very strong evidence that, the Jinkanpo Incinerator violates Kanagawa Prefecture nuisance laws for air pollutants and other U.S. ambient air quality guidelines. This air quality degradation is potentially due to two sources of air emissions. One is caused by the incomplete burning of wastes and lack of efficient pollution control devices for the incinerators; the other is caused by pouring waste solvents onto waste piles outdoors before incineration. The study results indicate that there is a significantly elevated risk to human health by these sources of pollution. Soil and groundwater contamination are also a potential public health concern.

Based on the results of this study the following recommendations are made: 1) Request that action be taken to provide alternative methods for handling hazardous waste and to reduce incinerator air emissions 2) Conduct additional sampling to include soil and groundwater 3) Provide health education to child care givers to reduce children's exposure to potentially contaminated soil 4) Educate base health care providers in the prompt recognition and treatment of potential medical conditions resulting from the incinerators' emissions 5) Curtail strenuous physical activities, particularly for sensitive populations during periods when respirable particulate levels are elevated.

The draft risk evaluation was provided to a number of independent scientists for their impartial review of the human health risk evaluation report. Peer review comments and our responses were incorporated in this final report.

NAVAL AIR FACILITY ATSUGI
HUMAN HEALTH PRELIMINARY RISK EVALUATION

References:

(a) Health Risk Assessment, Activities at the Jinkanpo Incineration Complex and the Impacts on NAF Atsugi Japan, February 1995

(b) Report of Ambient Air Monitoring of Emissions from the Jinkanpo Incinerator and the Health Risk Assessment for the Naval Air Facility Atsugi, Japan, March 1995

(c) Site Investigation of Incinerator Emissions Impacting the NAF Atsugi, Japan, August 1990

(d) Amended Guidance on Preliminary Risk Evaluations (PREs) for the purpose of reaching a Finding of Suitability to Lease (FOSL), EPA Region IV, December 1994

(e) Risk-Based Concentration Table, January-June 1995, EPA Region III, March 1995

(f) National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR Part 300

(g) Agency for Toxic Substances and Disease Registry (ATSDR) Public Health Assessment for Naval Education and Training Center, Newport, Rhode Island, August 1993

(h) Kurokawa, Y., et al, 1994. Distributions of Atmospheric Coplanar PCBs, Polychlorinated Dibenzo-p-dioxins and Dibenzofurans between Vapor Phase and Particle Phase. Organohalogen Compounds Volume 20: p. 91-94. Proceedings of the 14th International Symposium on Chlorinated Dioxins, PCB and Related Compounds November 21-25, 1994, Kyoto, Japan.

1.0 INTRODUCTION

The objective of this preliminary health risk evaluation is to provide an estimate of the potential human health risk associated with activities at the Jinkanpo Incineration Complex and the impacts on Naval Air Facility (NAF) Atsugi. The Base Environmental Office at NAF Atsugi has requested through the U.S.

Naval Hospital, Yokosuka, Japan that the Navy Environmental Health Center (NAVENVIRHLTHCEN), Norfolk, Virginia, conduct a health risk evaluation of data collected at NAF Atsugi. Information provided to NAVENVIRHLTHCEN included references (a) through (c) and laboratory results of environmental sampling conducted over an eight-week period in July, August and September 1994, described in Part A of the complete report on the impacts of the Jinkanpo Incineration Complex on NAF Atsugi. This report is based on a compilation of information extracted from those documents, laboratory data tables and telephone conversations. A draft of this report was sent to environmental scientists in academia, the United States Environmental Protection Agency (EPA) and the National Academy of Sciences for peer review. Review comments from peer reviewers and NAVENVIRHLTHCEN responses to the reviewers are included in Appendix D.

1.1 SITE HISTORY

Naval Air Facility Atsugi, Atsugi, Japan, is located directly north of the Japanese owned and operated Jinkanpo Incineration Complex. This complex operates as a private waste combustion and disposal facility and is equipped with four incinerators located approximately 100 yards outside the NAF Atsugi fence line.

Environmental concerns have been raised at NAF Atsugi regarding health impacts due to the emission of air pollutants through a fumigation condition and through fugitive emissions during the storage, handling and disposal of liquid and solid waste material on-site from Jinkanpo Incineration Complex. Studies conducted by the Navy Facilities Engineering Services Command (NFESC) in Part A on ambient air quality indicated that there is sufficient and compelling evidence showing that VOCs, PCBs, pesticides, PAHs, dioxins and furans, particulates and heavy metals are being released into the atmosphere at levels exceeding U.S. EPA health risk based standards.

2.0 IDENTIFICATION OF CHEMICALS OF POTENTIAL CONCERN

To identify chemicals of potential concern, ambient air sampling was conducted at a site predicted by air dispersion modeling as having the highest plume concentrations of chemicals released. Upwind background samples were also collected and used in this risk evaluation to demonstrate the incinerators' emissions impact at another site.

2.1 DATA COLLECTION PROCESS

Samples were collected by NFESC and analyzed by ALTA and Air Toxics, Ltd laboratories. Laboratory results located in the Part A Appendix were provided to NAVENVIRHLTHCEN by NFESC in references (a) and (b). The NAVENVIRHLTHCEN used Microsoft EXCEL spreadsheets to organize and convert the laboratory results to units necessary for the risk calculations.

The sampling objectives of the investigation conducted in Part A were to develop air pollution emission rates for the Jinkanpo complex, based on measured ambient air monitoring data, to predict the air quality impacts associated with the operation of the incineration complex for all expected air pollutant emissions, and to prepare Part B, a human health risk screening evaluation of the Jinkanpo Incineration Complex emissions for the area surrounding the complex.

2.1.1 Sampling Design

2.1.1.1 Location

Air samples were collected at the following locations indicated in Figure 1:

a) SITE 1 is located parallel to the incinerator, at approximately 150 meters from the incinerator, on the southwest side of Constellation Road, and on the west side of the green golf ball netting. This site, although very close to the incinerator was considered the best upwind sample location from the incinerator, that was still inside the base property.

b) SITE 2 is located on the south side of the intersection between Towers Avenue and Constellation Road. This site is the closest to the incinerator, and was predicted to have the highest concentration of chemicals released by the incinerator plume.

2.1.1.2 Rationale

Analytical data for this preliminary risk evaluation was provided for SITE 1 and SITE 2 samples. SITE 1 was chosen as an upwind background location for the dispersion modeling, but was not used in this risk evaluation to eliminate contaminants of possible concern, due to its close proximity to the incinerators. Instead it was used to demonstrate the impact of the incinerators's emissions at another site.

SITE 2 was chosen for providing the highest chemical concentrations predicted by the air dispersion model using site specific meteorological data, and for being the closest downwind from the incineration complex.

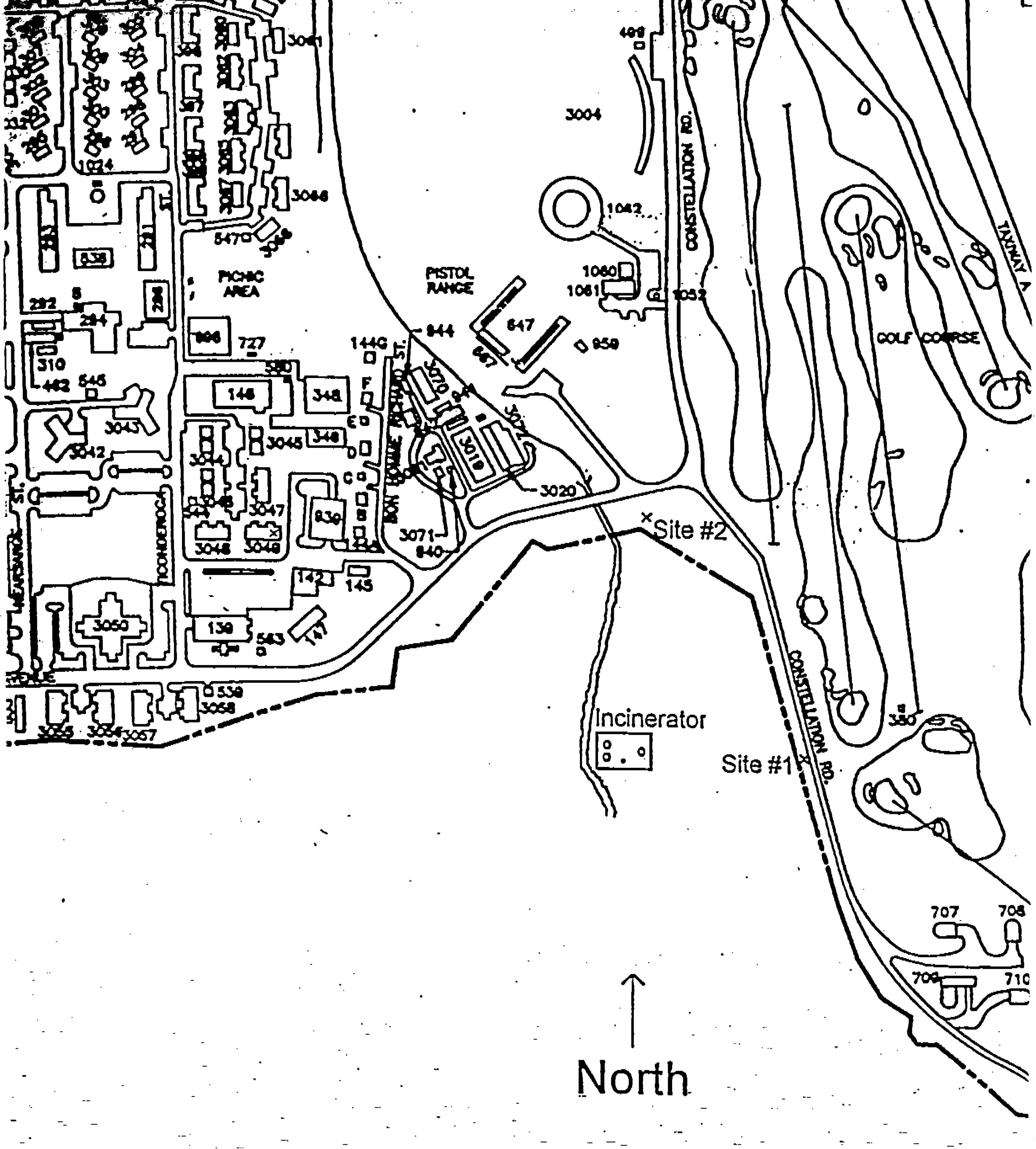


Figure 1
Sampling Locations

2.2 SAMPLING AND ANALYTICAL METHODOLOGY

SITE 1 and 2 samples were taken using Particulate Matter <10 Microns (PM10) and Polyurethane Foam (PUF) Samplers (EPA Methods TO-4, TO-9, TO-13), TENAX tubes (EPA Method TO-1) and SUMMA Canisters (EPA Method TO-1).

2.3 ANALYTICAL RESULTS

Tables 1-1 through 1-6 in Appendix A list the chemical concentrations reported by the laboratory, converted to ug/m^3 for all SITE 1 samples. Tables 1A-1 through 1A-6 indicate the highest, minimum and average concentrations of chemicals found in SITE 1 and number of samples where these chemicals were detected.

Tables 2-1 through 2-6 in the Appendix list the chemical concentrations reported by the laboratory, converted to ug/m^3 for all SITE 2 samples. Tables 2A-1 through 2A-6 indicate the highest, minimum and average concentrations of chemicals found in SITE 2 and number of samples where these chemicals were detected.

2.3.1 Volatile Organic Compounds (VOCs)

SITE 1

VOC analytical results for all SITE 1 samples are presented in the Appendix A Table 1-1 (30 seconds grab SUMMA canisters samples, EPA Method TO-14) and Table 1-2 (2 hours TENAX) tubes samples, EPA Method TO-1).

On Table 1A-1 the VOCs detected in at least one SUMMA sample are: FREON 12 or dichlorodifluoromethane (2-4 ug/m3), FREON 11 or trichlorofluoromethane (1-5 ug/m^3), 1,1-dichloroethene (2 ug/m^3), FREON 113 or 1,1,2-trichloro-1,2,2-trifluoroethane (1-8 ug/m^3), methylene chloride (5-25 ug/m^3), 1,1-dichloroethane (1 ug/m^3), 1,1,1 trichloroethane (3-100 ug/m^3), benzene (2-7 ug/m^3), 1,2 dichloroethane (20 ug/m^3), trichloroethene (3-100 ug/m^3), toluene (2-100 ug/m^3), 1,1,2-trichloroethane (8 ug/m^3), tetrachloroethene (3-54 ug/m^3), chlorobenzene (1-7 ug/m^3), ethylbenzene (1-19 ug/m^3), m,p-xylene (2-25 ug/m^3), o-xylene (3-28 ug/m^3), styrene (3-4 ug/m^3), 1,3,5-trimethylbenzene (1 ug/m^3), 1,2,4-trimethylbenzene (1-10 ug/m^3), 1,4-dichlorobenzene (1-4 ug/m^3), and 1,2,4-trichlorobenzene (6 ug/m^3).

On Table 1A-2, VOCs detected in at least one TENAX sample are: 1,1,1-trichloroethane (0.9- 200 ug/m^3), carbon tetrachloride (1.9-35.2 ug/m^3), benzene (0.9-25.6 ug/m^3), 1,2-dichloroethane (1.9 ug/m^3), n-heptane (0.7-13.8 ug/m^3), toluene (1.0-89.7 ug/m^3), tetrachloroethene (0.8-12.2 ug/m^3), 1,3-dichloropropene (4.4 ug/m^3), ethyl benzene (1.2-14.7 ug/m^3) , m,p-xylene (0.7-45.6 ug/m^3), o-xylene (0.8-22.1 ug/m^3) and bromoform (0.9 ug/m^3).

SITE 2

VOC analytical results for all samples in SITE 2 are presented in Table 2-1 (30 seconds grab SUMMA canisters samples, EPA Method TO-14) and Table 2-2 (2 hours Tenax tubes samples, EPA Method TO-1).

Table 2A-1 indicates that the following VOCs were detected in at least one SUMMA sample on SITE 2: FREON 12 or dichlorodifluoromethane (3-8 ug/m^3), chloromethane (3-5 ug/m^3), FREON 11 or trichlorofluoromethane (5-33 ug/m^3), 1,1-dichloroethene (1.0 ug/m^3), FREON 113 or 1,1,2-trichloro-1,2,2-trifluoroethane(2 ug/m^3), methylene chloride (2-1700 ug/m^3), chloroform (1-170 ug/m^3), 1,1,1 trichloroethane (4-24 ug/m^3), carbon tetrachloride (5 ug/m^3), benzene (5-84 ug/m^3), trichloroethene (1-260 ug/m^3), toluene (50-420 ug/m^3), 1,1,2-trichloroethane (1 ug/m^3), tetrachloroethene (3 ug/m^3), chlorobenzene (1-2 ug/m^3), ethylbenzene (9-110 ug/m^3), m,p-xylene (11-130 ug/m^3), o-xylene (6-42 ug/m^3), styrene (6-41 ug/m^3), 1,3,5-trimethylbenzene (2-10 ug/m^3), 1,2,4-trimethylbenzene (5-32 ug/m^3), 1,3-dichlorobenzene (2 ug/m^3), 1,4-dichlorobenzene (2-5 ug/m^3), and 1,2-dichlorobenzene (3 ug/m^3).

Table 2A-2 indicates that the following VOCs were detected in at least one TENAX sample on SITE 2: chloroform (0.8-12.4 ug/m^3), 1,1,1-trichloroethane (2.8-28 ug/m^3), carbon tetrachloride (0.6-5.1 ug/m^3), benzene (3.9-51.8 ug/m^3), n-heptane (0.8-6.8 ug/m^3), trichloroethene (1.1-29 ug/m^3), 1-2 dichloropropane (5.6-5.9 ug/m^3), toluene (8-142.8 ug/m^3), tetrachloroethene 1.3-10.1 ug/m^3), ethyl benzene (1.4-24.5 ug/m^3), m,p-xylene (1.6-40.8 ug/m^3), and o-xylene (0.7-14.3 ug/m^3).

2.3.2 Polynuclear Aromatic Hydrocarbons (PAHs)

SITE 1

Analytical results for PAHs for all SITE 1 samples are presented in Table 1-3 (24 hours PUF samples, EPA Method TO-13). Table 1A-3 shows that only phenanthrene (0.013-0.024 ug/m^3) was detected in SITE 1 air samples.

SITE 2

Analytical results for PAHs for all SITE 2 samples are presented in Table 2-3 (24 hours PUF samples, EPA Method TO-13). Table 2A-3 shows that PAHs detected in SITE 2 in at least one sample: phenanthrene (0.016-0.035 ug/m^3), fluoranthene (0.014-0.018 ug/m^3), pyrene (0.011-0.023 ug/m^3), and chrysene (0.01 ug/m^3).

2.3.3 Organochlorine Pesticides and PCBs

SITE 1

Table 1-4 shows the analytical results for pesticides and PCBs (24 hours PUF samples, EPA Method TO-4) for SITE 1. Table 1A-4 indicates that pesticides detected in SITE 1 samples are aldrin (0.0014-0.0018 ug/m^3), alpha-BHC or HCH-alpha (0.0023-0.0057 ug/m^3), beta-BHC or HCH-beta(0.0014-0.0034 ug/m^3), delta-BHC or HCH-delta (0.0014-0.0023 ug/m^3), gamma-BHC or HCH-gamma(0.0020-0.0025 ug/m^3), and chlordane (0.0013-0.003 ug/m^3). No PCBs were detected in any SITE 1 samples.

SITE 2

Table 2-4 shows the analytical results for pesticides and PCBs (24 hours PUF samples, EPA Method TO-4) for SITE 2. Table 2A-4 indicates that pesticides detected in SITE 2 samples are aldrin (0.002-0.02 ug/m^3), alpha-BHC or HCH-alpha (0.003-0.004 ug/m^3), beta-BHC or HCH-beta (0.002-0.005 ug/m^3), delta-BHC or HCH-delta (0.002-0.003 ug/m^3), gamma-BHC or HCH-gamma (0.002-0.003 ug/m^3), chlordane (0.001-0.003 ug/m^3), and heptachlor epoxide (0.0010-0.0011 ug/m^3). No PCBs were detected in any SITE 2 samples.

2.3.4 Dioxins and Furans

SITE 1

Analytical results for dioxins and furans are presented in Table 1-5 (24 hours PUF samples, EPA Method TO-9). The following polychlorinated dibenzodioxins and polychlorinated dibenzofurans indicated in Table 1A-5 were detected in SITE 1 samples: Tetrachlorodibenzodioxin (TCDD), Pentachlorodibenzodioxin (PeCDD), Hexachlorodibenzodioxin (HxCDD), and Heptachlorodibenzodioxin (HpCDD). Furans detected were: Tetrachlorodibenzofuran (TCDF), Pentachlorodibenzofuran (PeCDF), Hexachlorodibenzofuran (HxCDF), and Heptachlorodibenzofuran (HpCDF). These dioxins and furans are congeners (have similar physical and chemical properties and similar chemical structures) of 2,3,7,8 TCDD, the reference compound of dioxins and furans. No 2,3,7,8 TCDD was detected at SITE 1. Excluding Hexachlorodibenzodioxins (HxCDD) when the concentrations of the congeners were converted to an equivalent concentration of 2,3,7,8 TCDD shown on Table 1A-5.1, their sum ranged from 1.3 x 10^{-6}-3.4 X 10^{-6} ug/m^3. The HxCDD (total) concentrations ranged from 1.5 X 10-5 to 3.4 X 10^{-5} ug/m^3. Concentrations of these dioxins were converted to their equivalent concentrations of 2,3,7,8 TCDD because of their similar toxicity.

SITE 2

Analytical results for dioxins and furans are presented in Table 2-5 (24 hours PUF samples, EPA Method TO-9). The following polychlorinated dibenzodioxins(and polychlorinated dibenzofurans indicated in Table 2A-5 were detected in SITE 2 samples: Tetrachlorodibenzodioxin (TCDD), Pentachlorodibenzodioxin (PeCDD), Hexachlorodibenzodioxin (HxCDD), and Heptachlorodibenzodioxin (HpCDD). Furans detected were: Tetrachlorodibenzofuran (TCDF), Pentachlorodibenzofuran (PeCDF), Hexachlorodibenzofuran (HxCDF), and Heptachlorodibenzofuran (HpCDF). These dioxins and furans are congeners of 2,3,7,8 TCDD, the reference compound of dioxins and furans. The 2,3,7,8 TCDD concentration ranged from 1.4 X 10^{-7} to 3.3 X 10^{-7} ug/m3. Excluding Hexachlorodibenzodioxins (HxCDD) when the concentrations of the congeners were converted to an equivalent concentration of 2,3,7,8 TCDD shown on Table 2A-5.1, their sum ranged from 6.0 X 10^{-6} to 1.2 X 10^{-5} ug/m^3. The HxCDD (total) concentrations ranged from 6.1 X 10^{-6} to 1.0 X 10^{-4} ug/m^3.

2.3.5 Metals and Particulates

SITE 1

Analytical results for metals and particulates are presented in Table 1-6 (24 hours PM-10 samples). The metals analysis for SITE 1 indicated in Table 1A-6 the presence of chromium (0.0022-0.0071 ug/m^3), arsenic(0.001-0.0031 ug/m^3), selenium (0.0008-0.002 ug/m^3) and lead (0.015-0.070 mg/m^3). Particulates less than 10 microns in size (the respirable fraction) were also detected at 26.2-54.4 ug/m^3. Chromium VI was not detected.

SITE 2

Analytical results for metals and particulates are presented in Table 2-6 (24 hours PM10 samples). The metals analysis for SITE 2 indicated in Table 2A-6 the presence of chromium (0.006-0.138 ug/m^3), arsenic (0.003-0.013 ug/m^3), selenium (0.001-0.025 ug/m^3)and lead (0.27-0.70 ug/m^3). Particulates less than 10 microns in size (the respirable fraction) were also detected at 48.6-85.9 ug/m^3. Chromium VI was not detected.

2.4 DATA REVIEW SUMMARY

2.4.1 Holding Times

Holding times criteria were not consistently met for all VOC and SVOC analyses associated with SITE 1 and SITE 2, due to difficulties encountered in mailing the samples to the laboratory. This may have resulted in some sample loss.

TABLE 1A-1
STATISTICS SITE 1 VOLATILE ORGANIC COMPOUNDS
(SUMMA)

EPA Method TO-14 modified				
30 sec SUMMA samples, QUALIFIERS REMOVED				
SITE 1				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
CHEMICAL	***MINIMUM***	***AVERAGE***	***MAXIMUM***	**DETECTED**
Freon 12	2	3.00	4	5
Freon 114	ND	ND	ND	0
Chloromethane	ND	ND	ND	0
Vinyl Chloride	ND	ND	ND	0
Bromomethane	ND	ND	ND	0
Chloroethane	ND	ND	ND	0
Freon 11	1	2.33	5	3
1,1-Dichloroethene	2	2.00	2	1
Freon 113	1	4.50	8	2
Methylene Chloride	5	10.67	25	6
1,1-Dichloroethane	1	1.00	1	1
cis-1,2-Dichloroethene	ND	ND	ND	0
Chloroform	ND	ND	ND	0
1,1,1-Trichloroethane	3	19.50	100	8
Carbon Tetrachloride	ND	ND	ND	0
Benzene	2	3.50	7	6
1,2-Dichloroethane	20	20.00	20	1
Trichloroethene	3	31.60	100	5
1,2,-Dichloropropane	ND	ND	ND	0
cis-1,3-Dichloropropene	ND	ND	ND	0
Toluene	2	28.08	100	12
trans-1,3-Dichloropropene	ND	ND	ND	0
1,1,2-Trichloroethane	8	8.00	8	1
Tetrachloroethene	3	15.17	54	6
Ethylene Dibromide	ND	ND	ND	0
Chlorobenzene	1	3.00	7	3
Ethyl Benzene	1	5.50	19	10
m,p-Xylene	2	9.67	25	12
O-Xylene	3	10.22	28	9
Styrene	3	3.50	4	2
1,1,2,2-Tetra chloroethane	ND	ND	ND	0
1,3,5-Trimethybenzene	1	1.00	1	2
1,2,4-Trimethylbenzene	1	4.88	10	8
1,3-Dichlorobenzene	ND	ND	ND	0
1,4-Dichlorobenzene	1	2.50	4	4
Chlorotoluene	ND	ND	ND	0
1,2-Dichlorobenzene	ND	ND	ND	0
1,2,4- Trichlorobenzene	6	6.00	6	1
Hexachlorobutadiene	ND	ND	ND	0

TABLE 1A-2
SITE 1 STATISTICS VOLATILE ORGANIC COMPOUNDS
(TENAX)

SITE 1				
TENAX TUBE EPA METHOD TO-1 2 HOUR SAMPLE				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
CHEMICAL	***MINIMUM***	***AVERAGE***	***MAXIMUM***	**DETECTED**
Chloroform	ND	ND	ND	0
1,1,1-Trichloroethane	0.871	21.51218182	200.1	11
Carbon Tetrachloride	1.904	18.547	35.19	2
Benzene	0.884	4.392727273	25.84	11
1,2-Dichloroethane	1.904	1.904	1.904	1
1-Heptene	ND	ND	ND	0
n-Heptane	0.737	5.172333333	13.8	3
Trichloroethene	ND	ND	ND	0
1,2-Dichloropropane	ND	ND	ND	0
Toluene	0.98	22.99475	89.7	12
Tetrachloroethene	0.816	3.729142857	12.24	7
1,3-Dichloropropene	4.352	4.352	4.352	1
Ethylene Dibromide	ND	ND	ND	0
Chlorobenzene	ND	ND	ND	0
Ethyl Benzene	1.156	4.787	14.74	10
m,p-Xylene	0.7	8.005230769	45.56	13
o-Xylene	0.816	4.1233	22.11	10
Bromoform	0.884	0.884	0.884	1
Isopropylbenzene	ND	ND	ND	0
Bromobenzene	ND	ND	ND	0

TABLE 1A-3
SITE 1 STATISTICS POLYCYCLIC AROMATIC HYDROCARBONS
(PUF)

PAHs 24hr.+/- EPA Method TO-13 PUF/modified				
SITE 1				
	ug/m3	***ug/m3***	***ug/m3***	***SAMPLES***
	MINIMUM	***AVERAGE***	***MAXIMUM***	***DETECTED***
CHEMICAL				
Naphthalene	ND	ND	ND	0
2-Methylnaphthalene	ND	ND	ND	0
2-Chloronapthalene	ND	ND	ND	0
Acenaphthylene	ND	ND	ND	0
Acenapthylene	ND	ND	ND	0
Fluorene	ND	ND	ND	0
Phenanthrene	0.013	0.0198	0.0243	6
Anthracene	ND	ND	ND	0
Fluoranthene	ND	ND	ND	0
Pyrene	ND	ND	ND	0
Chrysene	ND	ND	ND	0
Benzo(a) anthracene	ND	ND	ND	0
Benzo(b)fluoranthene	ND	ND	ND	0
Benzo(k)fluoranthene	ND	ND	ND	0
Benzo(a) Pyrene	ND	ND	ND	0
Indeo(1,2,3-c,d)pyrene	ND	ND	ND	0
Dibenz(a,h)anthracene	ND	ND	ND	0
Benzo(g,h,i)perylene	ND	ND	ND	0

TABLE 1A-4
SITE 1 STATISTICS ORGANIC PESTICIDES AND PCBs (PUF)

ORGANOCHLORINE				
PESTICIDES AND PCBS				
24 HRS+/- EPA Method				
TO-4 PUF, modified				
DATE OF SAMPLE				
LAB IDENTIFICATION NUMBER				
SAMPLE NUMBER	***ug/m3***	***ug/m3***	***ug/m3***	***SAMPLES***
	MINIMUM	***AVERAGE***	***MAXIMUM***	**DETECTED**
CHEMICAL				
Aldrin	0.001401724	0.00157647	0.001832461	6
alpha-BHC	0.002303665	0.004080087	0.005710726	6
beta-BHC	0.001414057	0.002350635	0.003455497	6
delta-BHC	0.001361684	0.001771256	0.002325066	6
gama-BHC	0.002016859	0.002215186	0.002513089	6
Chlordane	0.001308901	0.002133171	0.002985231	6
4,4'-DDD	ND	ND	ND	0
4,4'-DDE	ND	ND	ND	0
4,4'-DDT	ND	ND	ND	0
Dieldrin	ND	ND	ND	0
Endosulfan I	ND	ND	ND	0
Endosulfan II	ND	ND	ND	0
Endosulfan Sulfate	ND	ND	ND	0
Endrin	ND	ND	ND	0
Endrine Ketone	ND	ND	ND	0
Heptachlor	ND	ND	ND	0
Heptachloro Epoxide	ND	ND	ND	0
Toaxaphene	ND	ND	ND	0
Aroclor 1016	ND	ND	ND	0
Aroclor 1221	ND	ND	ND	0
Aroclor 1232	ND	ND	ND	0
Aroclor 1242	ND	ND	ND	0
Aroclor 1248	ND	ND	ND	0
Aroclor 1254	ND	ND	ND	0
Aroclor 1260	ND	ND	ND	0

TABLE 1A-5
SITE 1 DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-				
EPA Method TO-9, PUF modified				
SITE 1				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
	MINIMUM	**AVERAGE**	***MAXIMUM***	**DETECTED**
CHEMICAL				
2,3,7,8-TCDD	ND	ND	ND	0
Total TCDD	2.28429E-06	3.73401E-06	4.87064E-06	6
1,2,3,7,8-peCDD	1.55747E-07	2.19E-07	3.08998E-07	6
Total PeCDD	2.95919E-06	4.75985E-06	6.80843E-06	6
1,2,3,4,7,8-HxCDD	1.71478E-07	2.74172E-07	4.1898E-07	6
1,2,3,6,7,8-HxCDD	4.17979E-07	5.78729E-07	8.3796E-07	6
1,2,3,7,8,9-HxCDD	2.35783E-07	3.71119E-07	5.76098E-07	6
Total HxCDD	4.56858E-06	6.95401E-06	9.95078E-06	6
1,2,3,4,6,7,8-HpCDD	2.78652E-06	5.38158E-06	7.22463E-06	6
Total HpCDD	5.89457E-06	1.09397E-05	1.44493E-05	6
OCDD	5.89457E-06	1.74937E-05	4.39035E-05	6
2,3,7,8-TCDF	1.71322E-07	2.89951E-07	4.24217E-07	6
Total TCDF	1.19406E-05	1.92787E-05	2.671E-05	6
1,2,3,7,8-PeCDF	3.84176E-07	6.20997E-07	9.42705E-07	6
2,3,4,7,8-PeCDF	1.14215E-06	1.88991E-06	2.671E-06	6
Total PeCDF	1.45364E-05	2.27148E-05	3.05658E-05	6
1,2,3,4,7,8-HxCDF	8.82567E-07	1.39414E-06	2.0949E-06	6
1,2,3,6,7,8-HxCDF	1.12533E-06	1.71251E-06	2.25202E-06	6
2,3,4,6,7,8-HxCDF	2.62576E-06	4.94865E-06	7.75715E-06	6
1,2,3,7,8,9-HxCDF	8.57392E-07	1.59546E-06	2.43057E-06	6
Total HxCDF	1.50044E-05	2.44452E-05	3.46486E-05	6
1,2,3,4,6,7,8-HpCDF	6.96631E-06	1.2255E-05	1.86171E-05	6
1,2,3,4,7,8,9-HpCDF	2.19707E-06	4.03688E-06	6.20572E-06	6
Total HpCDF	1.76837E-05	3.17527E-05	4.96457E-05	6
OCDF	9.64566E-06	1.77561E-05	2.61198E-05	6

TABLE 1A-5.1
SITE 1 TEF AJUSTED CONCENTRATIONS FOR DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-				
EPA Method TO-9,				
PUF modified				
SITE 1				
		TEF ADJUSTED	**TEF ADJUSTED**	**TEF ADJUSTED**
		ug/m3	***ug/m3***	***ug/m3***
	TEF	***MINIMUM***	**AVERAGE**	***MAXIMUM***
CHEMICAL				
2,3,7,8-TCDD	1	0	0	0
Total TCDD				
1,2,3,7,8-peCDD	0.5	7.78736E-08	1.095E-07	1.54499E-07
Total PeCDD	0	0	0	0
1,2,3,4,7,8-HxCDD				
1,2,3,6,7,8-HxCDD				
1,2,3,7,8,9-HxCDD				
Total HxCDD				
1,2,3,4,6,7,8-HpCDD	0.01	2.78652E-08	5.38158E-08	7.22463E-08
Total HpCDD				
OCDD	0.001	5.89457E-09	1.74937E-08	4.39035E-08
2,3,7,8-TCDF	0.1	1.71322E-08	2.89951E-08	4.24217E-08
Total TCDF				
1,2,3,7,8-PeCDF	0.05	1.92088E-08	3.10499E-08	4.71353E-08
2,3,4,7,8-PeCDF	0.5	5.71073E-07	9.44956E-07	1.3355E-06
Total PeCDF				
1,2,3,4,7,8-HxCDF	0.1	8.82567E-08	1.39414E-07	2.0949E-07
1,2,3,6,7,8-HxCDF	0.1	1.12533E-07	1.71251E-07	2.25202E-07
2,3,4,6,7,8-HxCDF	0.1	2.62576E-07	4.94865E-07	7.75715E-07
1,2,3,7,8,9-HxCDF	0.1	8.57392E-08	1.59546E-07	2.43057E-07
Total HxCDF				
1,2,3,4,6,7,8-HpCDF	0.01	6.96631E-08	1.2255E-07	1.86171E-07
1,2,3,4,7,8,9-HpCDF	0.001	2.19707E-09	4.03688E-09	6.20572E-09
Total HpCDF			0	0
OCDF	0.001	9.64566E-09	1.77561E-08	2.61198E-08
	TEF TOTAL	**1.34966E-06**	**2.29523E-06**	**3.36766E-06**

TABLE 1A-6
SITE 1 STATISTICS PM10 AND METALS

PM10 Site 1				
	ug/m-3	ug/m-3	ug/m-3	SAMPLES
COMPOUND	Minimum	Average	Maximum	DETECTED
	ug/m-3	**ug/m-3**	**ug/m-3**	
PM10	26.2236	37.5859	54.4165	6
Chromium	0.0022	0.0037167	0.0071	6
Arsenic	0.001	0.0019	0.0031	6
Selenium	0.0008	0.00134	0.002	5
Lead	0.0148	0.04645	0.0704	6
Chromium IV	ND	ND	ND	0

TABLE 2A-1
SITE 2 STATISTICS VOLATILE ORGANIC COMPOUNDS (SUMMA)

EPA Method TO-14 modified				
30 sec SUMMA samples,				
SITE 2				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
CHEMICAL	***MINIMUM***	***AVERAGE***	***MAXIMUM***	**DETECTED**
Freon 12	3	6.25	8	4
Freon 114	ND	ND	ND	0
Chloromethane	3	4.33	5	3
Vinyl Chloride	ND	ND	ND	0
Bromomethane	ND	ND	ND	0
Chloroethane	ND	ND	ND	0
Freon 11	5	11.00	33	8
1,1-Dichloroethene	1	1.00	1	1
Freon 113	2	2.00	2	1
Methylene Chloride	6	209.00	1700	13
1,1-Dichloroethane	ND	ND	ND	0
cis-1,2-Dichloroethene	ND	ND	ND	0
Chloroform	1	42.20	170	5
1,1,1-Trichloroethane	4	13.50	24	10
Carbon Tetrachloride	5	5.00	5	1
Benzene	5	24.69	84	13
1,2-Dichloroethane	ND	ND	ND	0
Trichloroethene	1	47.88	260	8
1,2,-Dichloropropane	ND	ND	ND	0
cis-1,3-Dichloropropene	ND	ND	ND	0
Toluene	50	176.85	420	13
trans-1,3-Dichloropropene	ND	ND	ND	0
1,1,2-Trichloroethane	1	1.00	1	1
Tetrachloroethene	3	3.00	3	1
Ethylene Dibromide	ND	ND	ND	0
Chlorobenzene	1	1.50	2	2
Ethyl Benzene	9	45.08	110	13
m,p-Xylene	11	53.64	130	14
0-Xylene	6	21.07	42	14
Styrene	6	18.00	41	10
1,1,2,2-Tetra chloroethane	ND	ND	ND	0
1,3,5-Trimethybenzene	2	6.17	10	6
1,2,4-Trimethylbenzene	5	13.33	32	12
1,3-Dichlorobenzene	2	2.00	2	1
1,4-Dichlorobenzene	2	4.00	5	4
Chlorotoluene	ND	ND	ND	0
1,2-Dichlorobenzene	3	3.00	3	1
1,2,4- Trichlorobenzene	ND	ND	ND	0
Hexachlorobutadiene	ND	ND	ND	0

TABLE 2A-2
SITE 2 STATISTICS VOLATILE ORGANIC COMPOUNDS (TENAX)

SITE 2				
TENAX TUBE EPA METHOD TO-1				
	ug/m3	***ug/m3***	***ug/m3***	**SAMPLES**
CHEMICAL	***MINIMUM***	***AVERAGE***	***MAXIMUM***	**DETECTED**
Chloroform	0.816	5.19	12.42	6
1,1,1-Trichloroethane	2.856	8.24	28	14
Carbon Tetrachloride	0.6566	1.60	5.11	6
Benzene	3.953	24.15	51.75	14
1,2-Dichloroethane	ND	ND	ND	0
1-Heptene	ND	ND	ND	0
n-Heptane	0.828	3.26	6.8	10
Trichloroethene	1.05	9.52	29	11
1,2-Dichloropropane	5.644	5.79	5.934	2
Toluene	8.04	61.51	142.8	14
Tetrachloroethene	1.273	4.32	10.05	3
1,3-Dichloropropene	ND	ND	ND	0
Ethylene Dibromide	ND	ND	ND	0
Chlorobenzene	ND	ND	ND	0
Ethyl Benzene	1.38	13.17	24.48	13
m,p-Xylene	1.608	17.75	40.8	14
o-Xylene	0.737	6.07	14.28	13
Bromoform	ND	ND	ND	0
Isopropylbenzene	ND	ND	ND	0
Bromobenzene	ND	ND	ND	0

TABLE 2A-3
SITE 2 STATISTICS POLYCYCLIC AROMATIC HYDROCARBONS (PUF)

PAHs 24hr. =/- EPA				
Method TO-13 PUF/modified				
SITE 2				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
	MINIMUM	***AVERAGE***	***MAXIMUM***	**DETECTED**
CHEMICAL				
Naphthalene	ND	ND	ND	0
2-Methylnaphthalene	ND	ND	ND	0
2-Chloronapthalene	ND	ND	ND	0
Acenaphthylene	ND	ND	ND	0
Acenapthylene	ND	ND	ND	0
Fluorene	ND	ND	ND	0
Phenanthrene	0.0164	0.023928571	0.0345	7
Anthracene	ND	ND	ND	0
Fluoranthene	0.014	0.015933333	0.0184	3
Pyrene	0.0106	0.014933333	0.0232	3
Chrysene	0.0104	0.0104	0.0104	1
Benzo(a) anthracene	ND	ND	ND	0
Benzo(b)fluoranthene	ND	ND	ND	0
Benzo(k)fluoranthene	ND	ND	ND	0
Benzo(a) Pyrene	ND	ND	ND	0
Indeo(1,2,3-c,d)pyrene	ND	ND	ND	0
Dibenz(a,h)anthracene	ND	ND	ND	0
Benzo(g,h,i)perylene	ND	ND	ND	0

TABLE 2A-4
SITE 2 STATISTICS ORGANIC PESTICIDES AND PCBs (PUF)

ORGANOCHLORINE				
PESTICIDES AND PCBS				
GC\ECD, 24 HR +/-				
EPA Method TO-4,				
PUF, MODIFIED				
SITE 2	***ug/m3***	***ug/m3***	***ug/m3***	**SAMPLES**
	MINIMUM	***AVERAGE***	***MAXIMUM***	**DETECTED**
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	
Aldrin	0.000192966	0.0013366	0.0019	7
alpha-BHC	0.00297991	0.00338897	0.0037	7
beta-BHC	0.0017244	0.00267043	0.00494364	7
delta-BHC	0.001673683	0.00225745	0.00304546	7
gama-BHC	0.001740265	0.00229147	0.0028	7
Chlordane	0.001483093	0.00209429	0.00270153	7
4,4'-DDD	ND	ND	ND	0
4,4'-DDE	ND	ND	ND	0
4,4'-DDT	ND	ND	ND	0
Dieldrin	ND	ND	ND	0
Endosulfan I	ND	ND	ND	0
Endosulfan II	ND	ND	ND	0
Endosulfan Sulfate	ND	ND	ND	0
Endrin	ND	ND	ND	0
Endrine Ketone	ND	ND	ND	0
Heptachlor	ND	ND	ND	0
Heptachloro Epoxide	0.001	0.00103066	0.00106132	2
Toaxaphene	ND	ND	ND	0
Aroclor 1016	ND	ND	ND	0
Aroclor 1221	ND	ND	ND	0
Aroclor 1232	ND	ND	ND	0
Aroclor 1242	ND	ND	ND	0
Aroclor 1248	ND	ND	ND	0
Aroclor 1254	ND	ND	ND	0
Aroclor 1260	ND	ND	ND	0

TABLE 2A-5
SITE 2 DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-				
EPA Method TO-9, PUF modified				
SITE 2				
	ug/m3	*ug/m3*	*ug/m3*	**SAMPLES**
	MINIMUM	***AVERAGE***	***MAXIMUM***	**DETECTED**
CHEMICAL				
2,3,7,8-TCDD	1.42E-07	2.40E-07	3.32E-07	6
Total TCDD	1.52E-05	2.53E-05	3.97E-05	6
1,2,3,7,8-peCDD	4.82E-07	1.17E-06	1.65E-06	6
Total PeCDD	2.12E-05	3.25E-05	4.95E-05	6
1,2,3,4,7,8-HxCDD	8.20E-07	1.24E-06	1.69E-06	6
1,2,3,6,7,8-HxCDD	1.40E-06	2.52E-06	3.81E-06	6
1,2,3,7,8,9-HxCDD	8.68E-07	1.56E-06	2.34E-06	6
Total HxCDD	2.22E-05	3.49E-05	5.44E-05	6
1,2,3,4,6,7,8-HpCDD	1.11E-05	1.92E-05	2.61E-05	6
Total HpCDD	2.27E-05	3.84E-05	5.28E-05	6
OCDD	2.17E-05	4.15E-05	7.56E-05	6
2,3,7,8-TCDF	1.25E-06	1.86E-06	2.64E-06	6
Total TCDF	7.61E-05	1.01E-04	1.31E-04	6
1,2,3,7,8-PeCDF	2.32E-06	3.72E-06	5.29E-06	6
2,3,4,7,8-PeCDF	5.79E-06	7.88E-06	1.11E-05	6
Total PeCDF	7.61E-05	1.00E-04	1.35E-04	6
1,2,3,4,7,8-HxCDF	3.91E-06	6.15E-06	8.70E-06	6
1,2,3,6,7,8-HxCDF	4.39E-06	6.11E-06	8.65E-06	6
2,3,4,6,7,8-HxCDF	8.90E-06	1.11E-05	1.63E-05	6
1,2,3,7,8,9-HxCDF	2.87E-06	3.56E-06	5.29E-06	6
Total HxCDF	6.09E-06	6.13E-05	1.01E-04	6
1,2,3,4,6,7,8-HpCDF	2.37E-05	3.11E-05	4.23E-05	6
1,2,3,4,7,8,9-HpCDF	5.44E-06	7.45E-06	1.06E-05	6
Total HpCDF	4.94E-05	6.63E-05	9.13E-05	6
OCDF	2.32E-05	2.90E-05	3.70E-05	6

TABLE 2A-5.1
SITE 2 TEF ADJUSTED CONCENTRATIONS FOR DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-				
EPA Method TO-9,				
PUF modified				
SITE 2				
Chemical				
		ug/m3	***ug/m3***	***ug/m3***
	TEF	***MINIMUM***	**AVERAGE**	***MAXIMUM***
2,3,7,8-TCDD	1	1.4201E-07	2.40E-07	3.31738E-07
Total TCDD				
1,2,3,7,8-peCDD	0.5	2.41208E-07	5.83E-07	8.2715E-07
Total PeCDD				
1,2,3,4,7,8-HxCDD				
1,2,3,6,7,8-HxCDD				
1,2,3,7,8,9-HxCDD				
Total HxCDD				
1,2,3,4,6,7,8-HpCDD	0.01	1.10956E-07	1.92E-07	2.6104E-07
Total HpCDD				
OCDD	0.001	2.17087E-08	4.15E-08	7.56251E-08
2,3,7,8-TCDF	0.1	1.25428E-07	1.86E-07	2.64347E-07
Total TCDF				
1,2,3,7,8-PeCDF	0.05	1.1578E-07	1.86E-07	2.64347E-07
2,3,4,7,8-PeCDF	0.5	2.8945E-06	3.94E-06	5.52726E-06
Total PeCDF				
1,2,3,4,7,8-HxCDF	0.1	3.90757E-07	6.15E-07	8.70133E-07
1,2,3,6,7,8-HxCDF	0.1	4.38999E-07	6.11E-07	8.65136E-07
2,3,4,6,7,8-HxCDF	0.1	8.89855E-07	1.11E-06	1.63415E-06
1,2,3,7,8,9-HxCDF	0.1	2.86731E-07	3.56E-07	5.28694E-07
Total HxCDF				
1,2,3,4,6,7,8-HpCDF	0.01	2.37295E-07	3.11E-07	4.22955E-07
1,2,3,4,7,8,9-HpCDF	0.01	5.438E-08	7.45E-08	1.05739E-07
Total HpCDF				
OCDF	0.001	2.32351E-08	2.90E-08	3.70086E-08
	TEF TOTAL	5.97284E-06	8.46959E-06	1.20153E-05

TABLE 2A-6
SITE 2 STATISTICS PM10 AND METALS

PM10 Site 2				
	ug/m-3	*ug/m-3*	*ug/m-3*	**SAMPLES**
COMPOUND	***Minimum***	***Average***	***Maximum***	**DETECTED**
PM10	48.5992	65.213817	85.9405	6
Chromium	0.0056	0.0309167	0.138	6
Arsenic	0.003	0.0071167	0.0133	6
Selenium	0.0014	0.0058667	0.025	6
Lead	0.2679	0.4404333	0.7032	6
Chromium IV	ND	ND	ND	0

2.4.2 Method Blank Samples

Method blanks are analytical quality control samples used to assess laboratory contamination that may have been present in the samples, due to contamination of the chemical reagents or the glassware and implements used to store or prepare the sample and resulting solutions. Acetone, methyl ethyl ketone, methylene chloride, toluene, and the phthalate esters are considered by EPA to be common laboratory contaminants. If the blank contains detectable levels of common laboratory contaminants, (e.g. methylene chloride) then the sample results should be considered as positive results only if the concentrations in the sample exceed ten times the maximum amount detected in any blank. For chemicals that are not common laboratory contaminants (e.g. FREON 113), the sample results should be considered positive only if the concentrations in the site sample exceed 5 times the maximum amount detected in any blank.

No contaminants were detected in the blanks, except for two method blanks associated with the VOC analysis of samples collected with SUMMA samplers (methylene chloride and FREON 113) and one blank associated with the dioxins and furans analysis (OCDD). The methylene chloride concentrations in the samples exceeded 10 times the concentrations in the blank concentrations and were considered positive results. FREON 113 concentrations were not considered positive results because the concentration in the sample was lower than in the blank.

2.4.3 Laboratory Control Samples, Surrogate Compound Recoveries, Matrix Spike/Matrix Spike Duplicate Samples, Field Duplicate Samples

The following QC elements have not been validated for completeness of the data package: results of laboratory control samples, recoveries of surrogate spikes in samples, and duplicate samples. However, the laboratory has qualified the data by using the following flags:

Organics

ND - Not detected.
J - Below detection limit but supported by mass spectra.
B - Compound present in laboratory blank. Background subtraction not performed.
E - Exceed calibration range, but within linear range.

2.5 RISK SCREENING METHODOLOGY

To determine the potential risk to human health by the Jinkanpo Complex emissions to on- and off-base communities living at or near NAF Atsugi, the cancer and non-cancer risks were estimated according to reference (d), the "Preliminary Risk

Evaluation (PRE) Guidance" from U.S. EPA Region IV using reference (e) U.S. EPA Region III RBCs. The PRE is accomplished using tables constructed for carcinogens and non-carcinogens. The tables include columns listing individual hazardous chemicals, their EPA Region III risk based concentrations (RBCs) and the ratios between the maximum concentrations and the screening values. For carcinogens these ratios are multiplied by 10^{-6} giving a risk estimate; for non-carcinogens, the ratios themselves give an estimate of the non-cancer hazard. The risks from all the chemicals are summed to arrive at an aggregate risk for the medium. In the risk screening for NAF Atsugi, the non-cancer hazard quotient for all chemicals were not summed because the non-cancer chemicals do not affect the same organs. If the cancer risk at a given site is greater than 10^{-4} or the non-cancer hazard is greater than 1, there is reason for concern and this is a general indication that the site will require further investigation.

The EPA Region III RBCs have been calculated for standard exposure scenarios to give chemical concentrations that correspond to fixed levels of risk (i.e., a hazard quotient of 1, or lifetime cancer risk of 10^{-6}, whichever occurs at the lower concentration) in tap water, ambient air, fish, industrial soil and residential soil. In other words, the Region III RBCs represent a concentration of chemicals below which little or no adverse health effects are observed even in most sensitive populations such as children and the elderly.

To calculate the RBCs, EPA Region III uses conservative assumptions for the numbers needed in the risk equations, to be protective of children and the elderly. The RBC risk equation and default parameters are included in Appendix B. In applying standard risk assessment methodologies to develop these screening concentrations EPA Region III makes the following assumptions:

Target Cancer Risk

For regulatory purposes EPA has established that the acceptable level of cancer risk due to a chemical is 1×10^{-6} or ("one times ten to the minus sixth"), which in scientific terms means "one-in-a-million". One-in-a-million is a probability based on data and many health protective assumptions that there may be one extra cancer case in a population of one million people over a lifetime of exposure to a chemical. It can be thought of as a maximum probability because worst case situations are assumed where science has no definite answers, just to be on the safe side of protecting public health. Because the cancer risk probability is a maximum probability it means that a cancer case may not occur at all, but if it does, there is at most a one-in-a-million likelihood for an extra cancer case above the expected 250,000 cancer cases that would normally occur in a population of one million.

Target Hazard Index

EPA has established for regulatory purposes that when the total hazard index for an exposed individual or group of individuals exceeds 1, there may be concern for potential non-cancer effects, such as respiratory illnesses. The hazard index is the sum of the hazard quotients for each chemical. The hazard quotient is the measure used to describe the potential for non-carcinogenic toxicity to occur in an individual. Unlike the cancer risk, the hazard index is not expressed as a probability of an individual suffering an adverse effect.

Averaging Time

The averaging time selected depends on whether cancer or non-cancer effects are being evaluated. For long-term exposure to non-cancer chemicals, the averaging time of exposure is the actual period of exposure, for example how long an individual lived at a place of exposure. For carcinogens the exposure is assumed to be 70 years, because the cancer causing exposure is considered over a lifetime.

Exposure Frequency

The assumed frequency of exposure for a residential setting is 350 days per year.

Exposure Duration

The exposure duration is how many years a person spends at a single residence. The risk assessment methodology assumes it to be 30 years for adults and 6 years for children. The RBC screening methodology uses an exposure duration of 30 years, 24 years as an adult and 6 years as a child. A 30-year exposure duration is a reasonable exposure assumption for the Japanese residents living off-base. However, in this report we considered various exposure durations of 30, 25, 20, 15, 10, 6 and 3 years.

Body Weight

The body weight used is the average body weight over the exposure duration. A constant body weight over the period of exposure is assumed to be 70 kg for adults and 15 kg for children (average body weight of a child during 6 years).

Other factors used in the risk equations are conversion factors such as the cancer slope factor (for carcinogens) and the reference concentration (for non-carcinogens). These factors are derived for each chemical based on animal studies and used to extrapolate toxicity results from animals to humans. Because they are based on animal studies there are a few layers of safety built into these factors.

2.6 HUMAN HEALTH RISK CALCULATIONS

2.6.1 HEALTH RISK FOR MAXIMUM CHEMICAL CONCENTRATIONS

SITE 1

Cancer and non-cancer risks were calculated for all maximum chemical concentrations detected in SITE 1 and they are summarized in Tables 1B-Max and 1C-Max constructed for carcinogens and non-carcinogens, respectively. The tables include columns listing the individual chemicals, their maximum detected concentrations, their Region III RBCs for ambient air and the estimated cancer or non-cancer hazard risks.

Carcinogens

Chemical carcinogens detected in ambient air are aldrin, arsenic, benzene, bromoform, carbon tetrachloride, chlordane, 1,2-dichloroethane, 1,1 dichloroethylene, 1,3 dichloropropene, alpha-BHC (HCH-alpha), beta-BHC (HCH-beta), gamma-BHC (HCH-gamma), heptachlor epoxide, hexachlorodibenzo-p-dioxin mixture, methylene chloride, 2,3,7,8-TCDD, tetrachloroethylene, 1,1,2-trichloroethane, and trichloroethylene.

The total cancer risk at SITE 1 is 1.14 X 10^{-3}, and it was calculated by summing the risks from all detected carcinogens, including those that did not exceed the RBCs. This information is presented on Table 2B-Max. Using EPA's criteria in reference (f), the carcinogens posing a cancer risk greater than 10^{-4} are benzene (1.17 X 10^{-4}), carbon tetrachloride (2.93 X 10^{-4}), 1,2-dichloroethane, and trichloroethylene (1.0 X 10^{-4}).

Non-carcinogens

Non-carcinogens detected in ambient air are arsenic, chlorobenzene, chromium, 1,2-dichlorobenzene, 1,3-dichlorobenzene, FREON 12 or dichlorodifluoromethane, 1,1-dichloroethane, ethylbenzene, selenium, styrene, toluene, 1,2,4-trichlorobenzene, 1,1,1-trichloroethane, FREON 11 or trichlorofluoromethane, FREON 113, 1,1,2-trichloro-1,2,2-trifluoroethane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, o-xylene, and p-xylene.

Non-carcinogens with levels higher than EPA Region III RBCs for ambient air were 1,2,4-trimethylbenzene (5.5), and chromium III and compounds (3.4). Their hazard quotients are presented on Table 2C-Max.

EPA Region III does not have RBC values for lead and respirable particulate matter; therefore these chemicals can not be quantitatively carried through the risk assessment. The U.S. EPA National Ambient Air Quality Standards (NAAQS) for lead (50

ug/m^3, annual average and 150 ug/m3 maximum quarterly average) and PM10 (50 ug/m^3, annual average and 150 ug/m^3 as a 24 hour average) were used to determine if lead and respirable particulates are contaminants of concern. PM10 concentrations of 54.4 ug/m^3 at SITE 2 slightly exceeded the NAAQS for annual average, but not the 24-hour averaging time not to be exceeded more than once a year. Lead concentrations of 0.07 ug/m^3 did not exceed the NAAQS of 1.5 ug/m^3 maximum quarterly average.

SITE 2

Cancer and non-cancer risks were calculated for all maximum chemical concentrations detected in SITE 2 and they are summarized in Tables 2B-Max and 2C-Max constructed for carcinogens and non-carcinogens respectively. The tables include columns listing the individual chemicals, their maximum detected concentrations, their Region III RBCs for ambient air and the estimated cancer and non-cancer hazard risks.

Carcinogens

Chemical carcinogens detected in ambient air are aldrin, arsenic, benzene, carbon tetrachloride, chlordane, chloroform, chloromethane, 1,4 dichlorobenzene, 1,1 dichloroethylene, 1,2 dichloropropane, alpha-BHC (HCH-alpha), beta-BHC (HCH-beta), gamma-BHC (HCH-gamma), heptachlor epoxide, hexachlorodibenzo-p-dioxin mixture, methylene chloride, chrysene, 2,3,7,8-TCDD, tetrachloroethylene, 1,1,2-trichloroethane, and trichloroethylene.

The total cancer risk at SITE 2 is $3.79 X 10^{-3}$, and it was calculated by summing the risks from all detected carcinogens, including those that did not exceed the RBCs. This information is presented on Table 2B-Max. Using EPA's criteria in reference (f), the carcinogens posing a cancer risk greater than 10^{-4} are benzene ($3.82 X 10^{-4}$), chloroform ($2.18 X 10^{-3}$), methylene chloride ($4.47 X 10^{-3}$), 2,3,7,8-TCDD ($2.4 X 10^{-4}$) and trichloroethylene ($2.6 X 10^{-4}$).

Non-carcinogens

Non-carcinogens detected in ambient air are arsenic, chlorobenzene, chromium, 1,2-dichlorobenzene, 1,3-dichlorobenzene, FREON 12 or dichlorodifluoromethane, ethylbenzene, fluoranthene, pyrene, selenium, styrene, toluene, 1,1,1-trichloroethane, FREON 11 or trichlorofluoromethane, FREON 113, 1,1,2-trichloro-1,2,2-trifluoroethane, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, o-xylene, and p-xylene.

Non-carcinogens with levels higher than EPA Region III RBCs for ambient air were 1,3,5-trimethylbenzene (6.7), 1,2,4-

TABLE 2B-MAXIMUM
AMBIENT AIR CANCER SCREENING RISK SITE 2

Contaminant	RBC	C or N	Sample	Carc-Risk
Aldrin	0.00037	C	0.0019	5.14E-06
Arsenic (as carcinogen)	0.00041	C	0.0133	3.24E-05
Benzene	0.22	C	84	3.82E-04
Carbon tetrachloride	0.12	C	5.11	4.26E-05
Chlordane	0.0049	C	0.002702	5.51E-07
Chloroform	0.078	C	170	2.18E-03
Chloromethane	0.99	C	5	5.05E-06
1,4-Dichlorobenzene	0.26	C	5	1.92E-05
1,1-Dichloroethylene (1,1-Dichloroethene)	0.036	C	1	2.78E-05
1,2-Dichloropropane	0.092	C	5.934	6.45E-05
HCH (alpha) (alpha-BHC)	0.00099	C	0.0037	3.74E-06
HCH (beta) (beta-BHC)	0.0035	C	0.004944	1.41E-06
HCH (gamma) Lindane (gamma-BHC)	0.0048	C	0.0028	5.83E-07
Heptachlor epoxide	0.00069	C	0.006132	8.89E-06
Hexachlorodibenzo-p-dioxin mixture	0.000001	C	5.44E-05	5.44E-05
Methylene chloride	3.8	C	1700	4.47E-04
PAH Chrysene	1	C	0.0104	1.04E-08
2,3,7,8-TCDD (dioxin)	5E-08	C	1.2E-05	2.40E-04
Tetrachloroethylene (PCE) (Tetrachloroethene)	3.1	C	10.05	3.24E-06
1,1,2-Trichloroethane	0.11	C	1	9.09E-06
Trichloroethylene (TCE)	1	C	260	2.60E-04
			TOTAL	3.79E-03

2,3,7,8 TCDD INCLUDES TEF CONVERTED CONCENTRATIONS FOR 2,3,7,8 CDD AND CDF CONGENERS EXCEPT FOR HxCDD CONGENERS

TABLE 2C-MAXIMUM
AMBIENT AIR NON-CANCER SCREENING RISK SITE 2

Contaminant	RBC	C or N	Sample	Non-carc Risk
Arsenic	1.1	N	0.0133	0.012090909
Chlorobenzene	21	N	2	0.095238095
Chromium III and compounds	0.0021	N	0.138	65.71428571
1,2-Dichlorobenzene	150	N	3	0.02
1,3-Dichlorobenzene	320	N	2	0.00625
Dichlorodifluromethane (Freon 12)	210	N	8	0.038095238
Ethylbenzene	1000	N	110	0.11
PAH Fluoranthene	150	N	0.0184	0.000122667
PAH Pyrene	110	N	0.0232	0.000210909
Selenium	18	N	0.025	0.001388889
Styrene	1000	N	41	0.041
Toluene	420	N	420	1
1,1,1-Trichloroethane	1000	N	28	0.028
Trichlorofluoromethane (Freon 11)	730	N	33	0.045205479
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	31000	N	2	6.45161E-05
1,2,4-Trimethylbenzene	1.8	N	32	17.77777778
1,3,5-Trimethylbenzene	1.5	N	10	6.666666667
o-Xylene	730	N	42	0.057534247
p-Xylene	310	N	130	0.419354839

trimethylbenzene (17.8), and chromium III and compounds (66.7). Their hazard quotients are presented on Table 2C-Max.

EPA Region III does not have RBC values for lead and respirable particulate matter. The U.S. EPA National Ambient Air Quality Standards (NAAQS) for lead (50 ug/m^3 and 150 ug/m^3 maximum quarterly average) and PM10 (50 ug/m^3, annual average and 150 ug/m^3 as a 24 hour average) were used to include lead and respirable particulates as contaminants of concern. PM10 concentrations of 85 ug/m^3 at SITE 2 exceeded the NAAQS for annual average, but not the 24-hour averaging time not to be exceeded more than once a year. Lead concentrations of 0.7 ug/m^3 did not exceed the NAAQS annual average or the 1.5 ug/m^3 maximum quarterly average.

2.6.2 HEALTH RISK FOR AVERAGE CHEMICAL CONCENTRATIONS

SITE 1

Cancer and non-cancer risks were calculated for all average chemical concentrations detected in SITE 1 and they are summarized in Tables 1B-Ave and 1C-Ave constructed for carcinogens and non-carcinogens, respectively. The tables include columns listing the individual hazardous chemicals, their maximum detected concentrations, their Region III RBCs for ambient air and the estimated cancer or non-cancer hazard risks.

Carcinogens

The total cancer risk at SITE 1 is 5.4 X 10^{-4}. This information is presented on Table 1B-Ave. Using EPA's criteria in reference (f), the only carcinogens posing a cancer risk greater than 10^{-4} is carbon tetrachloride (1.55 X 10^{-4}).

Non-carcinogens

Non-carcinogens with levels higher than EPA Region III RBCs for ambient air were 1,2,4-trimethylbenzene (2.7), and chromium III and compounds (1.8). Their hazard quotients are presented on Table 1C-Ave.

PM10 average concentrations of 37.6 ug/m^3 at SITE 1 did not exceeded the NAAQS for annual average, or the 24-hour averaging time not to be exceeded more than once a year. Average lead concentrations of 0.05 ug/m^3 did not exceed the NAAQS maximum quarterly average or the annual average.

TABLE 1B-AVERAGE
AMBIENT AIR CANCER SCREENING RISK SITE 1

Contaminant	RBC	C or N	Sample	Carc-Risk
Aldrin	0.00037	C	0.001576	4.26E-06
Arsenic (as carcinogen)	0.00041	C	0.0019	4.63E-06
Benzene	0.22	C	4.392727	2.00E-05
Bromoform (tribromomethane)	1.6	C	0.884	5.53E-07
Carbon tetrachloride	0.12	C	18.547	1.55E-04
Chlordane	0.0049	C	0.002133	4.35E-07
1,4-Dichlorobenzene	0.26	C	2.5	9.62E-06
1,2-Dichloroethane (EDC)	0.069	C	1.904	2.76E-05
1,1-Dichloroethylene (1,1-Dichloroethene)	0.036	C	2	5.56E-05
1,3-Dichloropropene	0.048	C	4.352	9.07E-05
HCH (alpha) (alpha-BHC)	0.00099	C	0.00408	4.12E-06
HCH (beta) (beta-BHC)	0.0035	C	0.002351	6.72E-07
HCH (gamma) Lindane (gamma-BHC)	0.0048	C	0.002215	4.61E-07
Hexachlorodibenzo-p-dioxin mixture	0.000001	C	6.95E-06	6.95E-06
Methylene chloride	3.8	C	10.67	2.81E-06
2,3,7,8-TCDD (dioxin)	5E-08	C	2.3E-06	4.59E-05
Tetrachloroethylene (PCE) (Tetrachloroethen	3.1	C	15.17	4.89E-06
1,1,2-Trichloroethane	0.11	C	8	7.27E-05
Trichloroethylene (TCE)	1	C	31.6	3.16E-05
			TOTAL	5.38E-04

2,3,7,8 TCDD INCLUDES TEF CONVERTED CONCENTRATIONS FOR 2,3,7,8 CDD AND CDF CONGENERS EXCEPT FOR HxCDD CONGENERS

TABLE 1C-AVERAGE
AMBIENT AIR NON CANCER SCREENING RISK SITE 1

Contaminant	RBC	C or N	Sample	Non-carc Risk
Arsenic	1.1	N	0.0019	0.001727273
Chlorobenzene	21	N	3	0.142857143
Chromium III and compounds	0.0021	N	0.003717	1.769857143
Dichlorodifluromethane (Freon 12)	210	N	3	0.014285714
1,1-Dichloroethane	520	N	1	0.001923077
Ethylbenzene	1000	N	5.5	0.0055
Selenium	18	N	0.00134	7.44444E-05
Styrene	1000	N	3.5	0.0035
Toluene	420	N	28.08	0.066857143
1,2,4-Trichlorobenzene	210	N	6	0.028571429
1,1,1-Trichloroethane	1000	N	21.51218	0.021512182
Trichlorofluoromethane (Freon 11)	730	N	2.33	0.003191781
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 1	31000	N	4.5	0.000145161
1,2,4-Trimethylbenzene	1.8	N	4.88	2.711111111
1,3,5-Trimethylbenzene	1.5	N	1	0.666666667
o-Xylene	730	N	10.22	0.014
p-Xylene	310	N	9.67	0.031193548

TABLE 2B-AVERAGE
AMBIENT AIR CANCER SCREENING RISK SITE 2

Contaminant	RBC	C or N	Sample	Carc-Risk
Aldrin	0.00037	C	0.001337	3.61E-06
Arsenic (as carcinogen)	0.00041	C	0.007117	1.74E-05
Benzene	0.22	C	24.69	1.12E-04
Carbon tetrachloride	0.12	C	5	4.17E-05
Chlordane	0.0049	C	0.002094	4.27E-07
Chloroform	0.078	C	42.2	5.41E-04
Chloromethane	0.99	C	4.33	4.37E-06
1,4-Dichlorobenzene	0.26	C	4	1.54E-05
1,1-Dichloroethylene (1,1-Dichloroethene)	0.036	C	1	2.78E-05
1,2-Dichloropropane	0.092	C	5.79	6.29E-05
HCH (alpha) (alpha-BHC)	0.00099	C	0.003389	3.42E-06
HCH (beta) (beta-BHC)	0.0035	C	0.00267	7.63E-07
HCH (gamma) Lindane (gamma-BHC)	0.0048	C	0.002291	4.77E-07
Heptachlor epoxide	0.00069	C	0.001031	1.49E-06
Hexachlorodibenzo-p-dioxin mixture	0.000001	C	3.49E-05	3.49E-05
Methylene chloride	3.8	C	209	5.50E-05
PAH Chrysene	1	C	0.0104	1.04E-08
2,3,7,8-TCDD (dioxin)	5E-08	C	8.47E-06	1.69E-04
Tetrachloroethylene (PCE) (Tetrachloroethen	3.1	C	4.32	1.39E-06
1,1,2-Trichloroethane	0.11	C	1	9.09E-06
Trichloroethylene (TCE)	1	C	47.88	4.79E-05
			TOTAL	1.15E-03

2,3,7,8 TCDD INCLUDES TEF CONVERTED CONCENTRATIONS FOR 2,3,7,8 CDD AND CDF CONGENERS EXCEPT FOR HxCDD CONGENERS

TABLE 2C-AVERAGE
AMBIENT AIR NON-CANCER SCREENING RISK SITE 2

Contaminant	RBC	C or N	Sample	Non-carc Risk
Arsenic	1.1	N	0.007117	0.006469727
Chlorobenzene	21	N	1.5	0.071428571
Chromium III and compounds	0.0021	N	0.030917	14.7222381
1,2-Dichlorobenzene	150	N	3	0.02
1,3-Dichlorobenzene	320	N	2	0.00625
Dichlorodifluromethane (Freon 12)	210	N	6.25	0.029761905
Ethylbenzene	1000	N	45.08	0.04508
PAH Fluoranthene	150	N	0.015933	0.000106222
PAH Pyrene	110	N	0.014933	0.000135757
Selenium	18	N	0.005867	0.000325928
Styrene	1000	N	18	0.018
Toluene	420	N	176.85	0.421071429
1,1,1-Trichloroethane	1000	N	13.5	0.0135
Trichlorofluoromethane (Freon 11)	730	N	11	0.015068493
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 1	31000	N	2	6.45161E-05
1,2,4-Trimethylbenzene	1.8	N	13.33	7.405555556
1,3,5-Trimethylbenzene	1.5	N	6.17	4.113333333
o-Xylene	730	N	21.07	0.028863014
p-Xylene	310	N	53.64	0.173032258

SITE 2

Carcinogens

The total cancer risk at SITE 2 is 1.15 X 10^{-3}. This information is presented on Table 2B-Ave. Using EPA's criteria in reference (f), the carcinogens posing a cancer risk greater than 10^{-4} are benzene (1.12 X 10^{-4}), chloroform (5.4 X 10^{-4}), and 2,3,7,8-TCDD (1.7 X 10^{-4}).

Non-carcinogens

Non-carcinogens with levels higher than EPA Region III RBCs for ambient air were 1,3,5-trimethylbenzene (4.1), 1,2,4-trimethylbenzene (7.4), and chromium III and compounds (14.7). Their hazard quotients are presented on Table 2C-Ave.

Average PM10 concentrations of 65.2 ug/m^3 at SITE 2 exceeded the NAAQS annual average for PM10, but not the 24-hour averaging time not to be exceeded more than once a year. Lead concentrations of 0.44 ug/m^3 did not exceed the NAAQS of 1.5 ug/m3 maximum quarterly average or the annual average.

3.0 EXPOSURE ASSESSMENT

3.1 CHARACTERIZATION OF EXPOSURE SETTING

The Jinkanpo Incineration Complex in Atsugi, Japan is located in a small river (Tade River) valley. NAF Atsugi is situated north at the end of the valley, up on a plateau. The incinerator stack heights are barely above the plateau height. In the summer months, May through August, the prevailing winds are south to north, towards NAF Atsugi. When the wind has a high enough velocity, the plume does not rise and is carried downwind toward the base at stack height which is ground level for the base. With high wind velocity, this condition known as fumigation is intensified and occurs almost daily during the summer months.

According to reference (c), the complex also stores various waste materials on site prior to incineration. Liquid industrial wastes were seen being poured onto the solid waste piles prior to burning, a waste management practice that still continues. In addition the piles appeared to rest on the ground with no lining, and no prevention of runoff migration to the Tade River. The four incinerators in the complex burn municipal solid waste, liquid and solid industrial waste, solid commercial waste, construction debris and tires. The incineration plant has operated since 1980. Although it has evolved from an unrestricted open burn pit to its current three wet scrubbers, it appears to be still far from producing clean emissions.

An air quality impact analysis using EPA approved air dispersion model ISCST2, performed in Part A shows the plume dilution (Figures 3-1 through 3-4). The analysis has indicated that for long term chronic health effects, as well as short term acute health effects, the maximum impact occurs for on-base receptors along the NAF Atsugi southern property boundary, closest to the Jinkanpo Incinerator Complex. Plume dilution isopleths indicate that, the plume does not completely dissipate with distance from the incinerators. Chemical concentrations at the end of the plume near the northern boundary 3-3.5 kilometers (km) away, still remain at one tenth of the values detected at the southern boundary.

Groundwater elevations obtained from the Kanagawa Prefectural Government indicate in Figure 3-5 that the groundwater flow direction is north, meaning that it runs under the Jinkanpo Incineration complex before reaching NAF Atsugi. Three groundwater wells located within a 0.5 km radius at NAF Atsugi, north of the incinerators, are used for drinking water in the winter months. Groundwater wells are 60 meters deep. Drinking water analysis in 1994 indicated that the levels of trichloroethylene before purification by the drinking water treatment plant are higher than the allowed maximum contaminant level (MCL) of 5 parts per billion. Several natural water springs found northwest of NAF Atsugi are likely to be contaminated also.

A deep well geological survey conducted at NAF Atsugi in 1989 indicated that surface soils are bank and old topsoil. The sub-surface soils are loam, pozzolanic cohesive soil, clayish gravel, silt and clay. There are two thin (0.5 m) clay layers at 43 and 55 meters.

The nearest surface water body is the Tade River which runs south and separates NAF Atsugi and the Jinkanpo Complex. According to base personnel the river shows visible signs of water pollution.

As indicated in Figure 3-6, the areas surrounding the Jinkanpo Incineration Complex within 1.5 km, besides NAF Atsugi housing areas, are off-base residential areas in the Japanese community. A pig farm is located east of the incineration complex.

NAF Atsugi accommodates housing, a youth center, a child development center, an elementary school and a golf course located 0.25 miles from the incinerators. The population for NAF Atsugi, an area of approximately 6 Km^2, is 7000 people. The NAF Atsugi population residing on base is 2,790 including 1,223 people under the age of 18, 1,489 people from ages 18-44, and 78 people over the age of 45.

3.2 IDENTIFICATION OF EXPOSURE PATHWAYS

A conceptual site model shown on Figure 3-7 illustrates completed and potential exposure pathways associated with incineration activities at the Jinkanpo Incineration Complex.

A complete exposure pathway includes five necessary elements: 1) a source of chemicals 2) a mechanism of chemical release 3) an environmental transport medium (air, surface water, etc.) 4) an exposure point 5) human intake route (inhalation, ingestion, etc.).

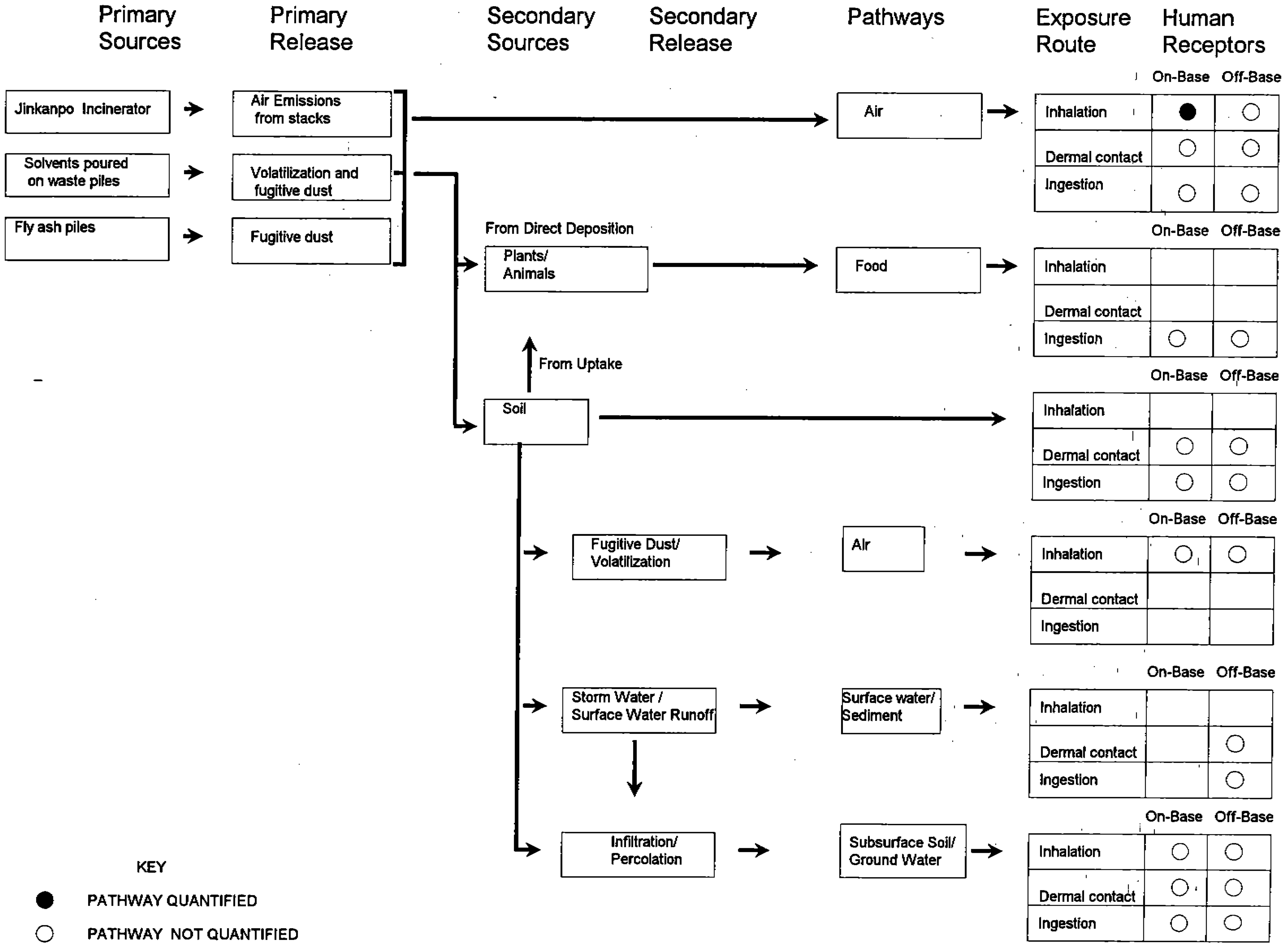
Air

Sampling conducted in references (a) through © indicated that VOCs, PAHs, pesticides, dioxins and furans, and particulate matter have been released to the air during municipal and industrial wastes incineration through the incinerators stack emissions. Additionally, fugitive emissions from the waste and fly ash storage areas at the Jinkanpo Incineration Complex have also been released to the atmosphere. Reports of liquid industrial wastes being poured onto solid waste piles prior to burning suggest that this activity may be the source of VOCs and dioxins by volatization, while the incomplete combustion of incineration may be the source of PAHs, pesticides, dioxins and furans. Treatment and disposal of incinerator ash could be a source of metals, dioxins and furans. Wind blown and stack emitted fly ash appear to be the sources of particulate matter. Resident adults and children, workers and visitors on NAF Atsugi, as well as the off-base residents living south of the Jinkanpo Incineration Complex, have been exposed to these chemicals by inhalation, therefore making ambient air a complete exposure pathway. Exposure is more frequent and longer during the warm season for U.S. and Japanese base residents and personnel, and for residents of the neighboring city of Ayase, when the wind blows to the north. In the opposite season, when the wind blows mainly to the south, exposure is more frequent and longer for the workers at the Ayase industrial complex located south of the Jinkanpo Incinerators.

Soil

Information contained in reference (c) indicates that surface and subsurface soil at the Jinkanpo Incineration Complex may be contaminated with industrial wastes. Liquid industrial wastes being poured onto unlined solid waste piles prior to incineration, potentially could result in surface and subsurface soil contamination. The release mechanism would be infiltration of liquid wastes into the soil. Fugitive dust from blown soil and fly ash could potentially result in inhalation by on-base

Figure 3-7
Conceptual Site Model Jinkanpo Incinerator



human receptors near the NAF fence line, or off-base, therefore creating a potential exposure pathway.

Wind blown and stack emitted fly ash accumulation on soil by deposition could also provide a potential soil pathway for children playing outside, in playgrounds or yards through incidental soil ingestion, skin contact and inhalation. However, exposure by inhalation is not anticipated in areas covered with grass. Children playing in bare soil at the day care center or in bare soil at other locations which may be impacted by the Incineration Complex are of concern; however, data to determine concentrations of chemicals in surface soils is not available. Of particular concern are those children who may have pica behavior (repeated ingestion of non-nutritive substances). Children are a sensitive segment of the exposed population because their relative exposure (mg/kg) by incidental soil ingestion is greater than that of adults. Children with pica behavior have even greater exposure potential. According to the Agency for Toxic Substances and Disease Registry (ATSDR), the reported prevalence of pica behavior among children ages 1-5 years range from 16-18.5% and approximately 23% of children with pica behavior are reported to ingest non-nutritive substances (reference (g)).

Groundwater

Liquid wastes infiltration in the soil could result in subsurface soils contamination and potentially transport chemicals to a shallow groundwater aquifer. Base personnel indicated that groundwater wells are used as drinking water in the winter months. Since groundwater flows away from the Incineration Complex toward NAF Atsugi, groundwater contamination is possible. Trichloroethylene has been detected in deep water drinking wells. However, exposure for on-base residents is unlikely, because the water is purified and trichloroethylene is removed by the water treatment plant. However, off-base residents north of the Jinkanpo Incineration Complex that may use untreated groundwater could be exposed to contaminants in groundwater by ingestion, shower inhalation and dermal contact.

Sediment

Reference (c) indications of liquid industrial wastes being poured on the unlined waste piles with no provision to prevent runoff into the nearby Tade River sediments suggest that river sediments may potentially be contaminated at the incineration complex location and downstream from it. However, because the river shows visual signs of pollution, no residents come in contact with these sediments. Therefore sediment is not an exposure pathway.

Surface Water

Reference (c) indicated that when liquid industrial wastes were poured on the unlined waste piles there was no provision to prevent runoff into the nearby Tade River water. Surface water could also be potentially contaminated by fly ash fallout. However, because the river shows visual signs of pollution, no residents come in contact with surface water. Therefore surface water is not an exposure pathway.

Food Chain

Wind blown and stack emitted fly ash could potentially impact the food chain through contamination of vegetable gardens and farm animal feed, e.g. pigs in the adjacent farm and subsequent consumption by the community.

4.0 FATE AND TRANSPORT

In this section only a few chemicals were selected for discussion of their fate and transport, based on their calculated risk value and hazard index.

4.1 Benzene

According to the Micromedex Hazardous Substance Data Base (HSDB), benzene will enter the atmosphere primarily from fugitive emissions and exhaust connected with its use in gasoline. If benzene is released to soil, it will be subject to rapid volatilization near the surface. Benzene which is not evaporated will be highly mobile in the soil and may leach to the groundwater.

4.2 Carbon Tetrachloride

Carbon tetrachloride is a stable chemical that is degraded very slowly. Carbon tetrachloride is expected to evaporate rapidly from soil due to its high vapor pressure and to migrate into groundwater due to its low soil adsorption coefficient.

4.3 Chloroform

Chloroform released to the atmosphere degrades by reaction with photochemically generated hydroxyl groups. In soil the dominant transport mechanism for chloroform near the surface will probably be volatilization because of its high volatility and low soil adsorption. All or nearly all of the remaining chloroform travels through the soil because of its low adsorption onto soil. The leaching potential of chloroform is further confirmed by detecting chloroform in groundwater. Chloroform is not expected to biodegrade significantly if released to the soil.

4.4 1,2-Dichloroethane

1-2-Dichloroethane released to the environment partitions to the atmosphere by volatilization. Photo-oxidation is the primary fate process. In the atmosphere, 1,2-Dichloroethane, which has an estimated residence time of 47-182 days, may be transported long distances before being washed out in precipitation or degraded. 1,2-Dichloroethane released to the soil is expected to volatilize rapidly to the atmosphere. The 1,2-dichloroethane remaining can migrate to groundwater, since this chemical does not adsorb to soil.

4.5 Dioxins

Dioxin (2,3,7,8 TCDD) is released to the environment in stack emissions from incineration of municipal refuse and certain chemical wastes, in exhaust from automobiles, in emissions from wood burning in the presence of chlorine and from the improper disposal of certain chlorinated chemical wastes. Incineration of chemical wastes including chlorophenol, chlorinated benzenes, and biphenyl ethers, may result in the presence of dioxins in flue gases, fly ash, and soot particles, which can deposit and transfer to vegetation and biota (grazing animals, earth worms, fur preening by burrowing animals). Dioxin can bioaccumulate in plants, fish and mammals. Dioxin exposed to sunlight on terrestrial surfaces may be susceptible to photo degradation, but this process is not expected to occur for sorbed dioxins. Dioxin-like compounds are persistent in the soil with a dissipation rate corresponding to a 10 year half-life. Because of strong sorption to soils, dioxins are not expected to migrate to groundwater.

4.6 Methylene Chloride

Methylene chloride released to the atmosphere degrades by reaction with photochemically generated hydroxyl groups. Methylene chloride released to the soil will evaporate rapidly from surface soil and partially leach into groundwater where its fate is unknown.

4.7 Trichloroethylene

Trichloroethylene released to the atmosphere is degraded by photo-oxidation with a half-life of 7 days. Spills or releases of trichloroethylene to soil will evaporate rapidly due to its high vapor pressure. It can also leach into groundwater since it does not adsorb to soil strongly. Trichloroethylene appears to be fairly stable in soil, although degradation in soil can occur. It has been reported in the literature as being detected in fruits and vegetables indicating the potential to bioconcentrate in plants.

4.8 Chromium

Chromium is associated with particulate matter in the air, and it is not expected to exist in gaseous form. Chromium VI in air may react with particulate matter or gaseous pollutants to form chromium III. Chromium is removed from the air through wet and dry depositions.

4.9 Particulate Matter

Particulate Matter (PM) represents a broad class of chemically and physically diverse compounds that exist as discrete dust particles ranging in size from 0.005 um to 100 um. These particles when released to the atmosphere are transported by the wind, dispersed and deposited by gravity and accumulated in the surface of soil, water and food chain. Chemicals associated with these particles such as metals and dioxins are therefore also likely to be deposited and accumulated in these media.

5.0 TOXICITY ASSESSMENT

In this section only a few chemicals were also selected for discussion of their toxicity, based on their overall contribution to the calculated cancer and non-cancer risks.

The Carcinogen Assessment Group (CAG), Office of Health and Environmental Assessment in EPA's Research and Development Office, has prepared a list of chemical substances for which substantial or strong evidence exists showing that exposure to these chemicals, under certain conditions causes cancer in humans, or can cause cancer in animals species which in turn, makes them potentially carcinogenic in humans. A classification of a chemical substance as an A carcinogen means that there is sufficient evidence of carcinogenicity in humans. A B2 classification is reserved for chemicals defined as probable human carcinogens based on limited animal evidence.

5.1 Benzene

The carcinogenic weight of evidence listed by CAG for benzene is A carcinogen. Chronic exposure to benzene usually involves the inhalation of vapor. Chronic benzene toxicity is expressed as bone marrow depression resulting in white and red blood cells and platelets, including leukemia as the major concern.

5.2 Carbon Tetrachloride

Carbon tetrachloride is classified as a B2 carcinogen. Non-carcinogen effects of carbon tetrachloride inhalation can be respiratory, neurologic, gastro-intestinal, hepatic, and renal.

5.3 Chloroform

Chloroform is classified as a B2 carcinogen. Non-carcinogen effects of chloroform inhalation can be neurologic, gastro-intestinal, hepatic, and genitourinary.

5.4 1,2-Dichloroethane

1,2-Dichloroethane is classified as a B2 carcinogen. Non-carcinogen effects of 1,2 dichloroethane inhalation can be hematologic, hepatic, and renal.

5.5 Dioxins and furans

Dioxins and furans carcinogenicity has not yet been classified for lack of cancer studies. Results of epidemiological studies and animal testing by the Agency for Toxic Substances and Disease Registry provide some evidence that 2,3,7,8-TCDD is a probable B2 carcinogen. The relevance of these findings to furans is unclear because it is not known if a common mechanism would be involved. Toxicological concerns resulting from exposure to dioxins and furans and gaps in available information with which to evaluate the human health risks from exposure are well recognized. In response to these concerns, the EPA Chlorinated Dibenzo-p-Dioxins/Chlorinated Dibenzofurans Technical Panel of the Risk Assessment Forum recommends the use of toxicity equivalency factor (TEF) methodology for dioxins and furans based on each compound's relative potency to the potency of 2, 3, 7, 8 TCDD. TEFs were used to convert the concentration of dioxins and furans to an equivalent concentration of 2,3,7,8 TCDD and derive their RBCs. Non-cancer effects of dioxin include reproductive and developmental effects, dermatological changes, and immunotoxicity effects.

5.6 Methylene Chloride

Methylene chloride is classified as a B2 carcinogen. Non-carcinogenic effects of methylene chloride inhalation can be neurologic and hepatic.

5.7 Trichloroethylene

Trichloroethylene is classified as a B2-C (possible-probable carcinogen). Non-carcinogenic effects of trichloroethylene inhalation can be neurologic, hepatic, hematologic, renal, and developmental.

5.8 Chromium

Health effects resulting from exposure to chromium III and chromium VI are well described in the literature. The respiratory tract in humans is a major target of inhalation exposure to chromium compounds. In a chrome plating plant where poor exhaust resulted in excessively high concentrations of chromium III, workers experienced symptoms of sneezing, runny nose, labored breathing and sensation when they were working over the chromate tanks. Chromium-induced asthma may occur in some sensitized individuals exposed to elevated concentrations of chromium in air.

5.9 Particulate Matter

Long-term epidemiological studies provide evidence of increased respiratory symptoms and illness likely with annual PM10 levels above 80-90 ug/m^3. Recent studies indicate the possibility of increased respiratory symptoms and illness in adults and children experiencing multi-year exposure levels across a range of 40-90 ug/m^3.

6.0 PUBLIC HEALTH IMPLICATIONS

This section is not generally addressed in a human health risk assessment. However, to place the preliminary human health risk evaluation in a public health perspective, the potential for developing adverse health effects from exposure to those chemicals of concern identified in the preliminary risk evaluation will be addressed.

Chemicals released into the environment do not always result in human exposure. People can only be exposed to a site contaminant if they breathe, ingest or touch the contaminant. Factors that influence exposure include the exposure concentration (how much), the duration of exposure (how long), the route of exposure (breathing, eating, drinking or skin contact), and the multiplicity of contaminants (combination of contaminants). Once a person is exposed, individual characteristics -- age, sex, nutritional and health status, lifestyle and family traits -- influence how the contaminant is taken up and eliminated by the body.

Health assessment comparison values such as the Agency for Toxic Substances and Disease Registry (ATSDR) Minimal Risk Level (MRL) and EPA's Reference Dose (RfD) and Cancer Slope Factor (CSF) are included in the ATSDR Toxicological Profiles. These comparison values are used by ATSDR to select contaminants for further evaluation in their public health assessment process. Therefore, comparison values are "screening values." If an environmental concentration (air, soil, water) exceeds the corresponding comparison value, further evaluation of that contaminant in the specific exposure pathway is required.

An MRL is defined as an estimate of human exposure to a substance that is likely to be without an appreciable risk of adverse effects (non-carcinogenic) over a specified duration of exposure. They are derived for noncancerous health effects only and do not consider carcinogenic effects. They provide a basis for comparison with concentration of contaminants in different environmental media (soil, air, water and food) to which people might be exposed. Although methods have been established to derive these levels, uncertainties are associated with them. MRLs can be derived for acute, intermediate and chronic exposures for inhalation and oral routes. Acute inhalation MRLs may not be protective for health effects that are delayed in development or are acquired following repeated acute insults such as hypersensitivity reactions, asthma, chronic bronchitis.

For carcinogenic substances, ATSDR has calculated Cancer Risk Evaluation Guides (CREG) for cancer end points, and Environmental Media Evaluation Guides (EMEGs). CREGs and EMEGs are media specific values that are used to select contaminants of concern at hazardous waste sites.

To evaluate the results of the human health risk evaluation from a public health point of view air concentrations of chemicals measured in the ambient air are compared to CREGs and EMEGs developed by ATSDR. A comparison of maximum and average ambient air chemical concentrations with the ATSDR human health evaluation is indicated on Table D.

Information extracted from the chemical specific toxicological profiles prepared by ATSDR summarizing chemical specific toxicological and adverse health effects information are included in Appendix C.

7.0 UNCERTAINTY ANALYSIS

In environmental risk assessment the uncertainty about numerical results is usually very large, on the range of at least one order of magnitude or greater. Therefore, it is important to fully specify the assumptions and uncertainties associated with the risk assessment to place the risk estimate in proper perspective.

Because EPA risk assessment screening methodology is designed to protect most sensitive populations, very conservative assumptions are used in risk calculations which may not apply to a specific site. These assumptions discussed in section 2.5 are target cancer risk of 10^{-6}, hazard index of 1, averaging exposure time of 70 years for carcinogens, exposure frequency of 350 days per year, exposure duration of 30 years, average body weight of 70 kg for adults and 15 kg for children, and the use of maximum concentrations may overestimate the risk by 1-3 orders of magnitude. Conversion factors used in these calculations, i.e,

TABLE D
COMPARISON OF AMBIENT AIR CONCENTRATIONS TO ATSDR HEALTH GUIDELINES

Chemical	Site 1	Site 1	Site 2	Site 2	US PUBLIC HEALTH SERVICE (ATSDR) COMPARISON VALUE			
	Average	Maximum	Average	Maximum		ACUTE	INTERMEDIATE	CHRONIC
					CREG	EMEG	EMEG	EMEG
	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3	ug/m3
Benzene	4.392727	25.84	24.69	84	0.1	6.4	N/A	N/A
Carbon Tetrachloride	18.547	35.19	5	5.11	0.07	1240	310	N/A
Chloroform			42.2	170	0.04	44.1	N/A	N/A
Total Chromium	0.003717	0.0071	0.030917	0.138	N/A	N/A	N/A	N/A
1,2 Dichloroethane	1.904	20			0.04	800	N/A	N/A
HxCDD (Dioxin) mixture	6.95E-06	9.95E-06	3.49E-05	5.44E-05	N/A	N/A	N/A	N/A
2,3,7,8 TCDD (Dioxin)	2.3E-06	3.37E-06	8.47E-06	1.20E-05	N/A	N/A	N/A	N/A
Methylene chloride	10.67	25	209	1700	2	1392	104.4	N/A
Trichloroethylene	31.6	100	47.88	260	0.6	N/A	10760	N/A
1,2,4 Trimethylbenzene	4.88	10	13.33	32	N/A	N/A	N/A	N/A
1,3,5 Trimethylbenzene	1	1	6.17	10	N/A	N/A	N/A	N/A
Toluene	28.08	100	176.85	420	N/A	11280	1504	3760

ATSDR: Agency for Toxic Substances and Disease Registry
CREG: Cancer Risk Evaluation Guide
EMEG: Environmental Media Evaluation Guide
N/A: An ATSDR guideline has not been developed

slope factors and reference concentrations, which are derived by extrapolating adverse cancer and non-cancer results in animals to humans, have a few built-in layers of safety. In other words, using more realistic assumptions that are site specific, a 10^{-3} (one-in-a-thousandth) risk could in reality be 10^{-5} (one-in-a-hundred thousandth).

The total risk in this human health risk evaluation was calculated using residential scenarios which assumed residents living at the site for 30 years. In reality, base residents do not live on base housing for more than 3-6 years and therefore, the actual risk may have been overestimated. However, this overestimation applies only to cancer risk, and not to non-cancer estimation. As long as the exposure is chronic, non-cancer risk estimation is independent of exposure duration.

To consider this uncertainty a risk comparison with different exposure frequency and durations for children and adults is shown in Table E. Table E indicates that when we consider more realistic exposure assumptions to calculate the risk for on-base residents, i.e. 1) average chemical concentrations instead of maximum, 2) 3 years exposure duration corresponding to the time people actually live on-base instead of 30 years, and 3) an exposure frequency of only 6 months out of the year, corresponding to the time the wind blows toward the base (May through September), instead of the whole year, the cancer risk actually decreases for children and adults at SITE 1 and SITE 2 by one to two orders of magnitude.

The estimated risk was calculated using concentrations at specific locations near the incinerator. The risk at locations farther away from the incinerator should decrease with distance from the incinerators.

Non-carcinogenic risk contribution by carcinogens, such as trichloroethylene (hepatic and central nervous systems effects), benzene (hematological effects) and tetrachloroethylene (central nervous system and renal effects) have not been evaluated, because there are no inhalation reference concentrations for these chemicals. The effect of this uncertainty would be an underestimation of the non-carcinogenic risk.

Because no RBCs are available for PM-10 and lead, particulate matter and lead contributions to the risk were not included and therefore the actual risk could have been underestimated.

Chromium VI, which is a carcinogen, was not detected in any PM-10 samples. There is a possibility that it was not detected because the sampling method was not suitable to collect chromium VI. If chromium VI is present in ambient air the risk could have been underestimated.

TABLE E

RISK COMPARISONS OF EXPOSURE FREQUENCIES AND DURATIONS

	Site 1	Site 1	Site 2	Site 2
	Average	Maximum	Average	Maximum
ADULT AND CHILD	**5.38E-04**	**1.14E-03**	**1.15E-03**	**3.79E-03**
30 years, 12 months/year	5.38E-04	1.14E-03	1.15E-03	3.79E-03
25 years, 12 months/year	4.72E-04	1.00E-03	1.01E-03	3.33E-03
20 years, 12 months/year	4.06E-04	7.55E-04	8.68E-04	2.86E-03
15 years, 12 months/year	3.40E-04	6.33E-04	7.27E-04	2.40E-03
10 years, 12 months/year	2.74E-04	3.22E-04	5.86E-04	1.93E-03
ADULT 6 years, 12 months/year	7.91E-05	9.30E-05	1.69E-04	5.57E-04
CHILD, 6 years, 12 months/ year	**2.22E-04**	**3.83E-05**	**4.74E-04**	**1.56E-03**
ADULT 3 years, 12 months/year	3.96E-05	6.84E-06	8.46E-05	2.79E-04
CHILD, 3 years, 12 months/year	**1.11E-04**	**2.35E-04**	**2.37E-04**	**7.80E-04**
ADULT AND CHILD				
30 years, 6 months/year	2.69E-04	5.70E-04	5.75E-04	1.90E-03
25 years, 6 months/year	2.36E-04	5.00E-04	5.05E-04	1.66E-03
20 years, 6 months/year	2.03E-04	3.78E-04	4.34E-04	1.43E-03
15 years, 6 months/year	1.70E-04	3.16E-04	3.64E-04	1.20E-03
10 years, 6 months/year	1.37E-04	1.61E-04	2.93E-04	9.66E-04
ADULT, 6 years, 6 months/year	3.96E-05	4.65E-05	8.46E-05	2.79E-04
CHILD, 6 years, 6 months/year	**1.11E-04**	**1.92E-05**	**2.37E-04**	**7.80E-04**
ADULT, 3 years, 6 months/year	1.98E-05	3.42E-06	4.23E-05	1.39E-04
CHILD, 3 years, 6 months/year	**5.54E-05**	**1.17E-04**	**1.18E-04**	**3.90E-04**

Other pollutants generally associated with emissions from incinerators, such as nitrous oxides, carbon monoxide and sulphur oxides, which could also contribute to the risk, were not sampled.

Chemicals with non-detect (ND) concentrations were assumed as zero concentrations. Chemicals with RBCs below the detection limit are therefore excluded causing the risk to be underestimated.

Concentrations of photoreactive chemicals may have decreased due to sunlight, and hence the actual risk could have been underestimated.

Due to the lack of consistency in meeting sample holding times before chemical analysis, the concentrations of VOCs and SVOCs may have been actually higher than the reported results and therefore, the risk may have been underestimated.

Changes in the wind direction and speed, and the terrain effect are also likely to cause chemical concentrations to vary throughout the year that could be reflected as an over- or underestimation of the risk.

Since groundwater, soil and biota has not been tested for VOCs, dioxins and metals contamination, contribution by the groundwater, soil and biota pathways is not known. For dioxins the risk from other pathways such as soil and food chain may equal or exceed the inhalation pathways. Dioxin bioaccumulate in food products of terrestial animals (beef, pork, chicken, eggs and milk, vegetables and fruits. The food chain pathway has not been evaluated. Calculations were not performed to determine the risk due to fly ash fallout from inhalation or ingestion of contaminated surface soil or consumption of contaminated food, from vegetable gardens and the adjacent pig farm. Therefore, the actual risk could have been underestimated.

8.0 HUMAN HEALTH PRELIMINARY RISK EVALUATION

As discussed in section 2.5 of this report, a preliminary human health risk evaluation following the EPA Region III RBCs was performed. The highest risk for SITE 2 is 3.8 X 10^{-3} and the average risk is 1.1 X 10^{-3} for carcinogens. The highest cancer risk for SITE 1 is 1.1 X 10^{-3} and the average risk is 5.4 X 10^{-4}. These results indicate that the risk is still above 10-4 even for average concentrations at both SITE 1 and SITE 2. Theoretically, according to standard EPA methodology the highest risk of 3.75 X 10^{-4} at SITE 2 represents an increased cancer risk of 3-4 cancer cases over the normal lifetime (70 years) cancer risk rate of 250 cases per 1,000 people. However, when more realistic assumptions are used, i.e., exposure frequency of six months out of the year, exposure duration of 3 years for on-base residency, using <u>average</u>

chemical concentrations, the cancer risk is reduced to 4.2 X 10^{-5} for adults and 1.1 X 10^{-4} for children on SITE 2. For SITE 1 the risk is reduced to 2 X 10^{-5} for adults and 5.5 X 10^{-5} for children.

The non-cancer hazard quotient for highest and average chromium and trimethylbenzene concentrations for SITE 1 and SITE 2, were significantly above 1, indicating that there is potential for non-cancer effects. The hazard quotients were not summed, as it was done for the carcinogens to give a total hazard index for non-carcinogens because of their effects on different organs. Some peer reviewers commented that adding hazard quotients for non-carcinogens would overestimate the non-cancer hazard risk.

In both sites carcinogens driving the cancer risk were methylene chloride, chloroform, benzene, 2,3,7,8-TCDD congeners and trichloroethylene. Trichloroethylene, chloroform, methylene chloride and benzene are not typically products of incineration. These chemicals along with other highly volatile organic compounds appear to be associated with emissions from the drum storage area and the area where liquid wastes, possibly waste solvents, are poured onto waste piles. More typical products of incomplete combustion at inefficient, low temperature incineration are dioxins such as 2,3,7,8-TCDD and its congeners.

In both sites the chemicals driving the non-carcinogenic risk are 1,3,5-trimethylbenzene, 1,2,4-trimethylbenzene and Chromium III. Trimethylbenzene is not typically a product of incineration and appears to be associated with emissions from waste solvents at the waste staging and drum storage area. Chromium III is a pollutant more typically associated with particulate matter emissions from incinerators.

A major concern associated with the human health risk is the elevated levels of dioxins at Atsugi in comparison to urban settings in the U.S and another site in Japan. The total dioxin air concentration at NAF Atsugi is 168 pg/m^3. Compared to dioxin air concentrations in the U.S. of 4.36 pg/m^3, and 18.3 (summer)/ 34.9 pg/m^3 (winter) for another site in Japan (reference (h)), the concentration of dioxin at Atsugi is almost 40 times higher than the U.S. and 4-5 times higher than another site in Japan. Another concern about dioxins is that since it is present in fly ash depositing on surface soil, vegetable and biota where it bioaccumulates, the cancer risk contribution may be increased.

As the emissions dissipate toward the northern boundary of the base, the health risk decreases with distance from the incineration complex. However, since the concentrations of pollutants at the northern boundary still remain at one tenth of the concentrations at the southern boundary, the health risk is only reduced by one order of magnitude, from 10^{-3} to 10^{-4} cancer risk, which according to EPA regulatory guidance is still cosidered an unacceptable risk. Chemical concentrations at the child development center, the youth center, the elementary school and the golf course, located within a 0.25 mile radius of the southern boundary fence, are reduced only to one fourth of their concentration at the fence. This indicates that Atsugi residents could be exposed by inhalation to concerning levels of chemical pollutants emitted by the Jinkanpo Incineration Complex.

Since surface soils have not yet been investigated for possible fly ash fallout contamination containing lead and dioxins, there is also a potential concern about incidental ingestion and inhalation of contaminated soil by children and adult at the elementary school, child development center, youth center, and golf course due to their proximity to the southern boundary near the incineration complex.

There is also a concern for the Japanese citizens living near the incinerator. While the exposure duration may be only 3-6 yars for NAF Atsugi residents, it is reasonable to expect that Japanese citizens may live near the incinerator for 30 years, therefore increasing the risk for the native population. Another concern is the consumption of potentially contaminated meat and vegetable food grown in the vicinity of the incinerator and sold to the community.

9.0 SUMMARY AND RECOMMENDATIONS

Volatile organic compounds (methylene chloride, chloroform, benzene, and trimethylbenzene), furans (2,3,4,7,8-PeCDF and 1,2,3,4,5,7,8-HxCDF), metals (chromium III) were found at NAF Atsugi at levels higher than the EPA Region III RBC screening values in ambient air at the southern boundary fence near the Jinkanpo Incineration Complex. The Oil and Hazardous Substances Pollution Contingency Plan, known as the National Contingency Plan (NCP) guidance in reference (f) establishes that for known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound (maximum) lifetime cancer risk to an individual of between 10^{-4} and 10^{-6} using information on the relationship between dose and response. According to the NCP, these compounds drove the total cancer and non-cancer risk to unacceptable levels higher than 10^{-4} and 1, respectively.

Based on these findings NAVENVIRHLTHCEN recommends the following to reduce and/or mitigate the risks associated with air emissions from the Jinkanpo Incineration Complex:

1) Inform the Japanese government of the potential threat to the health of on- and off-base NAF Atsugi residents, including the local Japanese community; the need for emission reduction; and implementation of alternative waste management practices to

replace the current practice of pouring waste solvents on trash piles prior to incineration. Request that action be taken to reduce the human health risk.

2) Conduct surface soil and air sampling at the child development center, the youth center, and the elementary school playgrounds and the golf course to determine surface soil contamination. Educate residents about potential surface soil contamination due to particulate matter fallout. Samples should be analyzed for metals, dioxins and furans. Determine if off-base residents are using private drinking water wells and/or are consuming spring water from off-base springs. Consideration should be given to conducting sampling of these water sources if it is determined that they are used. We recommend that TCL/TAL analysis be conducted for at least 20% of all samples.

3) Until surface soil concentrations are defined, measures to prevent possible adverse exposures are needed. Health education for day care workers about prevention of exposure and recognition of pica behavior in children is indicated. Recognition of this behavior and action to prevent exposures will be instrumental in prevention and mitigation of adverse health effects which may result from exposure to surface soil.

4) Continue to collect additional medical data from Branch Clinic Atsugi and other comparable Medical Treatment Facilities. Of particular importance is data concerning the number of people living at Atsugi and the other activities so that rates of illness incidence can be calculated.

5) Educate healthcare providers assigned to Branch Clinic Atsugi in the prompt recognition and treatment of medical conditions which might be caused/aggravated by the Atsugi environment.

6) Communicate results of the 1994 air sampling results, this health risk assessment, and the subsequent data collections to the Atsugi residents in an understandable, effective manner.

7) Curtail outside activities, particularly strenuous physical exertion, during periods when respirable particulate levels are elevated. This recommendation is particularly important for residents with known cardiovascular or respiratory conditions.

APPENDIX A

TABLE 1-1
SITE 1 VOLATILE ORGANIC COMPOUNDS
(SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples					
TIME OF SAMPLE	18:00	16:00	14:35	17:45	14:07
DATE OF SAMPLE	7/26/94	7/31/94	8/3/94	8/7/94	8/26/94
LAB IDENTIFICATION NUMBER	ID#9408060-01A	ID#9408060-03A	ID# 9408146-01A	ID#9408146-03A	ID#9409263-01A
SAMPLE NUMBER	**7/26 S1-1**	**7/31 S1-2**	**8/3 S1-3**	**8/7 S1-4**	**8/26 S1-5**
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Freon 12	3	3	2	3	ND
Freon 114	ND	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND
Freon 11	ND	1	ND	1	ND
1,1-Dichloroethene	2	ND	ND	ND	ND
Freon 113	ND	ND	1	ND	ND
Methylene Chloride	6	ND	6	5	11
1,1-Dichloroethane	ND	ND	ND	1	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	9	ND	3	3	100
Carbon Tetrachloride	ND	ND	ND	ND	ND
Benzene	ND	3	2	2	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND
Trichloroethene	3	ND	ND	ND	100
1,2,-Dichloropropane	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND
Toluene	14	4	9	2	100
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	8	ND	ND	ND	ND
Tetrachloroethene	16	ND	3	ND	5
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	7	ND	1	1	ND
Ethyl Benzene	3	1	3	2	8
m,p-Xylene	16	2	4	5	10
O-Xylene	28	ND	3	7	8
Styrene	ND	ND	ND	ND	ND
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	ND
1,3,5-Trimethybenzene	ND	ND	1	1	ND
1,2,4-Trimethylbenzene	4	1	2	2	5
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	2	3	1	ND
Chlorotoluene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,2,4- Trichlorobenzene	6	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND

TABLE 1-1
SITE 1 VOLATILE ORGANIC COMPOUNDS
(SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples					
TIME OF SAMPLE	16:54	15:05	15:35	17:38	11:00
DATE OF SAMPLE	8/26/94	8/31/94	9/2/94	9/3/94	9/6/94
LAB IDENTIFICATION NUMBER	ID#9409263-03A	ID#9409263-05A	ID#9409263-07A	ID#9409263-11A	ID#9409263-12A
SAMPLE NUMBER	**8/26 S1-6**	**8/31 S1-7**	**9/2 S1-8**	**9/3 S1-9**	**9/6 S1-10**
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Freon 12	ND	ND	4	ND	ND
Freon 114	ND	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND
Freon 11	ND	ND	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND
Freon 113	ND	ND	8	ND	ND
Methylene Chloride	ND	ND	25	ND	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	5	6	26	4	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND
Benzene	ND	ND	4	7	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND
Trichloroethene	ND	13	19	23	ND
1,2,-Dichloropropane	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND
Toluene	13	30	69	32	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	15
1,1,2-Trichloroethane	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	54	6	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	ND	ND	19	6	ND
m,p-Xylene	6	9	25	8	4
O-Xylene	7	8	14	4	6
Styrene	ND	ND	4	ND	ND
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	ND
1,3,5-Trimethybenzene	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	ND	5	10	ND	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	4	ND
Chlorotoluene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,2,4- Trichlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND

TABLE 1-1
SITE 1 VOLATILE ORGANIC COMPOUNDS
(SUMMA)

EPA Method TO-14 modified		
30 sec SUMMA samples		
TIME OF SAMPLE	9:55	14:20
DATE OF SAMPLE	9/7/94	9/8/94
LAB IDENTIFICATION NUMBER	ID#9409263-13A	ID#9409263-15A
SAMPLE NUMBER	**9/7 S1-11**	**9/8 S1-12**
QUALIFIERS REMOVED		
CHEMICAL	***ug/m3***	***ug/m3***
Freon 12	ND	ND
Freon 114	ND	ND
Chloromethane	ND	ND
Vinyl Chloride	ND	ND
Bromomethane	ND	ND
Chloroethane	ND	ND
Freon 11	5	ND
1,1-Dichloroethene	ND	ND
Freon 113	ND	ND
Methylene Chloride	ND	11
1,1-Dichloroethane	ND	ND
cis-1,2-Dichloroethene	ND	ND
Chloroform	ND	ND
1,1,1-Trichloroethane	ND	ND
Carbon Tetrachloride	ND	ND
Benzene	ND	3
1,2-Dichloroethane	ND	20
Trichloroethene	ND	ND
1,2,-Dichloropropane	ND	ND
cis-1,3-Dichloropropene	ND	ND
Toluene	13	36
trans-1,3-Dichloropropene	ND	ND
1,1,2-Trichloroethane	ND	ND
Tetrachloroethene	ND	7
Ethylene Dibromide	ND	ND
Chlorobenzene	ND	ND
Ethyl Benzene	4	5
m,p-Xylene	5	20
O-Xylene	ND	13
Styrene	3	ND
1,1,2,2-Tetra chloroethane	ND	ND
1,3,5-Trimethybenzene	ND	ND
1,2,4-Trimethylbenzene	ND	10
1,3-Dichlorobenzene	ND	ND
1,4-Dichlorobenzene	ND	ND
Chlorotoluene	ND	ND
1,2-Dichlorobenzene	ND	ND
1,2,4- Trichlorobenzene	ND	ND
Hexachlorobutadiene	ND	ND

TABLE 1-2
SITE 1 VOLATILE ORGANIC COMPOUNDS
(TENAX)

TENAX TUBE					
Conversion factor for ug/m3	0.067	0.067	0.067	0.07	0.69
TIME OF SAMPLE	5:21-7:21	15:30-17:30	14:45-16:45	17:50-19:50	14:47-16:47
DATE OF SAMPLE -	8/3/94	8/3/94	8/3/94	8/7/94	8/26/94
LAB IDENTIFICATION NUMBER	ID#9408057-01A	ID#9408057-02A	ID#9408179-01A	ID#9408179-03A	ID#9409182-22A
SAMPLE NUMBER	T1-1	8/3 T1-2	8/3 T1-3	8/7 T1-4	8/26 TI-5
EPA METHOD TO-1					
CHEMICAL	*ug/m3*	*ug/m3*	*ug/m3*	*ug/m3*	*ug/m3*
Chloroform	ND	ND	NA	ND	ND
1,1,1-Trichloroethane	1.273	0.871	NA	ND	200.1
Carbon Tetrachloride	ND	ND	NA	ND	35.19
Benzene	1.474	1.273	NA	ND	8.97
1,2-Dichloroethane	ND	ND	NA	ND	ND
1-Heptene	ND	ND	NA	ND	ND
n-Heptane	0.737	ND	NA	ND	13.8
Trichloroethene	ND	ND	NA	ND	ND
1,2-Dichloropropane	ND	ND	NA	ND	ND
Toluene	8.04	15.41	NA	0.98	89.7
Tetrachloroethene	ND	ND	NA	ND	ND
1,3-Dichloropropene	ND	ND	NA	ND	ND
Ethylene Dibromide	ND	ND	NA	ND	ND
Chlorobenzene	ND	ND	NA	ND	ND
Ethyl Benzene	1.742	14.74	NA	ND	ND
m,p-Xylene	2.479	45.56	NA	0.7	7.59
o-Xylene	0.938	22.11	NA	ND	ND
Bromoform	ND	ND	NA	ND	ND
Isopropylbenzene	ND	ND	NA	ND	ND
Bromobenzene	ND	ND	NA	ND	ND

TABLE 1-2
SITE 1 VOLATILE ORGANIC COMPOUNDS
(TENAX)

TENAX TUBE					
Conversion factor for ug/m3	0.132	0.068	0.68	0.073	0.07
TIME OF SAMPLE	13:40-14:43	14:30-16:30	11:05-13:05*	13:50-15:50	14:20-16:20
DATE OF SAMPLE	9/1/94	9/4/94	9/6/94	9/7/94	9/8/94
LAB IDENTIFICATION NUMBER	ID#9409182-01A	ID#9409182-03A	ID#9409182-08A	ID#9409182-10A	ID#9409182-16A
SAMPLE NUMBER	**9/1 T1-01**	**9/4 T1-02**	**9/6 T1-03**	**9/7 T1-04**	**9/8 T1-06**
EPA METHOD TO-1					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Chloroform	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	5.94	ND	14.96	2.044	3.15
Carbon Tetrachloride	ND	1.904	ND	ND	ND
Benzene	1.452	ND	25.84	1.387	1.26
1,2-Dichloroethane	ND	1.904	ND	ND	ND
1-Heptene	ND	ND	ND	ND	ND
n-Heptane	ND	ND	ND	ND	0.98
Trichloroethene	ND	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND
Toluene	18.48	ND	81.6	6.351	17.5
Tetrachloroethene	3.432	5.712	12.24	0.876	1.26
1,3-Dichloropropene	ND	4.352	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	5.412	ND	12.92	3.942	2.45
m,p-Xylene	7.392	1.564	19.72	5.913	3.29
o-Xylene	2.376	2.04	7.48	1.971	1.19
Bromoform	ND	0.884	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND	ND

TABLE 1-2
SITE 1 VOLATILE ORGANIC COMPOUNDS
(TENAX)

TENAX TUBE				
Conversion factor for ug/m3	0.068	0.069	0.068	0.068
TIME OF SAMPLE	14:20-16:20	13:00-15:00	13:00-15:00	19:20-21:20
DATE OF SAMPLE	9/8/94	9/10/94	9/10/94	9/11/94
LAB IDENTIFICATION NUMBER	ID#9409182-05A	ID#9409182-18A	ID#9409182-14A	ID#9409182-20A
SAMPLE NUMBER	**9/8 TI-07**	**9/10 T1-08**	**9/10 T1-09**	**9/11 T1-010**
EPA METHOD TO-1				
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Chloroform	ND	ND	ND	ND
1,1,1-Trichloroethane	3.468	1.428	1.972	1.428
Carbon Tetrachloride	ND	ND	ND	ND
Benzene	0.884	1.836	1.836	2.108
1,2-Dichloroethane	ND	ND	ND	ND
1-Heptene	ND	ND	ND	ND
n-Heptane	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND
Toluene	15.64	6.596	7.48	8.16
Tetrachloroethene	1.768	0.816	D	ND
1,3-Dichloropropene	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND
Ethyl Benzene	2.516	1.156	1.496	1.496
m,p-Xylene	3.332	1.564	2.04	2.924
o-Xylene	1.224	ND	0.816	1.088
Bromoform	ND	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND

TABLE 1-3
SITE 1 POLYCYCLIC AROMATIC HYDROCARBONS
(PUF)

PAHs 24hr.=/- EPA Method TO-13					
PUF/ MOIDIFIED					
SITE 1					
DATE OF SAMPLE	7/26/94	8/3/94	8/18/94	8/19/94	8/27/94
LAB IDENTIFICATION NUMBER	**9409189-C-02A**	**9409189C-01A**	**9409189C-03A**	**9409189C-04A**	**9409189C-05A**
SAMPLE NUMBER	**9/27 PUF1-1**	**9/27 PUF 1-2**	**9/27 PUF 1-10**	**9/27 PUF 1-11**	**9/27 PUF 1-13**
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Naphthalene	ND	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND	ND
2-Chloronapthalene	ND	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND	ND
Acenapthylene	ND	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND	ND
Phenanthrene	0.013	0.0228	0.0136	0.0243	0.0221
Anthracene	ND	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND	ND
Benzo(a) anthracene	ND	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND	ND
Benzo(a) Pyrene	ND	ND	ND	ND	ND
Indeo(1,2,3-c,d)pyrene	ND	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND	ND

TABLE 1-3
SITE 1 POLYCYCLIC AROMATIC HYDROCARBONS
(PUF)

PAHs 24hr.=/- EPA Method TO-13	
PUF/ MOIDIFIED	
SITE 1	
DATE OF SAMPLE	8/28/94
LAB IDENTIFICATION NUMBER	**9409189C-06A**
SAMPLE NUMBER	**9/27 PUF 1-14**
CHEMICAL	**ug/m3**
Naphthalene	ND
2-Methylnaphthalene	ND
2-Chloronapthalene	ND
Acenaphthylene	ND
Acenapthylene	ND
Fluorene	ND
Phenanthrene	0.023
Anthracene	ND
Fluoranthene	ND
Pyrene	ND
Chrysene	ND
Benzo(a) anthracene	ND
Benzo(b)fluoranthene	ND
Benzo(k)fluoranthene	ND
Benzo(a) Pyrene	ND
Indeo(1,2,3-c,d)pyrene	ND
Dibenz(a,h)anthracene	ND
Benzo(g,h,i)perylene	ND

TABLE 1-4
SITE 1 ORGANIC PESTICIDES AND PCBs
(PUF)

ORGANOCHLORINE PESTICIDES AND PCBS GC/ECD					
24 HR +/-					
EPA Method TO-4, PUF, modified					
DATE OF SAMPLE	7/26/94	8/3/94	8/18/94	8/19/94	8/27/94
LAB IDENTIFICATION NUMBER	**9409189B-02A**	**9409189B-01A**	**9409189B-03A**	**9409189B-04A**	**9409189B-05A**
SAMPLE NUMBER	**9/27 PUF 1-1**	**9/27 PUF 1-2**	**9/27 PUF 1-10**	**9/27 PUF 1-11**	**9/27 PUF 1-13**
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Aldrin	0.001401724	0.001611648	0.001832461	0.001654859	0.001439327
alpha-BHC	0.005710726	0.005501834	0.002303665	0.003568289	0.004096546
beta-BHC	0.002751532	0.001889519	0.003455497	0.002378859	0.002214349
delta-BHC	0.001401724	0.002000667	0.001780105	0.001758287	0.002325066
gama-BHC	0.002232375	0.002111815	0.002513089	0.002016859	0.002269708
Chlordane	0.001765133	0.002611982	0.001308901	0.00191343	0.002214349
4,4'-DDD	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND
Endrine Ketone	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND
Heptachloro Epoxide	ND	ND	ND	ND	ND
Toaxaphene	ND	ND	ND	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND

TABLE 1-4
SITE 1 ORGANIC PESTICIDES AND PCBs
(PUF)

ORGANOCHLORINE PESTICIDES AND	
24 HR +/-	
EPA Method TO-4, PUF, modified	
DATE OF SAMPLE	8/28/94
LAB IDENTIFICATION NUMBER	**9409189B-06A**
SAMPLE NUMBER	**9/27 PUF 1-14**
CHEMICAL	**ug/m3**
Aldrin	0.001518802
alpha-BHC	0.003299466
beta-BHC	0.001414057
delta-BHC	0.001361684
gama-BHC	0.002147271
Chlordane	0.002985231
4,4'-DDD	ND
4,4'-DDE	ND
4,4'-DDT	ND
Dieldrin	ND
Endosulfan I	ND
Endosulfan II	ND
Endosulfan Sulfate	ND
Endrin	ND
Endrine Ketone	ND
Heptachlor	ND
Heptachloro Epoxide	ND
Toaxaphene	ND
Aroclor 1016	ND
Aroclor 1221	ND
Aroclor 1232	ND
Aroclor 1242	ND
Aroclor 1248	ND
Aroclor 1254	ND
Aroclor 1260	ND

TABLE 1-5
SITE 1 DIOXINS AND FURANS
(PUF)

PCDD AND PCDF 24hrs+/-	0.000001	0.000001	0.000001	0.000001	0.000001
TOTAL VOLUME SAMPLED	192.62	179.94	191	193.37	180.64
Conversion factor for ug/m3	5.19157E-09	5.55741E-09	5.2356E-09	5.17143E-09	5.53587E-09
TIME OF SAMPLE					
DATE OF SAMPLE					
LAB IDENTIFICATION NUMBER	**13922-003-SA**	**13922-002-SA**	**13922-004-SA**	**13922-005-SA**	**13922-006-SA**
SAMPLE NUMBER	**9/27 PUF 1-1**	**9/27 PUF 1-2**	**9/27 PUF 1-10**	**9/27 PUF 1-11**	**9/27 PUF 1-13**
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
2,3,7,8-TCDD	ND	ND	ND	ND	ND
Total TCDD	2.28429E-06	3.94576E-06	3.76963E-06	3.56829E-06	3.96544E-06
1,2,3,7,8-peCDD	1.55747E-07	2.61198E-07	1.72775E-07	2.22371E-07	1.92913E-07
Total PeCDD	2.95919E-06	5.39069E-06	4.13612E-06	4.60257E-06	4.66207E-06
1,2,3,4,7,8-HxCDD	1.9728E-07	3.16772E-07	2.19895E-07	3.20629E-07	1.71478E-07
1,2,3,6,7,8-HxCDD	4.36092E-07	6.11315E-07	4.45026E-07	7.24E-07	4.17979E-07
1,2,3,7,8,9-HxCDD	2.59579E-07	4.22363E-07	3.03665E-07	4.29229E-07	2.35783E-07
Total HxCDD	4.56858E-06	8.33612E-06	5.2356E-06	8.27429E-06	5.3587E-06
1,2,3,4,6,7,8-HpCDD	5.71073E-06	7.22463E-06	4.08377E-06	6.72286E-06	2.78652E-06
Total HpCDD	1.09023E-05	1.44493E-05	8.37696E-06	1.34457E-05	5.89457E-06
OCDD	2.23238E-05	4.39035E-05	9.42408E-06	1.18943E-05	5.89457E-06
2,3,7,8-TCDF	1.71322E-07	3.33445E-07	2.67016E-07	2.27543E-07	3.16163E-07
Total TCDF	1.19406E-05	2.44526E-05	1.7801E-05	1.65486E-05	1.82196E-05
1,2,3,7,8-PeCDF	3.84176E-07	7.22463E-07	5.18324E-07	5.68857E-07	5.89457E-07
2,3,4,7,8-PeCDF	1.14215E-06	2.44526E-06	1.46597E-06	2.27543E-06	1.33968E-06
Total PeCDF	1.45364E-05	3.05658E-05	1.7801E-05	2.74086E-05	1.82196E-05
1,2,3,4,7,8-HxCDF	8.82567E-07	1.66722E-06	1.04712E-06	1.65486E-06	1.01815E-06
1,2,3,6,7,8-HxCDF	1.14215E-06	2.22296E-06	1.3089E-06	2.22371E-06	1.12533E-06
2,3,4,6,7,8-HxCDF	3.73793E-06	6.66889E-06	3.66492E-06	7.75715E-06	2.62576E-06
1,2,3,7,8,9-HxCDF	1.14215E-06	2.00067E-06	1.20419E-06	2.43057E-06	8.57392E-07
Total HxCDF	1.71322E-05	3.2233E-05	1.83246E-05	3.46486E-05	1.50044E-05
1,2,3,4,6,7,8-HpCDF	9.34483E-06	1.55607E-05	9.42408E-06	1.86171E-05	6.96631E-06
1,2,3,4,7,8,9-HpCDF	3.37452E-06	5.11282E-06	3.14136E-06	6.20572E-06	2.19707E-06
Total HpCDF	2.49195E-05	4.22363E-05	2.40838E-05	4.96457E-05	1.76837E-05
OCDF	1.60939E-05	2.61198E-05	1.46597E-05	2.43057E-05	9.64566E-06

TABLE 1-5
SITE 1 DIOXINS AND FURANS
(PUF)

PCDD AND PCDF 24hrs+/-	0.000001
TOTAL VOLUME SAMPLED	190.94
Conversion factor for ug/m3	5.23725E-09
TIME OF SAMPLE	
DATE OF SAMPLE	
LAB IDENTIFICATION NUMBER	**13922-007-SA**
SAMPLE NUMBER	**9/27 PUF 1-14**
CHEMICAL	**ug/m3**
2,3,7,8-TCDD	ND
Total TCDD	4.87064E-06
1,2,3,7,8-peCDD	3.08998E-07
Total PeCDD	6.80843E-06
1,2,3,4,7,8-HxCDD	4.1898E-07
1,2,3,6,7,8-HxCDD	8.3796E-07
1,2,3,7,8,9-HxCDD	5.76098E-07
Total HxCDD	9.95078E-06
1,2,3,4,6,7,8-HpCDD	5.76098E-06
Total HpCDD	1.25694E-05
OCDD	1.1522E-05
2,3,7,8-TCDF	4.24217E-07
Total TCDF	2.671E-05
1,2,3,7,8-PeCDF	9.42705E-07
2,3,4,7,8-PeCDF	2.671E-06
Total PeCDF	2.77574E-05
1,2,3,4,7,8-HxCDF	2.0949E-06
1,2,3,6,7,8-HxCDF	2.25202E-06
2,3,4,6,7,8-HxCDF	5.23725E-06
1,2,3,7,8,9-HxCDF	1.93778E-06
Total HxCDF	2.93286E-05
1,2,3,4,6,7,8-HpCDF	1.36169E-05
1,2,3,4,7,8,9-HpCDF	4.1898E-06
Total HpCDF	3.19472E-05
OCDF	1.57118E-05

TABLE 1-6
SITE 1 PM10 AND METALS

PM10 Site 1			
EPA METHOD			
RFPS-1087-062	**7/26 PM1-1**	**8/3 PM1-2**	**8/4 PM1-3**
	7/26/94	8/3/94	8/4/94
COMPOUND	**ug/m3**	**ug/m3**	**ug/m3**
PM10	34.5637	54.4165	48.2329
Chromium	0.0034	0.0025	0.0032
Arsenic	0.001	0.0018	0.0017
Selenium	0.0008	0.0016	0.002
Lead	0.0433	0.0439	0.0585
Chromium IV	ND	ND	ND

TABLE 1-6
SITE 1 PM10 AND METALS

PM10 Site 1			
EPA METHOD			
RFPS-1087-062	**8/12 PM1-8**	**8/18 PM1-10**	**8/19 PM1-11**
	8/12/94	8/18/94	8/19/94
COMPOUND	**ug/m3**	**ug/m3**	**ug/m3**
PM10	26.2236	32.1215	29.9572
Chromium	0.0022	0.0071	0.0039
Arsenic	0.0017	0.0021	0.0031
Selenium	"ND"	0.0015	0.0008
Lead	0.0148	0.0478	0.0704
Chromium IV	ND	ND	ND

TABLE 2-1

SITE 2 VOLATILE ORGANIC COMPOUNDS (SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples,					
TIME OF SAMPLE		16:00	14:35	17:45	14:07
DATE OF SAMPLE	7/26/94	7/31/94	8/3/94	8/7/94	8/26/94
LAB IDENTIFICATION NUMBER	ID#9408060-02A	ID# 9408060-04A	ID#9408146-02A	ID#9408146-04A	ID#9409263-02A
SAMPLE NUMBER	**7/26 S2-1**	**7/31 S2-2**	**8/3 S2-3**	**8/7 S2-4**	**8/26 S2-5**
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Freon 12	ND	ND	8	3	ND
Freon 114	ND	ND	ND	ND	ND
Chloromethane	ND	ND	ND	3	ND
Vinyl Chloride	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND
Freon 11	10	ND	33	5	5
1,1-Dichloroethene	ND	ND	1	ND	ND
Freon 113	ND	ND	2	ND	ND
Methylene Chloride	110	10	230	34	13
1,1-Dichloroethane	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND
Chloroform	ND	ND	3	1	ND
1,1,1-Trichloroethane	24	ND	17	8	19
Carbon Tetrachloride	5	ND	ND	ND	ND
Benzene	15	14	13	29	5
1,2-Dichloroethane	ND	ND	ND	ND	ND
Trichloroethene	1	ND	12	ND	ND
1,2,-Dichloropropane	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND
Toluene	80	ND	140	50	260
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	1	ND
Tetrachloroethene	ND	ND	ND	3	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	1	2	ND
Ethyl Benzene	26	9	ND	15	84
m,p-Xylene	37	11	34	17	97
O-Xylene	15	8	20	13	24
Styrene	16	8	24	41	ND
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	ND
1,3,5-Trimethybenzene	ND	ND	5	2	ND
1,2,4-Trimethylbenzene	6	ND	10	5	12
1,3-Dichlorobenzene	ND	ND	ND	2	ND
1,4-Dichlorobenzene	ND	ND	4	2	ND
Chlorotoluene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	3	ND
1,2,4- Trichlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND

TABLE 2-1
SITE 2 VOLATILE ORGANIC COMPOUNDS (SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples,					
TIME OF SAMPLE	16:54	15:05	15:35	15:35	17:38
DATE OF SAMPLE	8/26/94	8/31/94	9/2/94	9/2/94	9/3/94
LAB IDENTIFICATION NUMBER	ID#9409263-04A	ID#9409263-06A	ID#9409263-08A	ID#9409263-08B	ID#9409263-10A
SAMPLE NUMBER	**8/26 S2-6**	**8/31 S2-7**	**9/2 S2-8**	**9/2 S2-8 DUPLICATE**	**9/3 S2-9**
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Freon 12	ND	ND	7	7	ND
Freon 114	ND	ND	ND	ND	ND
Chloromethane	ND	ND	5	5	ND
Vinyl Chloride	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND
Freon 11	ND	ND	7	7	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND
Freon 113	ND	ND	ND	ND	ND
Methylene Chloride	ND	160	110	110	6
1,1-Dichloroethane	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND
Chloroform	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	11	ND	18	18	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND
Benzene	13	ND	12	12	9
1,2-Dichloroethane	ND	ND	ND	ND	ND
Trichloroethene	ND	13	5	6	ND
1,2,-Dichloropropane	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND
Toluene	69	69	420	420	61
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	25	10	110	100	14
m,p-Xylene	32	18	130	120	16
O-Xylene	27	10	41	39	6
Styrene	20	ND	26	26	ND
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	ND
1,3,5-Trimethybenzene	ND	ND	9	10	ND
1,2,4-Trimethylbenzene	7	ND	31	32	5
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	5	5	ND
Chlorotoluene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,2,4- Trichlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	ND

TABLE 2-1
SITE 2 VOLATILE ORGANIC COMPOUNDS (SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples,					
TIME OF SAMPLE	11:00	9:55	14:20	14:20	
DATE OF SAMPLE	9/6/94	9/7/94	9/8/94	9/8/94	8/6/94
LAB IDENTIFICATION NUMBER	ID#9409263-09A	ID#9409263-14A	ID#9409263-16A	ID#9409263-16B	ID#9408060-05A
SAMPLE NUMBER	**9/6 S2-10**	**9/7 S2-11**	**9/8 S2-12**	**9/8 S2-12 DUPLICATE**	**LAB BLANK**
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Freon 12	ND	ND	ND	ND	ND
Freon 114	ND	ND	ND	ND	ND
Chloromethane	ND	ND	ND	ND	ND
Vinyl Chloride	ND	ND	ND	ND	ND
Bromomethane	ND	ND	ND	ND	ND
Chloroethane	ND	ND	ND	ND	ND
Freon 11	6	15	ND	ND	ND
1,1-Dichloroethene	ND	ND	ND	ND	ND
Freon 113	ND	ND	ND	ND	ND
Methylene Chloride	25	1700	99	110	ND
1,1-Dichloroethane	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	ND	ND	ND	ND	ND
Chloroform	ND	170	18	19	ND
1,1,1-Trichloroethane	12	ND	4	4	ND
Carbon Tetrachloride	ND	ND	ND	ND	ND
Benzene	31	84	42	42	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND
Trichloroethene	ND	260	41	45	ND
1,2,-Dichloropropane	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	ND	ND	ND	ND	ND
Toluene	180	320	110	120	ND
trans-1,3-Dichloropropene	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	ND	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	49	100	21	23	ND
m,p-Xylene	53	130	27	29	ND
O-Xylene	18	42	11	21	ND
Styrene	6	ND	6	7	ND
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	ND
1,3,5-Trimethybenzene	5	6	ND	ND	ND
1,2,4-Trimethylbenzene	16	21	7	8	ND
1,3-Dichlorobenzene	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND	ND	ND
Chlorotoluene	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND	ND	ND
1,2,4- Trichlorobenzene	ND	ND	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND	ND	9

TABLE 2-1
SITE 2 VOLATILE ORGANIC COMPOUNDS (SUMMA)

EPA Method TO-14 modified					
30 sec SUMMA samples,					
TIME OF SAMPLE					
DATE OF SAMPLE	9/17/94	9/18/94	10/1/94	10/2/94	
LAB IDENTIFICATION NUMBER	ID#9408146-05A	ID#9408146-05B	ID#9409263-18A	ID#9409263-18B	
SAMPLE NUMBER	**LAB BLANK**	**LAB BLANK**	**LAB BLANK**	**LAB BLANK**	
QUALIFIERS REMOVED					
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	
Freon 12	ND	ND	ND	ND	
Freon 114	ND	ND	ND	ND	
Chloromethane	ND	ND	ND	ND	
Vinyl Chloride	ND	ND	ND	ND	
Bromomethane	ND	ND	ND	ND	
Chloroethane	ND	ND	ND	ND	
Freon 11	ND	ND	ND	ND	
1,1-Dichloroethene	ND	ND	ND	ND	
Freon 113	ND	3	ND	ND	
Methylene Chloride	1	ND	ND	ND	
1,1-Dichloroethane	ND	ND	ND	ND	
cis-1,2-Dichloroethene	ND	ND	ND	ND	
Chloroform	ND	ND	ND	ND	
1,1,1-Trichloroethane	ND	ND	ND	ND	
Carbon Tetrachloride	ND	ND	ND	ND	
Benzene	ND	ND	ND	ND	
1,2-Dichloroethane	ND	ND	ND	ND	
Trichloroethene	ND	ND	ND	ND	
1,2,-Dichloropropane	ND	ND	ND	ND	
cis-1,3-Dichloropropene	ND	ND	ND	ND	
Toluene	ND	ND	ND	ND	
trans-1,3-Dichloropropene	ND	ND	ND	ND	
1,1,2-Trichloroethane	ND	ND	ND	ND	
Tetrachloroethene	ND	ND	ND	ND	
Ethylene Dibromide	ND	ND	ND	ND	
Chlorobenzene	ND	ND	ND	ND	
Ethyl Benzene	ND	ND	ND	ND	
m,p-Xylene	ND	ND	ND	ND	
O-Xylene	ND	ND	ND	ND	
Styrene	ND	ND	ND	ND	
1,1,2,2-Tetra chloroethane	ND	ND	ND	ND	
1,3,5-Trimethybenzene	ND	ND	ND	ND	
1,2,4-Trimethylbenzene	ND	ND	ND	ND	
1,3-Dichlorobenzene	ND	ND	ND	ND	
1,4-Dichlorobenzene	ND	ND	ND	ND	
Chlorotoluene	ND	ND	ND	ND	
1,2-Dichlorobenzene	ND	ND	ND	ND	
1,2,4- Trichlorobenzene	ND	ND	ND	ND	
Hexachlorobutadiene	ND	ND	ND	ND	

TABLE 2-2
SITE 2 VOLATILE ORGANIC COMPOUNDS (TENNAX)

TENAX TUBE EPA METHOD TO-1					
Conversion factor for ug/m3	0.067	0.069	0.07	0.067	0.067
TIME OF SAMPLE	14:45-16:45	17:50-19:50	14:47-16:47	17:31-19:21	15:30-17:30
DATE OF SAMPLE	8/3/94	8/7/94	8/26/94	8/3/94	8/3/94
LAB IDENTIFICATION NUMBER	ID#9408179-02A	ID#9408179-04A	ID#9409182-23A	ID#9408057-03A	ID#9408057-04A
SAMPLE NUMBER	**8/3 T2-3**	**8/7 T2-4**	**8/26 T2-5**	**T2-1**	**T2-2**
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Chloroform	2.881	ND	ND	ND	ND
1,1,1-Trichloroethane	14.74	3.243	28	14.74	3.819
Carbon Tetrachloride	ND	ND	5.11	1.34	0.6566
Benzene	7.37	6.555	5.53	3.953	4.958
1,2-Dichloroethane	ND	ND	ND	ND	ND
1-Heptene	ND	ND	ND	ND	ND
n-Heptane	2.68	0.828	3.36	1.809	ND
Trichloroethene	3.752	ND	1.05	1.072	ND
1,2-Dichloropropane	ND	ND	ND	ND	ND
Toluene	100.5	20.01	61.6	67	8.04
Tetrachloroethene	10.05	ND	ND	1.273	ND
1,3-Dichloropropene	ND	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	11.39	6.417	22.4	18.76	ND
m,p-Xylene	14.07	6.831	30.1	28.14	1.608
o-Xylene	4.355	2.07	9.1	8.04	0.737
Bromoform	ND	ND	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND	ND

TABLE 2-2
SITE 2 VOLATILE ORGANIC COMPOUNDS (TENNAX)

TENAX TUBE EPA METHOD TO-1					
Conversion factor for ug/m3	0.137	0.07	0.07	0.069	0.068
TIME OF SAMPLE	13:40-14:40	14:30-16:30	11:05-13:05*	13:50-15:50	14:20-16:20
DATE OF SAMPLE	9/1/94	9/4/94	9/6/94	9/7/94	9/8/94
LAB IDENTIFICATION NUMBER	ID#9409182-02A	ID#9409182-04A	ID#9409182-09A	ID#9409182-11A	ID#9409182-17A
SAMPLE NUMBER	**9/1 T2-01**	**9/4 T2-02**	**9/6 T2-03**	**9/7 T2-04**	**9/8 T2-06**
CHEMICAL	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***	***ug/m3***
Chloroform	ND	ND	ND	12.42	7.48
1,1,1-Trichloroethane	4.795	5.48	2.94	4.968	4.76
Carbon Tetrachloride	ND	ND	ND	0.897	0.748
Benzene	9.864	5.48	25.2	38.64	48.96
1,2-Dichloroethane	ND	ND	ND	ND	ND
1-Heptene	ND	ND	ND	ND	ND
n-Heptane	ND	ND	5.04	6.417	2.312
Trichloroethene	ND	1.644	1.82	24.15	12.92
1,2-Dichloropropane	ND	ND	ND	ND	5.644
Toluene	56.17	39.73	51.8	51.75	68
Tetrachloroethene	ND	1.644	ND	ND	ND
1,3-Dichloropropene	ND	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	11.508	12.193	12.6	13.8	12.92
m,p-Xylene	17.81	16.44	19.6	17.94	19.04
o-Xylene	6.576	5.891	5.46	5.52	5.984
Bromoform	ND	ND	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND	ND

TABLE 2-2
SITE 2 VOLATILE ORGANIC COMPOUNDS (TENNAX)

TENAX TUBE EPA METHOD TO-1					
Conversion factor for ug/m3	0.069	0.068	0.069	0.068	
TIME OF SAMPLE	14:20-16:20	1:00-15:00	13:00-15:00	19:20-21:20	
DATE OF SAMPLE	9/8/94	9/10/94	9/10/94	9/11/94	9/22/94
LAB IDENTIFICATION NUMBER	ID#9409182-06A	ID#9409182-19A	ID#9409182-15A	ID#9409182-21A	ID#9409182-25A
SAMPLE NUMBER	**9/8 T2-07**	**9/10 T2-08**	**9/10 T2-09**	**9/11 T2-010**	**9/22 LAB BLANK**
CHEMICAL	***ug/m3***	***ug***	***ug***	***ug***	***ug***
Chloroform	6.624	0.816	0.897	ND	ND
1,1,1-Trichloroethane	4.83	2.856	3.174	17	ND
Carbon Tetrachloride	0.828	ND	ND	ND	ND
Benzene	51.75	39.44	46.23	44.2	ND
1,2-Dichloroethane	ND	ND	ND	ND	ND
1-Heptene	ND	ND	ND	ND	ND
n-Heptane	2.346	ND	1.035	6.8	ND
Trichloroethene	16.56	1.904	29	10.88	ND
1,2-Dichloropropane	5.934	ND	ND	ND	ND
Toluene	89.7	57.12	46.92	142.8	ND
Tetrachloroethene	ND	ND	ND	ND	ND
1,3-Dichloropropene	ND	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND	ND
Ethyl Benzene	14.49	8.84	1.38	24.48	ND
m,p-Xylene	21.39	12.92	1.863	40.8	ND
o-Xylene	6.831	4.08	ND	14.28	ND
Bromoform	ND	ND	ND	ND	ND
Isopropylbenzene	ND	ND	ND	ND	ND
Bromobenzene	ND	ND	ND	ND	ND

TABLE 2-2
SITE 2 VOLATILE ORGANIC COMPOUNDS (TENNAX)

TENAX TUBE EPA METHOD TO-1				
Conversion factor for ug/m3				
TIME OF SAMPLE				
DATE OF SAMPLE	9/22/94	8/12/94	9/22/94	9/7/94
LAB IDENTIFICATION NUMBER	ID#9409182-25B	ID#94057-05A	ID#9409182-07A	ID#9408179-05A
SAMPLE NUMBER	**9/22 LAB BLANK**	**9/22 BLANK**	**9/22 BLANK**	**LAB BLANK**
CHEMICAL	***ug***	***ug***	***ug***	***ug***
Chloroform	ND	ND	ND	ND
1,1,1-Trichloroethane	ND	ND	ND	ND
Carbon Tetrachloride	ND	ND	ND	ND
Benzene	ND	ND	ND	ND
1,2-Dichloroethane	ND	ND	ND	ND
1-Heptene	ND	ND	ND	ND
n-Heptane	ND	ND	ND	ND
Trichloroethene	ND	ND	ND	ND
1,2-Dichloropropane	ND	ND	ND	ND
Toluene	ND	ND	ND	ND
Tetrachloroethene	ND	ND	ND	ND
1,3-Dichloropropene	ND	ND	ND	ND
Ethylene Dibromide	ND	ND	ND	ND
Chlorobenzene	ND	ND	ND	ND
Ethyl Benzene	ND	ND	ND	ND
m,p-Xylene	ND	ND	ND	ND
o-Xylene	ND	ND	ND	ND
Bromoform	ND	ND	ND	ND
Isopropylbenzene	0.016	ND	ND	ND
Bromobenzene	ND	ND	ND	ND

TABLE 2-3
SITE 2 POLYCYCLIC AROMATIC HYDROCARBONS (PUF)

PAHs 24hr. =/-				
EPA Method TO-13				
PUF MODIFIED				
SITE 2				
DATE OF SAMPLE	7/26/94	8/3/94	8/3/94	8/18/94
LAB IDENTIFICATION NUMBER	**9409198C-01A**	**9409198C-02A**	**9409198C-02B**	**9409198C-03A**
SAMPLE NUMBER	**9/27 PUF 2-1**	**9/27 PUF 2-2**	**9/27 PUF 2-2**	**9/27 PUF 2-10**
			DUPLICATE	
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3***	**ug/m3**
Naphthalene	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND
2-Chloronapthalene	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND
Acenapthylene	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND
Phenanthrene	0.0345	0.0164	0.0174	0.0321
Anthracene	ND	ND	ND	ND
Fluoranthene	0.0184	0.014	0.0154	ND
Pyrene	0.0232	0.0106	0.011	ND
Chrysene	0.0104	ND	ND	ND
Benzo(a) anthracene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a) Pyrene	ND	ND	ND	ND
Indeo(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND

TABLE 2-3
SITE 2 POLYCYCLIC AROMATIC HYDROCARBONS (PUF)

PAHs 24hr. -/-				
EPA Method TO-13				
PUF MODIFIED				
SITE 2				
DATE OF SAMPLE	8/19/94	8/27/94	8/28/94	
LAB IDENTIFICATION NUMBER	**9409198C-04A**	**9409198C-05A**	**9409198C-06A**	**9409189C-07A**
SAMPLE NUMBER	**9/27 PUF 2-11**	**9/27 PUF 2-13**	**9/27 PUF 2-14**	**9/27 PUF BLANK**
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Naphthalene	ND	ND	ND	ND
2-Methylnaphthalene	ND	ND	ND	ND
2-Chloronapthalene	ND	ND	ND	ND
Acenaphthylene	ND	ND	ND	ND
Acenapthylene	ND	ND	ND	ND
Fluorene	ND	ND	ND	ND
Phenanthrene	0.025	0.0228	0.0193	ND
Anthracene	ND	ND	ND	ND
Fluoranthene	ND	ND	ND	ND
Pyrene	ND	ND	ND	ND
Chrysene	ND	ND	ND	ND
Benzo(a) anthracene	ND	ND	ND	ND
Benzo(b)fluoranthene	ND	ND	ND	ND
Benzo(k)fluoranthene	ND	ND	ND	ND
Benzo(a) Pyrene	ND	ND	ND	ND
Indeo(1,2,3-c,d)pyrene	ND	ND	ND	ND
Dibenz(a,h)anthracene	ND	ND	ND	ND
Benzo(g,h,i)perylene	ND	ND	ND	ND

TABLE 2-3
SITE 2 POLYCYCLIC AROMATIC HYDROCARBONS (PUF)

PAHs 24hr. = /·		
EPA Method TO-13		
PUF MODIFIED		
SITE 2		
DATE OF SAMPLE		
LAB IDENTIFICATION NUMBER	**9409189C-08A**	**9409198C-08A**
SAMPLE NUMBER	**9/27 PUF**	**9/27 PUF**
	METHOD BLANK	**METHOD BLANK**
CHEMICAL	**ug/m3**	**ug/m3**
Naphthalene	ND	ND
2-Methylnaphthalene	ND	ND
2-Chloronapthalene	ND	ND
Acenaphthylene	ND	ND
Acenapthylene	ND	ND
Fluorene	ND	ND
Phenanthrene	ND	ND
Anthracene	ND	ND
Fluoranthene	ND	ND
Pyrene	ND	ND
Chrysene	ND	ND
Benzo(a) anthracene	ND	ND
Benzo(b)fluoranthene	ND	ND
Benzo(k)fluoranthene	ND	ND
Benzo(a) Pyrene	ND	ND
Indeo(1,2,3-c,d)pyrene	ND	ND
Dibenz(a,h)anthracene	ND	ND
Benzo(g,h,i)perylene	ND	ND

TABLE 2-4
SITE 2 ORGANIC PESTICIDES AND PCBs (PUF)

ORGANOCHLORINE					
PESTICIDES AND PCBS GC/ECD					
GC/ECD 24 HR +/-					
EPA Method TO-4, PUF, modified					
PUF, MODIFED	7/26/94	8/3/94	8/3/94	8/18/94	8/19/94
SITE 2	**9409198B-01A**	**9409198B-02A**	**9409198B-02B**	**9409198B-03A**	**9409198B-04A**
	9/27 PUF 2-1	**9/27 PUF 2-2**	**9/27 PUF 2-2**	**9/27 PUF 2-10**	**9/27 PUF 2-11**
			DUPLICATE		
CHEMICAL	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
Aldrin	0.001370705	0.000192966	0.0019	0.00138422	0.001826396
alpha-BHC	0.003639457	0.003521636	0.0037	0.003213368	0.00297991
beta-BHC	0.002221487	0.002508563	0.0027	0.004943642	0.002691531
delta-BHC	0.002221487	0.002556804	0.0027	0.001730275	0.001874459
gama-BHC	0.002174221	0.002605046	0.0028	0.002521258	0.002018648
Chlordane	0.001607033	0.002701529	0.0026	0.001483093	0.001778333
4,4'-DDD	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND
Endrine Ketone	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND
Heptachloro Epoxide	ND	0.001061315	0.001	ND	ND
Toaxaphene	ND	ND	ND	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND

TABLE 2-4
SITE 2 ORGANIC PESTICIDES AND PCBs (PUF)

ORGANOCHLORINE					
PESTICIDES AND PCBS GC/ECD					
GC/ECD 24 HR +/-					
EPA Method TO-4, PUF, modifi					
PUF, MODIFED	8/27/94	8/28/94			
SITE 2	**9409198B-05A**	**9409198B-06A**	**9409189B-07A**	**9409189B-08A**	**9409198B-08A**
	9/27 PUF 2-13	**9/27 PUF 2-14**	**9/27 SAMPLE**	**9/27 METHOD**	**9/27 Method**
			BLANK	**BLANK**	**BLANK**
CHEMICAL	**ug/m3**	**ug/m3**	**ug**	**ug**	**ug**
Aldrin	0.001413966	0.001267941	ND	ND	ND
alpha-BHC	0.003371764	0.003296648	ND	ND	ND
beta-BHC	0.001903415	0.0017244	ND	ND	ND
delta-BHC	0.003045464	0.001673683	ND	ND	ND
gama-BHC	0.001740265	0.002180859	ND	ND	ND
Chlordane	0.001903415	0.0025866	ND	ND	ND
4,4'-DDD	ND	ND	ND	ND	ND
4,4'-DDE	ND	ND	ND	ND	ND
4,4'-DDT	ND	ND	ND	ND	ND
Dieldrin	ND	ND	ND	ND	ND
Endosulfan I	ND	ND	ND	ND	ND
Endosulfan II	ND	ND	ND	ND	ND
Endosulfan Sulfate	ND	ND	ND	ND	ND
Endrin	ND	ND	ND	ND	ND
Endrine Ketone	ND	ND	ND	ND	ND
Heptachlor	ND	ND	ND	ND	ND
Heptachloro Epoxide	ND	ND	ND	ND	ND
Toaxaphene	ND	ND	ND	ND	ND
Aroclor 1016	ND	ND	ND	ND	ND
Aroclor 1221	ND	ND	ND	ND	ND
Aroclor 1232	ND	ND	ND	ND	ND
Aroclor 1242	ND	ND	ND	ND	ND
Aroclor 1248	ND	ND	ND	ND	ND
Aroclor 1254	ND	ND	ND	ND	ND
Aroclor 1260	ND	ND	ND	ND	ND

TABLE 2-5
SITE 2 DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-	0.000001	0.000001	0.000001	0.000001	0.000001
TOTAL VOLUME SAMPLED	211.57	207.29	202.28	208.06	183.88
Conversion factor for ug/m3	4.72657E-09	4.82416E-09	4.94364E-09	4.80631E-09	5.43833E-09
DATE OF SAMPLE					
	13922-008-SA	**13922-009-SA**	**13922-010-SA**	**13922-011-SA**	**13922-012-SA**
CHEMICAL	**9/27 PUF 2-1**	**9/27 PUF 2-2**	**9/27 PUF 2-10**	**9/27 PUF 2-11**	**9/27 PUF 2-13**
	ug/m3	**ug/m3**	**ug/m3**	**ug/m3**	**ug/m3**
2,3,7,8-TCDD	3.1668E-07	1.97791E-07	1.92802E-07	2.59541E-07	3.31738E-07
Total TCDD	3.07227E-05	1.88142E-05	1.82915E-05	2.88379E-05	3.96998E-05
1,2,3,7,8-peCDD	1.6543E-06	4.82416E-07	8.89855E-07	1.58608E-06	1.52273E-06
Total PeCDD	3.87579E-05	2.12263E-05	2.32351E-05	4.08536E-05	4.94888E-05
1,2,3,4,7,8-HxCDD	1.41797E-06	8.20107E-07	9.39292E-07	1.63415E-06	1.68588E-06
1,2,3,6,7,8-HxCDD	2.55235E-06	1.39901E-06	1.77971E-06	3.41248E-06	3.80683E-06
1,2,3,7,8,9-HxCDD	1.70157E-06	8.68349E-07	1.0876E-06	2.11478E-06	2.33848E-06
Total HxCDD	3.78126E-05	2.21911E-05	2.42238E-05	4.56599E-05	5.43833E-05
1,2,3,4,6,7,8-HpCDD	2.36329E-05	1.10956E-05	1.38422E-05	2.16284E-05	2.6104E-05
Total HpCDD	4.72657E-05	2.26736E-05	2.81787E-05	4.42181E-05	5.27518E-05
OCDD	7.56251E-05	2.17087E-05	3.46055E-05	2.97991E-05	4.29628E-05
2,3,7,8-TCDF	2.03243E-06	1.25428E-06	1.68084E-06	2.64347E-06	2.22972E-06
Total TCDF	0.000113438	7.71866E-05	7.90982E-05	0.00012977	0.00013052
1,2,3,7,8-PeCDF	3.97032E-06	2.3156E-06	3.11449E-06	5.28694E-06	4.94888E-06
2,3,4,7,8-PeCDF	7.56251E-06	5.78899E-06	6.42673E-06	1.10545E-05	1.03328E-05
Total PeCDF	9.9258E-05	7.71866E-05	8.40419E-05	0.000134577	0.00013052
1,2,3,4,7,8-HxCDF	5.67188E-06	3.90757E-06	4.8942E-06	8.65136E-06	8.70133E-06
1,2,3,6,7,8-HxCDF	5.67188E-06	4.38999E-06	4.79533E-06	8.65136E-06	8.1575E-06
2,3,4,6,7,8-HxCDF	9.9258E-06	9.64832E-06	8.89855E-06	1.63415E-05	1.25082E-05
1,2,3,7,8,9-HxCDF	3.025E-06	3.1357E-06	2.86731E-06	5.28694E-06	3.96998E-06
Total HxCDF	6.6172E-05	5.30658E-05	5.438E-05	0.000100933	8.70133E-05
1,2,3,4,6,7,8-HpCDF	2.59961E-05	2.46032E-05	2.37295E-05	4.22955E-05	4.07875E-05
1,2,3,4,7,8,9-HpCDF	6.14454E-06	6.75382E-06	5.438E-06	1.05739E-05	8.70133E-06
Total HpCDF	5.67188E-05	5.78899E-05	4.94364E-05	9.13199E-05	8.1575E-05
OCDF	2.45782E-05	2.79801E-05	2.32351E-05	3.70086E-05	3.31738E-05

TABLE 2-5
SITE 2 DIOXINS AND FURANS

PCDD AND PCDF 24hrs+/-	0.000001
TOTAL VOLUME SAMPLED	197.17
Conversion factor for ug/m3	5.07177E-09
DATE OF SAMPLE	
	13922-013-SA
CHEMICAL	**9/27 PUF 2-14**
	ug/m3
2,3,7,8-TCDD	1.4201E-07
Total TCDD	1.52153E-05
1,2,3,7,8-peCDD	8.62201E-07
Total PeCDD	2.13014E-05
1,2,3,4,7,8-HxCDD	9.12919E-07
1,2,3,6,7,8-HxCDD	2.18086E-06
1,2,3,7,8,9-HxCDD	1.26794E-06
Total HxCDD	2.53589E-05
1,2,3,4,6,7,8-HpCDD	1.87655E-05
Total HpCDD	3.55024E-05
OCDD	4.41244E-05
2,3,7,8-TCDF	1.31866E-06
Total TCDF	7.60766E-05
1,2,3,7,8-PeCDF	2.68804E-06
2,3,4,7,8-PeCDF	6.08612E-06
Total PeCDF	7.60766E-05
1,2,3,4,7,8-HxCDF	5.07177E-06
1,2,3,6,7,8-HxCDF	4.97033E-06
2,3,4,6,7,8-HxCDF	9.12919E-06
1,2,3,7,8,9-HxCDF	3.09378E-06
Total HxCDF	6.08612E-06
1,2,3,4,6,7,8-HpCDF	2.89091E-05
1,2,3,4,7,8,9-HpCDF	7.10048E-06
Total HpCDF	6.08612E-05
OCDF	2.78947E-05

TABLE 2-6
SITE 2 PM10 AND METALS

PM10 Site 2			
EPA METHOD			
RFPS- 1087-062			
	7/26 PM2-1	**8/3 PM2-2**	**8/4 PM2-3**
COMPOUND	7/26/94	8/3/94	8/4/94
	ug/m-3	**ug/m-3**	**ug/m-3**
PM-10	65.2093	85.9405	64.956
Chromium	0.0084	0.012	0.0081
Arsenic	0.0043	0.0133	0.0055
Selenium	0.0024	0.002	0.0024
Lead	0.6277	0.3151	0.3015
Chromium IV	ND	ND	ND

TABLE 2-6
SITE 2 PM10 AND METALS

PM10 Site 2			
EPA METHOD			
RFPS- 1087-062			
	8/12 PM2-8	**8/18 PM2-10**	**8/19 PM2-11**
COMPOUND	8/12/94	8/18/94	8/19/94
	ug/m-3	**ug/m-3**	**ug/m-3**
PM-10	48.5992	57.8071	68.7708
Chromium	0.0056	0.138	0.0134
Arsenic	0.003	0.0084	0.0082
Selenium	0.025	0.002	0.0014
Lead	0.2679	0.4272	0.7032
Chromium IV	ND	ND	ND

APPENDIX B

EPA REGION III RBC RISK EQUATIONS AND ASSUMPTIONS

EPA Region III has calculated the RBCs for ambient air using the following equations based on combined childhood and adult exposure (for carcinogens) and on adult exposure (for non-carcinogens):

Carcinogens

$$\mathrm{RBC\ ug/m^3} = (\mathrm{TR}*\mathrm{AT}c*1000\mathrm{ug/mg})/(\mathrm{EFr}*\mathrm{IFA}adj*\mathrm{CPS}i)$$

Non-Carcinogens

$$\mathrm{RBC\ ug/m^3} = (\mathrm{THQ}*\mathrm{RfD}i*\mathrm{BW}a*\mathrm{AT}n*1000\mathrm{ug/mg})/(\mathrm{EFr}*\mathrm{ED}tot*\mathrm{IRA}a)$$

Age-adjusted factors

$$\mathrm{IFA}adj\ \mathrm{m^3.y/kg.d} = (\mathrm{Ed}c*\mathrm{IRA}c/\mathrm{BW}c) + [(\mathrm{Ed}tot-\mathrm{Ed}c)*\mathrm{IRA}a/\mathrm{BW}a]$$

The exposure assumptions used on these equations are:

TR = Target Cancer Risk = 10^{-6}
AT*c* = Averaging time, carcinogens = 25550 days
AT*n* = Averaging time, non-carcinogens = ED*365 days
ED*tot* = Exposure duration = 30 years (adult)
Ed*c* = Exposure duration, age 1-6 years = 6 years
EFr = Exposure frequency (days/year) = 350 days
IFA*a* = Inhalation factor, age adjusted (m^3/y/kg-d) = 11.66
CPS*i* = Carcinogenic potency slope inhaled (risk per mg/kg/d) (chemical specific)
THQ = Target hazard quotient = 1
RfD*i* = Reference dose inhaled (mg/kg/d)
BWa = Body weight, adult = 70 kg
BW*c* = Body weight, children 1-6 years = 15 kg
IRA*a* = Inhalation, adult = 20 (m^3/d)
IRA*c* = Inhalation, child = 12 (m^3/d)

APPENDIX C

Benzene

Benzene is a colorless liquid with a sweet odor which most people can smell in air at 1.5 to 4.7 parts of benzene per million parts of air (ppm). It is found in air, water and soil. The benzene found in the environment is from both human activities and natural processes. Today, benzene is mostly made from petroleum sources and ranks in the top 20 in production volume for chemicals produced in the United States. Various industries use benzene to produce other chemicals, such as styrene (for Styrofoam and other plastics), cumen (for various resins) and cyclohexane (for nylon and synthetic fibers). Benzene is also used for the manufacturing of some types of rubber, lubricants, dies, detergents, drugs and pesticides. Natural sources of benzene include volcanoes and forest fires. Consumer products containing benzene include glues, adhesives, household cleaning products, paint strippers, some art supplies, tobacco smoke and gasoline.

Benzene levels in the air can increase from emissions from burning coal and oil, benzene waste and storage operations, motor vehicle exhaust, evaporation from gasoline service stations, and use of industrial solvents. Background air concentrations of benzene generally range from 2.8 to 20 parts per million of benzene per billion parts of air (ppb).

Most data involving effects of long-term benzene exposure are from studies of workers that make or use benzene. These workers were exposed to levels in air far greater than those levels measured at NAF Atsugi.

The Department of Health and Human Services has determined that benzene is a known human carcinogen. Long-term exposures to relatively high concentrations of benzene in the air can cause cancer of the blood. This condition is called leukemia. Noncancer effects from long-term exposures to benzene include affects on normal blood production, possibly resulting in anemia and internal bleeding.

Carbon Tetrachloride

Carbon tetrachloride is a clear liquid that evaporates easily. It does not burn easily. It has a sweet odor that most people can begin to smell at 10 parts per million (ppm).

Carbon tetrachloride does not occur naturally. It has been produced in large quantities to make refrigeration fluid and propellants for aerosol cans. Since many refrigerants and aerosol propellants have been found to effect the earth's ozone layer, the production of these chemicals is being phased out. In the past, it was used as a cleaning fluid, as a degreasing agent and in households as a spot remover for carpets, clothing and furniture. Most uses were discontinued in the mid-60's.

Very low background levels of carbon tetrachloride are found in the air because of past and present releases. Concentrations of 0.1 ppb are common around the world with somewhat higher levels (0.2-0.6 ppb) found in cities. Exposure to carbon tetrachoride higher than these background levels can occur at specific industrial locations where emissions into air, water or soil are not properly controlled. Exposure at such sites could occur by breathing carbon tetrachloride present in the air, by drinking water contaminated with carbon tetrachloride or by getting soil that is contaminated with carbon tetrachloride on the skin. Young children may also be exposed if they eat soil that is contaminated with carbon tetrachloride.

Most information on the health effects of carbon tetrachloride in humans comes from cases where people have been exposed to relatively high levels of carbon tetrachloride either only once or for a short period of time. Experiments have not been performed on the effects of long term exposure of humans to low levels of carbon tetrachloride, so the human health effects of such exposure is unknown.

The liver is especially sensitive to carbon tetrachloride. In mild cases, the liver becomes swollen and tender, and fat builds up inside the organ. In severe cases, liver cells may become damaged or destroyed leading to a decrease in liver function. Such effects are generally reversible if exposure is not too high or too long. Carbon tetrachloride can also effect other organs of the body including the kidneys and brain.

Studies have not been performed to determine if carbon tetrachloride causes tumors in animals, or whether swallowing or breathing it causes tumors in humans. Studies have been conducted to indicate that some species of animals can increase the frequency of liver tumors when given carbon tetrachoride by mouth. Therefore, the International Agency for Research on Cancer (IARC) has determined that carbon tetrachloride is a possible carcinogen to humans. The EPA has determined that it is a probable human carcinogen.

Chloroform

Chloroform is a colorless liquid with a pleasant non-irritating odor. Most of it found in the environment comes from industry. Nearly all of it that is made in the United States is made to make other chemicals, but some has been sold or traded to other countries.

Chloroform enters the environment from paper mills, chemical companies, wastewater from sewage traetment plants, and drinking water that contains chlorine. In addition to its industrial use, small amounts of chloroform are formed as unwanted byproducts during the process of treating water with chlorine to destroy bacteria. Chlorine is added to most drinking water and wastewater; therefore, at least small amounts are likely to be found everywhere.

Chloroform exposure likely occurs during the consumption of water and beverages that are made using drinking water, such as soft drinks, by eating food, by breathing air and by skin contact with water that contains chlroform. The estimated amount of chloroform expected to be in air is 0.02 to 0.05 parts of chloroform per billion parts of air (ppb) and from 2 to 44 ppb in drinking water. It is not known how many areas have surface water, groundwater or soil that contains chloroform. The average amount of chloroform that you may be exposed to on a typical day be breathing air in various places ranges from 2 to 5 micrograms per day (ug/day) in rural areas and 6 to 200 ug/day in cities, and 80 to 2200 ug/day in areas near major sources of the chemical.

Chloroform can enter the body by breathing air, eating foods and drinking water that contains it. Studies show that after chloroform enters the body, it quickly enters the bloodstream from the lungs and/or intestines. It is carried by the blood to many other organs. Chloroform generally collects in body fat.

In humans, chloroform affects the central nervous system, liver, and kidneys after breathing air or drinking liquids that contain it. It was used as an anesthetic in surgery for many years. Breathing about 900 ppm, for a short time, causes tiredness, dizziness and headache. Breathing 8,000 to 10,000 ppm for a short time causes unconsciousness and death. Exposure over a long period of time to chloroform may damage the liver and kidneys. It can cause sores upon contact with the skin. Results of studies in humans who drank water with chlorine in it showed a possible link between the chloroform in water and the occurrence of cancer of the colon and urinary bladder.

1,2-Dichloroethane

1,2- Dichloroethane is a clear man-made material that is not found naturally in the environment. It has a pleasant smell and sweet taste. It is most commonly used today to make vinyl chloride and several substances that dissolve grease, glue and dirt. It is added to leaded gasoline to remove lead. In the past, it was found in trace amounts in products that industry used to clean cloth, remove grease from metal, and to break down oil, fats,waxes, resins and rubber. It was formerly used in home products such as cleaning solutions, pesticides, adhesives, glue, and some paint, varnish and finish removers.

It can enter the environment when it is made, packaged, shipped or used. Exposure to 1,2-dichloroethane occurs mainly by breathing it or by drinking water that contains 1,2-dichloroethane. Human exposure has occurred when the chemical has been improperly disposed of or spilled on the ground. However, it has also been found in the air near industries where it was made to be used in manufacturing. Humans can be exposed to low levels of 1,2-dichloroethane through the skin or by air contact with old products made with 1,2-dichloroethane, such as cleaning agents, pesticides and glued wallpaper and carpet. Such exposure is probably not enough to cause harmful health effects.

1,2-dichloroethane has been found in U.S. drinking water supplies at levels ranging from 0.05 to 19 parts of 1,2-dichloroethane per billion (ppb) parts of water. An average amount of 175 ppb has been found in 12% of the surface water and groundwater samples taken at 2,783 hazardous waste sites. 1,2-dichloroethane has also been found in the air near urban areas at levels of 0.1 - 1.5 ppb and near hazardous waste sites at levels of 0.01 to 0.003 ppb.

Cancer was found in laboratory animals that were fed large doses of 1,2-dichloroethane. When it was put on their skin they also developed lung tumors. Breathing 1,2-dichloroethane may also cause cancer in animals. In view of these cancer findings, one cannot rule out the possibility of cancer in humans. The International Agency for Research on Cancer (IARC) has determined that 1,2-dichloroethane is possibly carcinogenic to humans.

Experiments have shown that the chemical 1,2-dichloroethane is breathed in or eaten, it goes to many organs of the body but usually leaves in the breath within one or two days. Its' breakdown products leave the body quickly through the urine. Soil near hazardous waste sites do not generally contain high amounts of the chemical because it evaporates quickly. So, exposure near a hazardous waste site is more often by breathing air than by touching the soil.

Dioxin and Related Compounds

Chlorinated dibenzo-p-dioxins and related compounds (commonly known simply as dioxins) are present in a variety of environmental media. This class of compounds have caused a great deal of concern in the general public and interest in the scientific community.

Dioxins are not intentially produced other than for use in laboratory chemical analyses. They are generated from natural and synthetic processes. Natural processes include wood burning in fireplaces, forest fires and incineration of municipal and industrial wastes. Synthetic processes include the past manufacturing of PCBs for use in commercial products such as transformers and capacitors. The extensive use of PCBs have lead to wide-spread dispersal of these compounds in the environment.

Chloracne is a noncancer effect of dioxins. This is a severe acne like condition that develops within months of exposure to high concentrations of dioxin. There is little data to determine the amount of dioxin which causes chloracne to occur. Humans appear to have little susceptibility to low levels of dioxin.

Recent data indicates that dioxin-like compounds are potential multi-stage carcinogens in more highly exposed human populations. These studies are not yet complete but the data appears to be consistent with animal studies. Dioxin-like compounds are currently classified as "probable human carcinogens."

Methylene Chloride

Methylene chloride is a colorless liquid that has a mild sweet odor, evaporates easily and does not easily burn. People can smell methylene chloride at about 200 parts methylene chloride per 1 million parts of air (ppm) . It is widely used as an industrial solvent and paint stripper. It may be found in some spray paints, automotive cleaners and other household products. It can be found in certain aerosol and pesticide products and is used in the manufacture of photographic film. Hobby and household use of paint stripping chemicals and methylene chloride - containing aerosol products are major sources of exposure.

Methylene chloride may enter the body when it is inhaled or ingested. High levels of it in the air above 500 ppm can irritate the eyes, nose and throat. If breathed at concentrations higher than this, it may cause effects such as those produced by alcohol, including sluggishness, irritability, lightheadedness, nausea and headaches. Some effects have been noticed at concentrations as low as 300 ppm. These symptoms often disappear rapidly after the exposure ends.

Methylene chloride has not been shown to cause cancer in humans exposed to vapors in the workplace. However, breathing high concentrations of methylene chloride for long periods did increase the incidence of cancer in mice. ATSDR did not find any information regarding the carcinogenic effects of methylene chloride after oral exposure. The International Agency for Research on Cancer (IARC) has classified methylene chloride in Group 2B, possibly carcinogenic to humans. The EPA has determined that it is a probable human carcinogen.

Trichloroethylene

Trichloroethylene is a colorless, nonflammable liquid with a sweet odor. It is a manmade chemical that does not occur naturally in the environment. It is mainly used as a solvent to remive grease from metal parts. It also has other uses as a solvent and is used to make other chemicals. It is found in some household products including typewriter correction fluid, paint removers, adhesives and spot removers. Most peope can begin to smell it in the air at concentrations of 100 parts trichloroethylene per a million parts of air (ppm).

Trichloroethylene is found in the outdoor air at levels far less than 1 ppm. People living near hazardous waste sites may be exposed to it in the air or in their drinking water.

Trichloroethylene enters the body when it is inhaled or when water containing it is drunk. It can also enter the body by skin contact. It was once used as an an anesthetic for surgery. People who are exposed to large amount can becopme dizzy or unconscious at very high levels. Animals that were exposed to moderate levels of trichloroethylene had enlarged livers and high-level exposure caused liver and kidney damage. Many people work with Trichloroethylene and can breathe it or get it on their skin. Some people develop skin rashes when they get concentrated solutions on their skin. People who breathe moderate levle sget headaches or dizziness.

It is uncertain whether people who breathe air containg trichloroethylene or get it on their skin are at a higher risk of cancer. There is not any clear evidence as to whether it can cause cancer in humans.

Chromium

Chromium is a naturally occurring element found in rocks, animals, plants, soil and in volcanic dust and gases. It is present in the environment in several different forms. The most common forms are chromium (0), trivalent [or chromium (III)] and hexavalent [or chromium (VI)]. Chromium VI and chromium (0) are generally produced by industrial processes. Chromium III occurs naturally in the body and is an essential nutrient required by the human body to promote the action of insulin in body tissues so that sugar, protein and fat can be used by the body. You can be exposed to chromium by breathing air, drinking water and eating food containing chromium or by skin contact with chromium or chromium compounds.

The concentration of chromium in air is generally low, the air concentration of total chromium (chromium III plus chromium VI) generally ranges between 0.01 and 0.03 ug/m^3. Chromium III occurs naturally in many fresh vegetables, fruits, yeast, meat and grain. People who work in industries that process or use chromium and chromium-containing compounds in the workplace may be exposed to chromium. You may also be exposed to chromium from using consumer products such as household utensils, wood preservatives, cement, cleaning products, textiles and tanned leather.

Health effects resulting from exposure to chromium III and VI are well described in the literature. Chromium III is less toxic than chromium VI. Chromium VI is believed to primarily be responsible for an increased rate of lung cancer for workers exposed to high levels of chromium in workroom air. Breathing in small amounts of chromium for short or long periods of time does not cause a problem in most people. However, high levels of chromium in the workplace have caused asthma attacks to people who are allergic to chromium. Breathing in chromium III does not cause irritation to the nose or mouth in most people. In the same way, small amounts of chromium VI that you swallow will not hurt you; however, accidental swallowing of large amounts have caused stomach upsets and ulcers, convulsions, kidney and liver damage. Swallowing large amounts of chromium III may cause health problems. Because chromium VI levels have been associated with lung cancer in workers, certain chromium VI compounds are known as carcinogens. Chromium III compounds are not classified as to their carcinogenicity in humans.

Particulate Matter (PM_{10})*

Particulate matter (smoke, dust, dirt) is a broad class of chemical and physical substances that exist as particles ranging in various sizes. Sources include motor-vehicle exhaust, factory and utility smoke stacks, home chimneys, mining, agriculture, open-burning, fire, and wind-blown dust.

Acute effects on the respiratory system include respiratory disease, a worsening of chronic respiratory disease, and restrictions in activity. Persons with asthma are particularly sensitive to the effects of particulate air pollution. Individuals at increased risk for developing a condition, illness or other abnormal state from exposure to PM_{10} include preadolescent children, the elderly, persons with asthma or other respiratory illnesses.

Particles with diameters less than 10 micrometers (um) in size pose a greater health risk than larger particles because they can reach the deeper regions of the lung. Therefore, the EPA has established a standard for particulates that are smaller than 10 um, termed PM_{10}. The existing PM_{10} standards are 150 ug/m^3, as a 24-hour average and 50 ug/m^3, as an annual average. The federal standard is met if this value is not exceeded more than once per calendar year, and the annual arithmetic mean is less than or equal to 50 ug/m^3. EPA is reviewing technical and scientific information to determine whether the current federal ambient air quality standard should be lowered.

The average PM_{10} concentration measured at Site 2 was 65 ug/m^3 which is above the EPA annual average ambient air quality standard of 50 ug/m^3 for the time period monitored. The highest 24-hour concentration at Site 2 measured during the sampling period was 85 ug/m^3.

APPENDIX D

EPA REGION III RBC RISK EQUATIONS AND ASSUMPTIONS

EPA Region III has calculated the RBCs for ambient air using the following equations based on combined childhood and adult exposure (for carcinogens) and on adult exposure (for non-carcinogens):

Carcinogens

$$\mathrm{RBC}\ \mathrm{ug/m^3} = (\mathrm{TR} * \mathrm{AT}\mathit{c} * 1000\,\mathrm{ug/mg}) / (\mathrm{EFr} * \mathrm{IFA}\mathit{adj} * \mathrm{CPS}\mathit{i})$$

Non-Carcinogens

$$\mathrm{RBC}\ \mathrm{ug/m^3} = (\mathrm{THQ} * \mathrm{RfD}\mathit{i} * \mathrm{BW}\mathit{a} * \mathrm{AT}\mathit{n} * 1000\,\mathrm{ug/mg}) / (\mathrm{EFr} * \mathrm{ED}\mathit{tot} * \mathrm{IRA}\mathit{a})$$

Age-adjusted factors

$$\mathrm{IFA}\mathit{adj}\ \mathrm{m^3.y/kg.d} = (\mathrm{Ed}\mathit{c} * \mathrm{IRA}\mathit{c} / \mathrm{BW}\mathit{c}) + [(\mathrm{Ed}\mathit{tot} - \mathrm{Ed}\mathit{c}) * \mathrm{IRA}\mathit{a} / \mathrm{BW}\mathit{a}]$$

The exposure assumptions used on these equations are:

TR = Target Cancer Risk = 10^{-6}
AT*c* = Averaging time, carcinogens = 25550 days
AT*n* = Averaging time, non-carcinogens = ED*365 days
ED*tot* = Exposure duration = 30 years (adult)
Ed*c* = Exposure duration, age 1-6 years = 6 years
EFr = Exposure frequency (days/year) = 350 days
IFA*a* = Inhalation factor, age adjusted (m^3/y/kg-d) = 11.66
CPS*i* = Carcinogenic potency slope inhaled (risk per mg/kg/d) (chemical specific)
THQ = Target hazard quotient = 1
RfD*i* = Reference dose inhaled (mg/kg/d)
BW*a* = Body weight, adult = 70 kg
BW*c* = Body weight, children 1-6 years = 15 kg
IRA*a* = Inhalation, adult = 20 (m^3/d)
IRA*c* = Inhalation, child = 12 (m^3/d)

UNIVERSITY OF
FLORIDA

Center for Environmental & Human Toxicology

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July 26, 1995

Yvonne Walker, CIH
Deputy Director, Environmental Programs
Navy Environmental Health Center
2510 Walmer Avenue - Code 641
Norfolk, Virginia 23513-2617

Dear Ms. Walker:

As you may know, in addition to my research and teaching responsibilities here at the University, I also serve as an advisor to the Department of Environmental Protection of the State of Florida on matters pertaining to toxicology and health risks posed by environmental contaminants. I regularly review risk assessments for hazardous waste sites and work with the State and the U.S. Environmental Protection Agency in determining acceptable contaminant concentrations to protect both human health and the environment. I am familiar with special issues involved with hazardous waste incineration, having recently served on a panel comprised of faculty from the State University System tasked with evaluating methodology for assessing risks from hazardous waste incinerator facilities. Our report, entitled *Evaluation of the Health Impacts Associated with Commercial Hazardous Waste Incinerators*, is currently being finalized.

With this background and perspective, I have reviewed the report entitled *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility, Atsugi, Japan*, prepared by the Navy Environmental Health Center, dated July, 1995. This report describes a preliminary risk evaluation, focusing on risks posed to personnel at the Atsugi Naval Air Facility from airborne contaminants which apparently originate principally from the nearby Jinkanpo Incineration Complex. Risks were calculated by comparing air measurement data with risk-based screening criteria from U.S. EPA Region III. For the purposes of this preliminary evaluation, this methodology represents an efficient and effective means to estimate cancer risks for airborne contaminants, as well as to determine the level of concern warranted for non-cancer health effects.

As noted in the uncertainty analysis, the exposure assumptions inherent in these risk-based screening criteria are somewhat conservative given the characteristics of the population at the Naval Air Facility. Specifically, the 30-year exposure duration assumption implicit in the screening value upon which the risk calculations are made will tend to overestimate somewhat cancer risks if the typical exposure duration is for a shorter period of time, such as 5 years. As discussed in the report, however, the degree of overestimation resulting from this is not particularly large (i.e., less than an order of magnitude). Further, it should be recognized that this overestimation applies only to cancer risk, and not to non-cancer risk estimation – as long as the exposure is chronic, non-cancer risk is independent of exposure duration. It must also be kept in mind that the preliminary evaluation is incomplete – other potentially significant exposure routes were not considered (e.g., exposure to contaminated soils or groundwater). As such, the preliminary evaluation will tend to underestimate the risks posed by exposure from all relevant pathways.

A cancer risk of 6.61 x 10^{-3} was calculated for airborne pollutants measured at the southern boundary of the site, and the hazard index was 92.46. These values are well outside the acceptable risk range for the U.S. EPA, and vastly greater than what would be acceptable for the State of Florida, in my experience. Even if a 10-fold dilution and attenuation of the airborne pollutant concentrations across the Naval Air Facility is considered, the average risk at this facility (or even the lowest risk, at the most distant point on the site) would be outside the acceptable range. Many states have developed ambient air quality standards relevant to hazardous waste incinerators and other emission sources. As best I can determine, concentrations of several chemicals in air at the southern boundary exceed values from most, if not all, states with such standards. I think that it would be fair to conclude – given the calculated risks and comparisons with air quality standards – that the situation that exists at Atsugi, Japan, would not be allowed to continue if it were in the United States. Public health concerns would lead to either voluntary steps or enforcement actions to promptly reduce air emissions to acceptable levels.

This report raises significant concerns about potential health impacts from air pollution at the Naval Air Facility at Atsugi, Japan. I am surprised, and a bit disappointed, that the Japanese government would permit this situation to exist, not only in regard to U.S. military personnel and their dependents, but also for Japanese citizens living and working in the vicinity of this incinerator. I sincerely hope that the Navy will be able to persuade the owners of the incinerator complex to adopt, or the Japanese government to require, an immediate change to more modern, health-protective practices and technology.

Regards,

Stephen M. Roberts, Ph.D.
Associate Professor and Center Director

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Stephen M. Roberts, Ph.D.
Associate Professor and Center Director
Center for Environmental & Human Toxicology
University of Florida
Alachua, Florida 32615

DATE: July 26, 1995

1. COMMENT: Third paragraph

"As noted in the uncertainty analysis, the exposure assumptions inherent in these risk-based screening criteria are somewhat conservative given the characteristics of the population at the Naval Air Facility. .... As discussed in the report, however, the degree of overestimation resulting from this is not particularly large (i.e., less than an order of magnitude). Further, it should be recognized that this overestimation applies only to cancer risk, and not to non-cancer risk estimation - as long as the exposure is chronic, non-cancer risk is independent of exposure duration. It must also be kept in mind that the preliminary evaluation is incomplete - other potentially significant exposure routes were not considered (e.g., exposure to contaminated soils or groundwater). As such the preliminary evaluation will tend to underestimate the risks posed by exposure from all relevant pathways."

ANSWER: Due to the conservative assumptions used by Region III in calculating the RBCs used to estimate the human health risk, other peer reviewers have expressed a concern that our estimation of the risk may have been over interpreted. Your comment pointing out that other potentially significant exposure routes were not considered, therefore underestimating the risks posed by exposure from all relevant pathways is well received. The overestimation of risk by use of conservative assumptions is balanced by many other underestimated factors, e.g., the lack of data on the risk posed from soil and groundwater. We agree with your comment, and we will emphasize in the uncertainty section of the final report, that the overestimation only applies to cancer risks, because on chronic exposures the non-cancer risk is independent of exposure duration. In addition, we will strongly accentuate that there are other potentially significant exposure routes which may increase the risk and must be considered to evaluate the total risk to the on- and off-base population.

faxed 804. 444-1261

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
National Center for Environmental Assessment (MD-52)
Research Triangle Park, North Carolina 27711

July 19, 1995

Yvonne P, Walker
Deputy Director, Environmental Programs
Navy Environmental Health Center
2510 Walmer Ave.
Norfolk, VA 23513-2617

Dear Ms. Walker:

Further discussions I have had with Charles Gross regarding the Jinkanpo situation uncovered other issues, in addition to those I indicated to you in my earlier letter, that I wish to address. I think it is important to indicate in discussions with the Japanese officials that the potential health problems associated with the incinerator activities would affect the Japanese citizens who live/work at or near the naval base. It is not just a navy problem, but affects the Japanese as well.

Mr. Gross pointed out that the noncancer effects of the carcinogens on your list have not been well addressed. I agree. The carcinogens such as methylene chloride, trichloroethylene, tetrachloroethylene, and carbon tetrachloride all have potential to cause liver toxicity. The absence of a hazard ranking in the noncancer list of effects is likely to underestimate the total potential hazard. Although these noncancer effects are not now included in the hazard quotient for noncarcinogens, I feel that some qualitative statement should be included in your report to stress that some of these carcinogens also cause liver and CNS problems. Since there are no inhalation IRIS values for these substances, a qualitative description of noncancer effects could be assembled from information in the ATSDR profiles.

Our office, which develops the Inhalation Reference Concentrations (RfCs), has looked at benzene and trichloroethylene, for example, but we do not have any official numbers or supporting documentation. I perhaps would need more time than indicated (26 July) in your letter to put together a short, scientifically-defensible assessment for trichloroethylene, tetrachloroethylene, and benzene with respect to their noncancer effects.

I hope these additional comments are useful to you. If I can be of further help, please call at 919-541-4156 or fax to 919-541-1818.

Sincerely,

Mark Greenberg

Mark M. Greenberg
Physical Scientist
Hazardous Pollutant Assessment Group

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Mark M. Greenberg, Ph.D.
Physical Scientist
Hazardous Pollutant Assessment Group
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment
Research Triangle Park, North Carolina 27711

DATE: July 19, 1995

1. COMMENT: First Paragraph, second sentence

"I think that it is important to indicate in discussions with the Japanese officials that the potential health problems associated with the incinerator activities would affect the Japanese citizens who live/work at or near the naval base. It is not just a navy problem, but effects the Japanese as well."

ANSWER: The effect of hazardous chemicals from air emissions associated with the Jinkanpo Incinerator Complex activities on the Japanese citizens who live/work at or near the naval base will be addressed in the final report.

2. COMMENT: Second Paragraph, beginning on the second sentence

..."The carcinogens such as methylene chloride, trichloroethylene, tetrachloroethylene, and carbon tetrachloride all have potential to cause liver toxicity. The absence of a hazard ranking in the noncancer effects are not now included in the hazard quotient for noncarcinogens, I feel that some qualitative statements should be now included in your report to stress that some of these carcinogens also cause liver and CNS problems. Since there are no inhalation IRIS values for these substances, a qualitative description of non-cancer effects could be assembled from information in the ATSDR [Agency for Toxic Substances and Disease Registry] profiles."

ANSWER: A public health implications section has been added to the report which compares concentrations of chemicals measured in the ambient air to ATSDR minimum risk values for non-carcinogenic effects and their cancer risk evaluation guides for carcinogens. Additionally, a qualitative description of non-cancer effects is included in Appendix C of the final report.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
National Center for Environmental Assessment
Research Triangle Park, NC 27711

August 8, 1995

Vera Wang
Environmental Programs
The Navy Environmental Health Center
2510 Walmer Avenue
Norfolk, VA 23513

Dear Ms Wang:

As requested by Charles Gross, I have evaluated the noncancer effects of three known or suspected human carcinogens on your list at the Jinkapo incinerator complex in Japan. The three chemicals are benzene, trichloroethylene, and tetrachloroethylene. There are no official USEPA Inhalation Reference Concentrations (RfC) for these chemicals. As the lead USEPA scientist involved in evaluating the toxicological database for RfC development for these chemicals, I recommend the following approach in deriving toxicity values not-to-be-exceeded with regard to the incinerator activities. The values I have identified are best compared to measured annual time-weighted average concentrations for each chemical in determining adjustments to your hazard index.

If I can be of further help, please call at 919-541-4156.

Sincerely,

Mark Greenberg

Mark M. Greenberg
Hazardous Pollutant
Assessment Group

Enclosure

Noncancer Effects of Trichloroethylene

The principal effect of trichloroethylene (TCE) exposure in humans is dysfunction of the central nervous system. Subjective symptoms, such as drowsiness, fatigue and headache have been demonstrated in a number of occupational and controlled acute exposure studies. The agent responsible for these effects is believed to be trichloroethanol, a potent CNS depressant and metabolite of TCE. Identification of chronic exposure levels associated with CNS symptoms or dysfunction in published studies is confounded by the acute nature of the effects.

Because of a lack of adequate human data and inadequate data from laboratory animal testing, the U.S. EPA has not been able to identify an inhalation reference concentration for CNS effects. However, application of PBPK modeling to datasets from human exposures suggests that if 1 ppm is not exceeded, initial symptoms of CNS dysfunction are not likely to occur. This is not to suggest that chronic CNS effects for which symptoms are not readily observable are precluded. Changes in brain chemistry, for example, may occur at lower exposure levels. If one were to apply conventional uncertainty factors to the 1 ppm level, a not-to-be-exceeded level of 10 ppb would not seem unreasonable.

Noncancer Effects of Benzene

The USEPA has not as yet developed an inhalation reference concentration for noncancer effects of benzene. However, the nature and extent of the database clearly indicates that blood dyscrasia is likely to be a critical effect. In particular bone marrow cells are a target for benzene toxicity. Evidence developed over the years indicate that benzene is particularly toxic to actively replicating hematopoietic cells. Studies by Keller and Snyder (1986,1988) indicate that exposure of pregnant mice to 5 ppm results in reduced numbers of erythropoietic precursor cells in 2-day-old neonates. Thus, in utero exposure to 5 ppm may be a reasonable adverse effect level for benzene. Under current EPA guidelines for developmental toxicity, such an effect would most likely be considered adverse. If one were to apply conventional uncertainty factors to 5 ppm to account for intra- and interspecies variation, a level of 50 ppb could be considered a not-to-be-exceeded level for noncancer effects in humans.

The reference citations are Toxicology 42: 171-181, 1986 and Fund. Appl. Toxicol. 10: 224-232, 1988.

Noncancer Effects of Tetrachloroethylene

A number of studies have examined dry-cleaning workers exposed to PERC and it is not clear what chronic exposure level is associated with CNS dysfunction. Also, the effect of PERC on liver function has been difficult to assess in these workers although most studies suggest that PERC does not show an effect. A chronic inhalation study with laboratory animals (National Toxicology Program, 1986) did show some liver effects at 100 ppm. However, there was high mortality at this level. In the same study, a concentration-response relationship was observed for the incidence of tubular cell karymegaly in mice. This observation, in conjunction with the findings of the Franchini et al. (1983) study (Int. Arch.Occup. Environ. Health 52: 1-9) in humans, suggests that renal toxicity may be an endpoint for which a toxicity value can be derived. In this latter study, an increase in renal enzymes was observed and this suggests possible renal injury. The exposure estimate in this study is a TWA of 10 ppm. However, since the study was cross-sectional in design and duration of exposure was 14 years, the TWA responsible for the renal effects may have been higher. Nevertheless, the use of the 10 ppm value in deriving a toxicity value not-to-be-exceeded would be conservative. After duration-adjustment to account for less-than-continuous exposure and application of conventional uncertainty factors, a level of 10 ppb seems to be a level not-to-be-exceeded.

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Mark M. Greenberg, Ph.D.
Physical Scientist
Hazardous Pollutant Assessment Group
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment
Research Triangle Park, North Carolina 27711

DATE: August 8, 1995

1. COMMENT: First paragraph

"As requested by Charles Gross, I have evaluated the noncancer effects of three known or suspected human carcinogens on your list at the Jinkanpo incinerator complex in Japan. The three chemicals are benzene, trichloroethylene, and tetrachloroethylene. There are no official USEPA Inhalation Reference Concentrations (RfC) for these chemicals. As the lead USEPA scientist involved in evaluating the toxicological database for RfC development for these chemicals, I recommend the following approach in deriving toxicity values not-to-be-exceeded with regard to the incinerator activities. The values I have indicated are best compared to measured annual time-weighted average concentrations for each chemical in determining adjustments to your hazard index."

ANSWER: The RfCs you provided are addressed in Appendix C as comparison values to assist in addressing the likelihood of observing noncancer effects from exposure to benzene and trichloroethylene. Additionally, the uncertainty section will address the uncertainty of not calculating a hazard quotient for benzene, trichloroethylene and tetrachloroethylene.

Faxed 804 - 447 - 1261

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
National Center for Environmental Assessment (MD-52)
Research Triangle Park, North Carolina 27711

July 18, 1995

Yvonne Walker
Deputy Director
Environmental Programs
The Navy Environmental Health Center
2510 Walmer Avenue
Norfolk, VA 23513

Dear Ms Walker:

Charles Gross, of your office on July 13, 1995, requested my review of the risk evaluation of the Jinkanpo incineration complex activities. I have completed my review with a focus on the those substances associated with noncarcinogenic effects. Please note that my comments do not constitute an official U.S. EPA position on this issue.

The approach used in developing the hazard quotient, comparing measured levels with the Region III RBC's, appears reasonable, particularly when the RBC's are based on IRIS values, as they have for certain of the organics. However, only three chemicals dominate the total hazard quotient with respect to noncancer effects. They are chromium III and compounds, 1,2,4- and 1,3,5-trimethylbenzene. Since there is no IRIS documentation on inhalation reference concentrations, it is difficult to determine if the RBC's derived for these chemicals are scientifically-defensible. For the methylbenzenes, there are no reference concentrations values for inhalation, only oral. Thus, you should be aware that the inhalation RBC's developed by Region III for the methylbenzenes and chromium III may have a limited scientific basis. I would encourage development of further documentation on these three organics to detail the nature of the types of health effects they can cause at the levels currently measured. The most up-to-date source of such information is perhaps the profiles prepared by the Agency for Toxic Substances and Disease Registry.

The sampling time for the organics represents another issue that directly affects the total hazard quotient. The sampling time for organics was stated as ranging from 30 minutes to 2 hours, whereas others on the noncancer list, e.g., chromium, were measured for 24 hours. It seems possible that unless 24 hour sampling was conducted significant emissions from the site were not detected and that the individual hazard quotients may be underestimated. If, for example, sampling was conducted only during daylight hours, a time in which some organics are likely to undergo photooxidation and reaction with hydroxyl radicals, higher concentrations reached during darkness may have gone undetected. More extensive sampling over 24-hour periods may strengthen your position.

Your overall approach to risk estimation appears thorough and does demonstrate that the incineration activities are associated with potential health problems. The information you have developed should be useful in your negotiations with the Japanese government.

If I can be of further assistance, please call at 919-541-4156.

Sincerely,

Mark M. Greenberg
Physical Scientist
Hazardous Pollutant Assessment Group

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Mark M. Greenberg, Ph.D.
Physical Scientist
Hazardous Pollutant Assessment Group
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment
Research Triangle Park, North Carolina 27711

DATE: July 18, 1995

1. COMMENT: Second Paragraph

"The approach used in developing the hazard quotient, comparing measured levels with the Region III RBC's, appears reasonable, particularly when the RBC's are based on IRIS values, as they have for certain of the organics. However, only three chemicals dominate the total hazard quotient with respect to non-cancer effects. They are chromium III and compounds, 1,2.4- and 1,3,5-trimethylbenzene. Since there is no IRIS documentation on inhalation reference concentrations, it is difficult to determine if the RBC's derived for these chemicals are scientifically-defensible. For the methylbenzenes, there are no reference concentration values for inhalation, only oral. Thus you should be aware that the inhalation RBC's developed by Region III for the methylbenzenes and chromium III may have a limited scientific basis. I would encourage development of further documentation on these three organics to detail the nature of the types of health effects they can cause at the levels currently measured. The most up to date source of such information is perhaps the profiles prepared by the Agency for Toxic Substances and Disease Registry."

ANSWER: We recognize that the RBC values Region III developed for trimethylbenzenes are based on an oral reference dose rather than an inhalation reference concentration value. We are also aware that the inhalation reference concentration for chromium developed by IRIS and HEAST was withdrawn. The values used by Region III to calculate the RBC's for chromium III and compounds and 1,2.4-/1,3,5-trimethylbenzene currently represent the most-up-date reference concentrations we can use to estimate the risk posed by these chemicals. To further detail the nature of the types of health effects these chemicals can cause the final report will provide a qualitative description of the health effects of chromium III and compounds, and 1,2.4-/1,3,5-trimethylbenzene in Appendix C of the finaL report.

2. COMMENT: Third Paragraph

"The sampling time for the organics represents another issue that directly affects the total hazard quotient. The sampling time for organics was stated as ranging from 30 minutes to 2 hours, whereas others on the noncancer list, e.g., chromium, were measured for 24 hours. It seems possible that unless 24 hours sampling was conducted significant emissions from the site were not detected and that the individual hazard quotients may be underestimated. If, for example, sampling was conducted only during daylight hours, a time in which some organics are likely to undergo photo oxidation and reaction with hydroxyl radicals, higher concentrations reached during darkness may have gone undetected. More extensive sampling over 24-hour periods may strengthen your position."

ANSWER: Due to the conservative assumptions used by Region III in calculating the RBCs used to estimate the human health risk, other peer reviewers have expressed a concern that our estimation of the risk may have been over interpreted. Your comment pointing out that higher concentrations of some organics reached during darkness may have gone undetected significantly strengthens our position that, an overestimation of the risk is balanced by many other underestimated factors, such as decrease in measurable chemical concentrations of certain organics due to photo oxidation. We will include this issue as one of the factors that could cause the risk to be underestimated in the uncertainty section of the final report.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
National Center for Environmental Assessment
Washington, DC 20460

NCEA Washington Office (8602))

August 9, 1995

MEMORANDUM

SUBJECT: Review of Risk Assessment for the Naval Air Facility at Atsugi, Japan

FROM: Matthew Lorber, Environmental Engineer Matt Lorber
National Center for Environmental Assessment (8603)

TO: Charles Grosse
Navy Environmental Health Center

As per your request, I have reviewed the report titled, "Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities At The Naval Air Facility Atsugi, Japan". My expertise in reviewing this report is in exposure and human health risk assessment generally, and specifically for dioxin and dioxin-like compounds. My review will focus on this class of compounds. I would recommend further review of this or subsequent assessments of the Naval Air Facility at Atsugi, Japan (hereafter referred to as the NAF site). I would recommend that you have Roy Smith of Region III review this assessment since you have used his Risk-Based Concentration (RBC) methodology. The Agency for Toxic Substances and Disease Registry could also provide pertinent comment to this site. I have reviewed this site and this assessment with my management and we would be willing to sit and further discuss this site at a later date if that would be desirable.

First, let me comment that EPA's Region III guidance appears to have been applied correctly, from a technical perspective. Specifically, air concentrations found by monitoring were correctly compared against the RBCs to determine a Hazard Index or a cancer risk estimate for the inhalation pathway, for all contaminants evaluated. Except for the dioxins, I have not checked to see that the correct RBCs were used - i.e., that the RBC supplied in the Region III guidance was in fact a cancer or a non-cancer RBC, or that the RBC was correctly transcribed from the Region III table. I have no reason to believe that there were any errors in the technical use of the methodology.

From a policy perspective, I do note that it would appear that a conclusion regarding human health risk has been made using the Region III guidance (p. 1): "The human health risk caused by these two sources of pollution is unacceptable.". It was noted in the text that the Region III guidance was used as a screening tool, although the sentence stating that was unclear (p. 5): "The EPA Region III Risk Based Concentrations (RBCs) tables for ambient air were used as a screening tool in the identification of chemicals of potential concern and indirectly in the estimation of Cancer/Hazard (non-cancer) Risk associated with the Jinkanpo Incineration Complex." What is meant by, "indirectly" in this sentence? It appears that cancer risk estimates and Hazard Indices were generated and apparently used to support the conclusion made above. This would appear to be a "direct" use of the Region III methodology.

Region III notes that, "The Region III toxicologists use the table to screen sites not yet on the NPL, respond rapidly to citizen inquiries, and spot-check formal baseline risk assessments.", and then in italics, "*To summarize, the table should generally not be used to (1) set cleanup or no-action levels at CERCLA or RCRA Corrective Action sites, (2) substitute for EPA guidance for preparing baseline risk assessments, or (3) determine if a waste is hazardous under RCRA*" (memorandum from R.L. Smith to RBC Mailing List dated 3/7/1995).

It would appear that the Region III authors of this RBC methodology use, and recommend the use of, the methodology for screening purposes only. However, the principal audience for these quotes is EPA risk assessors and not other assessors. This does not preclude the use of this methodology to evaluate the monitoring data conducted at the Naval Air Facility at Atsugi (abbreviated NAF site hereafter). It also does not preclude the use of the methodology to support, along with other information, some of the recommendations made in this assessment - to conduct more monitoring, to halt the dumping of solvent waste on the waste piles, and so on. The concern that I am expressing is simply that the NAF site assessment should be clear about what the Region III methodology is - a screening methodology - and that it appears to have been "directly" to support conclusions regarding potential human health impact.

I am also concerned that this assessment may not provide a compelling argument that the high air concentrations at Site 2 are solely the responsibility of the Jinkanpo incineration complex. First, the measurements at the "background" Site 1 were not displayed or used in any way in this assessment. It was stated in the assessment that Site 1 was close in proximity to Site 2 and may have been influenced by vehicle pollution. It is not stated in the report, but the implication is that the concentrations found at Site 1 are similar to those at Site 2. If they were similar, than several possibilities exist: that the air concentrations at Sites 1 and 2 both are predominantly influenced by the incineration complex, that neither site is predominantly influenced by the incineration complex, or that other sources *and* the incineration complex contributed to the findings at Sites 1 and 2. In other words, Site 1 did not perform its function as an appropriate background site and the picture may be more unclear since the air concentrations measured at Site 1 were comparable to that at Site 2.

It was stated that Site 2 corresponds to a location that is predicted by modeling to be maximally impacted by the plume from the incineration. Air modeling with ISCST2 can be used to locate a site that is maximally impacted on a long-term average basis. Are wind speed and direction data available on the days when air sampling occurred at Site 2 to verify that the winds were similar to long term averages? If so, it would be important to discuss this trend. If wind data were available and they indicated that winds were opposite of historical averages on some of the days, what do the concentrations look like on those days compared to days when winds were more nearly like historical averages? What would be the interpretation of the data for site 2 if winds were blowing from the air monitor to the incineration complex (instead of the other way around) during the 24 hours of air sampling and the air concentrations on that day were high? These kinds of questions and issues need to be further investigated.

The information on the incineration complex in this assessment certainly does suggest that the complex could be the principal source of the high air concentrations found at Site 2. Still, fairly definitive conclusions are being drawn regarding human health, and recommendations for remediation are outlined. The conclusions and recommendations would be bolstered with further data such as: 1) stack emission testing (discussed below), 2) further air monitoring to include northernmost and southernmost parts of the NAF (and other sites if possible) taken concurrently. A comparison of data from disperse air monitoring sites, along with wind speed and direction information during the time sampling occurs, and computer modeling insights, would be helpful, 3) discussion of potential sources at the NAF and their exclusion if appropriate (solvents used to clean jets, vehicle pollution, e.g.), and 4) other environmental monitoring such as soil sampling, at the incineration complex as well as the NAF, as already suggested in this assessment.

I would also recommend the following:

1) Additional verbiage should be added to the uncertainty section. This additional discussion would more fully describe the screening nature of the methodology and the fact that all assumptions made to develop the RBCs were assumed to be true for the NAF site. Most importantly, the inhalation pathway assumes 30 years exposure. The uncertainty section does acknowledge that this is likely that this exposure period is high, by up to six times.

2) It is noted that scrubbers were put on the incinerators at a cost of billions of yen. Before a recommendation is made to spend additional monies on further pollution control, I would recommend analysis on the existing emissions. Specifically, I would recommend stack testing for dioxins. This would allow for an estimate of dioxin emissions. We have developed ample information on the rates of dioxin emissions from incinerators and can share that information with you at any time; you already have the Executive Summary for the Exposure Assessment documents which discusses dioxin emissions from incinerators. The emission rate of dioxins, together with your air dispersion modeling, will allow you to estimate the average dioxin concentrations at the point you were monitoring for dioxins. Comparing the model predictions

with observations will allow you to make some judgement as to the contribution of stack emissions to observed concentrations. This is discussed in more detail below.

3) Bolster your arguments regarding the severity of the dioxin air concentrations with information I have supplied in this review. Specifically, emphasize the degree to which the dioxin air concentrations are elevated above typical concentrations (you may wish to try and track down other monitoring for dioxins in the air in Japan; I was only able to find one article). Emphasize using the qualitative statements I have made in this review that other pathways equal or exceed the inhalation pathway, particularly the terrestrial animal pathway, which can be up to 2 orders of magnitude higher than the inhalation pathway.

My comments on dioxin are as follows:

1) Since I am not a chemist and have little expertise with air monitoring protocols, I will assume that the dioxin concentrations on Table 1-5 are correct. I have no reason to believe otherwise - the method is the correct one to use, the QA indicated no dioxins except OCDD found in the blank (and OCDD is always found in blanks), and so on. Assuming they are correct, I can conclude that the levels found are very high compared to what we have found in the US and around the world. Table 1 includes a comparison of dioxin ambient air concentrations found at the site, in the US, and at another site in Japan (Kurokawa, et al, 1994). Then NAF site air concentrations are the average of the five samples given in Table 1-5 of the NAF site assessment. The US air samples are a compilation we did the 1994 dioxin exposure assessment document (EPA, 1994). This compilation included 84 samples from around the country, mostly in urban settings, and all taken to measure ambient conditions rather than downwind from a known source. The Toxic Equivalent (TEQ) air concentration of 0.095 pg/m^3 is generally consistent with urban air concentrations in studies from Europe. The third column does not contain individual congener concentrations. These data come from an unidentified site in Japan and were reported in Kyoto in 1994 at Dioxin '94 (Kurokawa, et al., 1994). I have included a copy of the extended abstract of this monitoring work. It would appear that this site is elevated compared to the US but the air concentrations measured in the NAF site are substantially elevated above that.

2) In the NAF assessment, the high concentrations of each of the individual congeners from the five samples were selected and congener-specific RBC were developed by adjusting the Region III 2378-TCDD RBC based on the Toxicity Equivalency Factor (TEF) of the individual congener. I would recommend that a more appropriate approach is to estimate a TEQ air concentration from the five data points and then apply that to the 2378-TCDD RBC. I calculated an overall TEQ concentration of 8.46 pg/m^3 from the five data points from Site 2. I did this by taking the average concentration of each congener, determining its toxic equivalent concentration by multiplying it by its TEF, and then summing the toxic equivalent concentration of each congener. This TEQ concentration of 8.46 pg TEQ/m^3 can be used with the RBC for 2378-TCDD. The calculation for a cancer risk then becomes, $[(8.46*10^{-6})/(5*10^{-8})]*10^{-6}$, which equals $1.7*10^{-4}$. This is similar to the sum of all the

individual congener cancer risk estimates for the dioxin congeners in the NAF assessment.

3) We have found in our evaluations that the consumption of animal food products of terrestrial (beef, pork, chicken, eggs, milk, etc.) or aquatic (fish) origin which contain dioxin lead to significantly higher risks as compared to the inhalation of air containing dioxin. In specific exercises where an air concentration at a hypothetical exposure site was routed through the terrestrial food chain, and exposed individuals both breathed the air and consumed these terrestrial food products, we found that consumption of the food exceeded the inhalation exposure and risk by about two orders of magnitude. In other words, if terrestrial animal food products were being produced and consumed at the NAF site where the air concentrations were taken, than an estimated risk from consuming those food products could be in the 10^{-2} range. This trend is due to the fact that these compound bioaccumulate in the fat of animals. We have also found that other pathways, such as soil related pathways (dermal contact or ingestion, even typical ingestion patterns by children) or vegetable/fruit ingestion lead to comparable or greater impacts as compared to the inhalation pathway. Given the fact that the air concentration appears significantly higher than is typical for urban settings, and that the estimated risk for the inhalation pathway may already be in the 10^{-4} range, an appropriate next step would be to evaluate other possible pathways that may be relevant for the NAF site.

4) As discussed above, it is recommended that a more compelling argument be developed that the high air concentrations originate from the incineration complex. The implication is that high concentrations of dioxin originated from the stack emissions. Dioxins could also have originated from soil volatilization, from the treatment and disposal of the incinerator ash, from emissions from the waste piles before they are burned (solvents were said to be poured onto waste piles could strip existing dioxins from the waste), and so on. One way to begin to evaluate this issue is to do some stack monitoring for dioxins. The emission rate for dioxins could be fed into the ISCST2 model runs. One can use the existing model output together with the measured emission rate to estimate what the air concentration might be the Site 2 air sampling point. If the predicted air concentrations are significantly lower, say 1 order of magnitude or more lower, than the measured air concentration, this would imply that other sources should be identified and controlled. It is recommended that an attempt be made to tie the measured air concentrations of dioxins to stack emissions before concluding that the stack emissions have caused the high concentrations.

5) Beside the use of the ISCST2 model runs to locate the point of maximum impact and with an emission rate, to estimate the air concentration at sampling site 2, I would suggest they have limited value since the incinerators are apparently located in complex terrain (complex terrain is defined as a situation where the stack height is at or below the receptor locations). It appears that the air monitoring was also used to discuss the possible dilution of the plume at points further from the point of maximum impact, such as the northernmost point of the NAF. Is the ISCST2 capable of modeling complex terrain with fumigation? Air and soil monitoring would be effective means of obtaining information on impacts hundreds to thousands of meters away.

6) The toxicity characterization of dioxin on page 12 is inappropriate. I would suggest you consult the Risk Characterization chapter which I gave you when I was in Norfolk earlier this year for better language on dioxin toxicity. The fate characterization on page 11 also could use some work.

Comments on topics other than dioxin include:

1) I agree with the recommendation for more soil sampling, particularly for dioxin. Air monitoring at the sites noted on bullet "3)" on page 15 at the NAF would also be informative.

2) On page 2 it is stated that the sampling objectives of the investigation conducted in references (a) and (b) were to develop air pollution emission rates for the Jinkanpo complex. How were emission rates estimated with ambient air monitoring? Were they estimated by back calculating given air dispersion modeling? I don't see emission rates in this report, and recommended above that they be measured by direct stack monitoring.

3) On page 6, 1000 Ug/m^3 in the carcinogen formula for RBC is a typo. It should be 1000 Ug/mg.

4) On page 7, 1,2,-dichloropropane is noted as exceeding the HI on Table 2-2, but it is not on this table. The other three compounds cited are on this table. Also, it is invalid to sum Hazard Indices for several compounds unless it is known that the target organ for each compound evaluated is the same. Is this the case for the HI summation of 92.46 (too many significant digits anyway)? Also, on page 13, is there a typo where the HI summation is listed as 992.46?

References:

Kurokawa, Y., T. Matsueda, M. Nakamura, S. Takada, and K. Fukamachi. 1994. Distributions of Atmospheric Coplanar PCBs, Polychlorinated Dibenzo-p-dioxins and Dibenzofurans between Vapor Phase and Particle Phase. Organohalogen Compounds Volume 20: p. 91-94. proceedings of the 14th International Symposium on chlorinated Dioxins, PCB and Related Compounds November 21-25, 1994, held at Kyoto, Japan.

EPA, 1994. Estimating Exposure to Dioxin-Like Compounds. Volumes I, II, III. EPA/600/6-88/005Ca-c. June, 1994. External Review Draft.

cc. -- W. Farland
R.L. Smith

Table 1. Comparison of dioxin air concentration in urban settings in the United States, as reported for the Jinkanpo incinerator, and as reported for another site in Japan (see text for more detail).

Dioxin Congener	United States, pg/m^3	NAF site, pg/m^3	Japan site, pg/m^3
2378-TCDD	0.010	0.22	NA
12378-PCDD	0.032	1.09	NA
123478-HxCDD	0.025	1.14	NA
123678-HxCDD	0.037	2.26	NA
123789-HxCDD	0.049	1.41	NA
1234678-HpCDD	0.583	17.80	NA
OCDD	2.843	41.2	NA
2378-TCDF	0.113	1.78	NA
12378-PCDF	0.050	3.47	NA
23478-PCDF	0.029	7.38	NA
123478-HxCDF	0.060	5.64	NA
123678-HxCDF	0.059	5.69	NA
123789-HxCDF	0.016	3.48	NA
234678-HxCDF	0.045	10.8	NA
1234678-HpCDF	0.210	29.1	NA
1234789-HpCDF	0.03	7.20	NA
OCDF	0.17	28.1	NA
TOTAL, pg/m^3	4.36	168.0	18.53 - Summer 34.90 - Winter
TEQ, pg/m^3	0.095	8.46	0.38 - Summer 0.45 - Winter

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Matthew Lorber
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment
Washington, DC 20460

DATE: August 9, 1995

1. COMMENT: Page 2, first Paragraph

"From a policy perspective, I do note that it would appear that a conclusion regarding human health risk has been made using the Region III guidance (p.1): "the human health risk caused by these two sources of pollution is unacceptable." It was noted in the text that Region III guidance was used as a screening tool, although the sentence stating that was unclear (p.5): "The EPA Region III Risk Based Concentrations (RBCs) tables for ambient air, were used as a screening tool in the identification of chemicals of potential concern and indirectly in the estimation of Cancer/Hazard (non-cancer) Risk associated with the Jinkanpo Incineration Complex." What is meant by, "indirectly" in this sentence? It appears that cancer risk estimates and Hazard Indices were generated and apparently used to support the conclusion above. This would appear to be a "direct" use of the Region III methodology."

ANSWER: In the final report the first paragraph in section 2.5, page 5, has been modified to clarify what the indirect use of EPA Region III RBCs means. By stating that EPA Region III RBCs were indirectly used in the estimation of the cancer and non-cancer risk associated with the Jinkanpo Incineration Complex, we mean that the human health risk was estimated by using Region IV guidance which applies EPA Region III RBC values to calculate the cancer risk and hazard index for each chemical and the aggregate cancer and non-cancer risk. To make this paragraph clearer we have described the EPA Region IV methodology in the final report.

2. COMMENT: Page 2, fourth paragraph

"I am also concerned that this assessment may not provide a compelling argument that the high air concentrations at site 2 are solely the responsibility of the Jinkanpo incineration complex. First, the measurements at the "background" site 1 were not displayed or used in any way in this assessment. It was stated in the assessment that Site 1 was close in proximity to Site 2 and may have been influenced by vehicle pollution. It is

not stated in the report, but the implication is that the concentrations found at Site 1 are similar to those at Site 2. If they were similar, than several possibilities exist: that the air concentrations at sites 1 and 2 both are predominantly influenced by the incineration complex, or that other sources and the incineration complex contributed to the findings at Sites 1 and 2. In other words, Site 1 did not perform its function as an appropriate background site and the picture may be more unclear since the air concentrations measured at Site 1 were comparable to that at site 2.

ANSWER: Site 1 results are now included in the final report. The entire report on the Jinkanpo Incineration Complex activities includes two parts. Part A is a report on the emissions inventory, an emission rate analysis, ambient air sampling data, and a comparison with air emission standards and guidelines for diagnosing potential health impacts due to the emissions from the incineration complex. This investigation was conducted by the Navy Engineering Facilities Services Center. Part B is the Preliminary Health Risk Evaluation conducted by our office, the Navy Environmental Health Center. Ambient air sampling for Site 1 was reported in Part A, as a background site upwind from the incineration complex. Although Site 1 is located parallel to the incinerator, about 150 meters from it, it was the best upwind location available on NAF Atsugi, still inside the base property. This site is not affected by the plume when the wind is blowing from the south to the north. Site 1 data was used in Part A in the air dispersion modeling along with stack sampling data from the incinerator to back calculate the emissions rate necessary to cause the downwind air concentrations detected during ambient air sampling. The sampling results reported in Part A indicated that there is a significant difference in air quality between the background Site 1 and the downwind Site 2 located about 200 meters away. Therefore, Site 1 <u>did</u> perform its function as an appropriate background site for air modeling purposes described in Part A of the complete report. However, in Part B draft report, Site 1 could not be used for health risk assessment purposes, because being so close to the incinerators, it would not be a suitable background site for the elimination of chemicals of potential concern. Therefore, in preliminary risk evaluation, we did not use Site 1 data. However, in Part B of the final report Site 1 data is now included to show that there is a potential impact to human health at this site, even though Site 1 is upwind from the base.

Site 1 is not the best background site. Site contamination may have occurred with the Tenax tubes at Site 1 due to vehicle pollution. However, the summa canisters were not effected by vehicle pollution. The same trends between the summa canisters and the Tenax can be seen in Part A of the report. Thus, for the Tenax samples there was only at best minimal contamination. The samples most likely to have been effected by other sources are the PUF and PM_{10} samples because they were taken over 24 hours.

The samples do show a difference in concentrations between the two sites, with Site 2 being higher.

3. COMMENT: Page 3, first paragraph

It was stated that site 2 corresponds to a location that is predicted by modeling to be maximally impacted by the plume from the incineration. Air modeling with ISCST2 can be used to locate a site that is maximally impacted on a long-term average basis. Are wind speed and direction data available on the days when air sampling occurred at site 2 to verify that the winds were similar to long term averages? If so, it would be important to discuss this trend. If wind data were available and they indicated that winds were opposite of historical averages on some of the days, what do the concentrations look like compared to days when winds were more nearly like historical averages? What would be the interpretation of the data for site 2 if winds were blowing from the air monitor to the incinerator complex (instead of the other way around) during the 24 hours of air sampling and the air concentrations on that day were high? These kinds of questions and issues need to be further investigated.

ANSWER: Wind speed and wind direction data are available from two meteorological stations. Air sampling was only performed when the typical summer wind was present that historically blows from the incineration complex to NAF Atsugi. This wind blows for approximately 8 hours each day. No data was collected when the wind blew in the opposite direction. The goal of sampling was to collect information on the extent of air pollution coming from the Jinkanpo complex area as it is perceived as the major source of local air pollutants. The goal was not to determine all of the sources of air pollution in the area, which would have required a significant increase in time and money.

4. COMMENT: Page 3, second paragraph

"The information on the incineration complex in this assessment certainly suggests that the complex could be the principal source of the high air concentrations found at Site 2. Still, fairly definitive conclusions are being drawn regarding human health, and recommendations for remediation are outlined. The conclusions and recommendations would be bolstered with further data such as :1) stack emission testing (discussed below), 2) further air monitoring to include northernmost and southernmost parts of the NAF (and other sites if possible) taken concurrently. A comparison of data from disperse air monitoring sites, along with wind speed and wind direction information during the time sampling occurs, and computer modeling insights, would be helpful, 3) discussion of potential sources at the NAF and their exclusion if appropriate (solvents used to clean jets, vehicle-pollution, e.g.) And 4) other environmental monitoring such as soil sampling, at the incineration complex as well as the NAF, as already suggested in this assessment."

ANSWER: During the time periods sampled, industrial operations on NAF Atsugi could not have affected the results. Sampling was conducted only when the air pattern was from the incineration complex to NAF Atsugi and potential sources on NAF Atsugi would have been downwind from Sites 1 and 2. Therefore, it is not necessary to define all of the sources on NAF Atsugi. A great deal of time and money would be involved in characterizing base emissions. This would not be necessary if the incinerator complex provided additional stack emission test data. However, there is no stack data for these additional compounds, and the integrity of such data would be questionable because the limited stack test data received to date neglect the emission rates of certain compounds. These compounds should have been reported according to local laws; however, this information has not been made available to us and would be required for risk assessment.

5. COMMENT: Page 3, first recommendation

"Additional verbiage should be added to the uncertainty section. This additional discussion would more fully describe the screening nature of the methodology and the fact that all assumptions made to develop the RBCs were assumed to be true for the NAF site. Most importantly, the inhalation pathway assumes 30 years exposure. The uncertainty section does acknowledge that this is likely that this exposure period is high, by up to six times."

ANSWER: Additional verbiage will be included in the uncertainty analysis section of the final report describing the screening nature of the EPA Region IV methodology and the assumptions made to derive the Region III RBCs. We will explain that although human exposure may be overestimated by using conservative assumptions, there are uncertainties in other pathways that may cause the risk to be underestimated as well. We will also mention that a 30 year exposure assumption is a reasonable exposure assumption for the Japanese residents living just outside the base. The final report includes a table that indicates cancer risks for varying resident exposure durations, including 30, 25, 20, 15, 10, 6 and 3 years.

6. COMMENT: Page 3, second recommendation, second and third sentences

"Before a recommendation is made to spend additional monies on further pollution control, I would recommend analysis on the existing emissions. Specifically I would recommend stack testing for dioxins."

ANSWER: Our recommendation for implementing pollution controls was meant to eliminate/prevent any potential adverse health effects predicted by the results of our screening risk assessment, to on-base and off-base residents, including American and Japanese families. It was based on results that indicated an unacceptable risk posed not only by the emission of dioxins, but also of several other chemicals, by these incinerators through the air pathway alone. We recognize that stack testing for dioxins would give more accurate results on dioxin emissions. However, because this is a Japanese owned incineration complex, stack sampling could only be accomplished with the cooperation of the owners of the Jinkanpo Incinerators. At the time, estimation of the emissions by air modeling using sampling from inside the base fence line was the only available option to collect this data. Because Site 2 ambient air samples were collected at the fence line located only within 50 yards from the incineration complex, it is reasonable to assume that the chemical concentrations found at Site 2 are valid data that can be used in the ISCST2 model to estimate the emissions from the incinerator. It's also important to point out in the final report that when Site 2 air samples were collected, there were only three of the four incineration stacks in use, and the emission rates and chemical concentrations could actually have been underestimated.

7. COMMENT: Page 4, third recommendation

"Bolster your argument regarding the severity of the dioxin air concentrations with information I have supplied in this review. Specifically, emphasize the degree to which the dioxin air concentrations are elevated above typical concentrations.... Emphasize using the qualitative statements I have made in this review that other pathways equal or exceed the inhalation pathways, particularly the terrestrial animal pathway, which can be up to 2 orders of magnitude higher than the inhalation pathway."

ANSWER: Using the qualitative statements 1 on page 4 made in your review, we will emphasize in the Fate and Transport Section of the final report the degree to which the dioxin air concentrations are elevated above typical concentrations. To do this, we will reference the data you provided to comparing dioxin ambient air concentrations found at NAF Atsugi, in the US and at another site in Japan.

Using qualitative statement 2 on page 4 we will include in section 2.5 of the COPCs a table showing the risks posed by total TCDD and TCDF developed by taking the average concentration of each congener, determining its toxic equivalent concentration by multiplying it by its TEF, and then summing the toxic equivalent concentration of each congener.

Addressing qualitative statement 3 on page 5, in the uncertainty section of the final report, we will stress that the dioxin risk from other pathways, such as soil and food chain, may equal or exceed the inhalation pathway. We will incorporate the report information you provided us about bioaccumulation of dioxins in food products of terrestrial animals (beef, pork, chicken, eggs, milk, etc.), vegetables and fruits.

Addressing qualitative statement 4 on page 5, we will incorporate in the final report in section 3.2, that dioxin could also have originated from waste piles volatilization, prior to burning, and or treatment and disposal of incinerator ash. However, pinpointing whether dioxins are being emitted through the incinerator stacks or through volatilization should not preclude mitigation of the potential health hazard risks to on- and off-base residents created by either source of dioxin emission. We should also recall that dioxin is not the only air contaminant posing a potential health hazard. Moneys spent on further pollution control should not be addressed in this report.

In regard to qualitative statement 5 on page 5, air concentrations at Site 2 were actually measured and not estimated. The ISCST2 used stack emissions data, limited to only a few chemicals, which was available on the incinerators, and meteorological data to predict the highest air concentrations on-base. Once the model indicated that Site 2 was the location on-base where the highest air concentrations would be found, actual ambient air sampling of Site 2 was conducted. In other words, the ISCST2 model was first used to predict the highest concentrations based on limited stack and adequate meteorological data available. Then, once ambient concentrations were measured at Site 2 and at background Site 1, it was used to back calculate the emissions that would correspond to the impact indicated downwind from the incinerators, to draw the new concentration isopleths. Details on the use to the ISCST2 air dispersion model are found in Part A of the complete report on the Jinkanpo Incineration Complex activities.

Addressing statement 6, additional information on the toxicity and fate characterization of dioxins will be included in the final report.

8. COMMENT: Page 6, comment 2

On page 2 it is stated that the sampling objectives of the investigation conducted in references (a) and (b) were to develop air pollution emission rates for the Jinkanpo complex. How were emission rates estimated with ambient air monitoring? Were they estimated by back calculating given air dispersion modeling? I don't see emission rates in this report, and recommended above that they be measured by direct stack monitoring.

ANSWER: This comment has been addressed in the answer to qualitative statement 5 in our response to COMMENT 4. Information regarding the back calculation of emission rates is provided in the final report.

9. COMMENT: Page 6, comment 3

On page 6, 1000Ug/m^3 in the carcinogen formula for RBC is a typo. It should be 1000Ug/mg.

ANSWER: The typographical error has been corrected in the final report.

10. COMMENT: Page 6, comment 4

On page 7, 1,2-dichloropropane is noted as exceeding the HI on Table 2-2, but it is not on this table. The other three compounds cited are on this table. Also, it is invalid to sum Hazard Indices for several compounds unless it is known that the target organ for each compound evaluated is the same. Is this the case for the HI summation of 92.46 (to many significant digits anyway)? Also, on page 13, is there a typo where the HI summation is listed as 992.46?

ANSWER: The inconsistency and typographical error have been corrected in the final report. We summed the Hazard Quotients (HQs) for all non-carcinogenic compounds per guidance provided in the EPA guidance document *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* that states that this is appropriate for a screening level approach. However, we agree that since there are as many as four chemicals having HQs above unity and in the absence of a target organ evaluation it is more appropriate to separately address their values. Individual HQs will not be summed in the final report.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

July 25, 1995

4WD-OHA

MEMORANDUM

SUBJECT: Risk review comments, human health aspects, Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities, Naval Air Facility, Atsugi, JAPAN

FROM: Ted W. Simon, Ph.D. DABT, Toxicologist
BRAC Team Risk Assessor
Office of Health Assessment
Ted

THROUGH: Elmer W. Akin, Chief
Office of Health Assessment
for EWA

TO: Yvonne P. Walker, Deputy Director, Environmental Programs
Navy Environmental Health Center

In early July, 1995, I was approached by Ms. Vera Wang and asked by telephone to review the Preliminary Risk Assessment for the facility. This memorandum constitutes my review.

Summary

In general, I concur with the findings of the evaluation and the action plan presented at the end. There is definitely cause for concern with the total cancer risk at $7x10^{-3}$ and the non-cancer hazard approaching 100.

The last of the recommendations presented is to provide the occupational medicine staff of NAVENVIRHLTHCEN with a copy of this report to determine if a health or epidemiological study is warranted. If any evidence surfaces suggesting that base residents have been adversely impacted by environmental releases from the incinerator, prompt medical intervention is advisable. The occupational medicine staff should complete their study as quickly as possible so that, if necessary, testing individuals for evidence of exposure to hazardous materials can be performed.

General Comments:

1) **Additivity of Toxic Effects.** The procedure for Preliminary Risk Evaluations is to sum the risks from carcinogens and non-carcinogens separately to arrive at a total cancer risk and total non-cancer hazard. Chloroform and methylene chloride both produce liver cancer in rats. Both are metabolized via the mixed function oxidase to produce toxic metabolites.

   Because of these similarities, the cancer risks from all chemicals are likely to be additive and the cancer risk of 7×10^{-3} is definitely of concern.

2) **Plume Estimation.** The details of the air dispersion model, ISCTST2, were not presented. The modeling predicted the location of SITE 2. It would be helpful to collect data at several other sampling locations for the purposes of (1) ensuring that SITE 2 does present the highest level of emissions; and (2) to validate the model.

   If a more detailed assessment is performed at a future time, the results of the modeling should be reviewed by someone knowledgeable in this area.

3) **Risk from dibenzodioxins/dibenzofurans.** All the dioxins and furans (and PCBs to some extent) interact with the Aryl Hydrocarbon (AH) receptor. The normal function of the AH receptor is steroid recognition by cells. The Toxic Equivalency Factors (TEFs) indicate the strength of binding of individual congeners to the AH receptor relative to that of 2,3,7,8-TCDD. It is generally best to sum the products of the concentrations and TEFs of the congeners to arrive at an equivalent concentration of 2,3,7,8-TCDD.

   This approach recognizes the toxicological similarity of the dioxins/furans and should be employed in this assessment. A table of TEFs is attached.

4) **Source of water for off-base residents.** Because of the potential for off-base residents south of the Jinkanpo complex to be exposed to contaminated groundwater, the description of the water supply of the area should be expanded to enable the reader to gauge the likelihood of such exposure.

5) **Valence State of Chromium.** The assumption was made that all chromium present in the emissions is in the form of chromium III. The basis for this assumption should be presented. Note that chromium III is not carcinogenic whereas chromium VI is carcinogenic.

6) **Analyses for future sampling.** Any future environmental sampling should have 20% of the samples from each medium analyzed for all TCL/TAL chemicals. This will increase the likelihood that all hazardous substances present will be detected.

Specific Comments:

1) **Executive Summary, last sentence.** It says:

> *... 2) to conduct surface soil and groundwater sampling to further assess human health.*

Rewrite as follows:

> *... 2) to conduct surface soil and groundwater sampling to assess potential risks to human health from contact with these media.*

2) **References.** Several references are given by lower case letters. The reviewer was unable to find a list of these references. This list should be placed at the end of the text portion of the report.

Please let me know if I can be of any further help. I can be reached at (404)347-3555 X6368.

Attachment
Table 9-1, Toxic Equivalency Factors for CDDs and CDFs

T.W. Simon/tws:4WD-OHA:1586/07/24/95/A:\DISK_6\JUL95\JINKANPO.DOC

Table 9-1. Toxicity Equivalency Factors (TEF) for CDDs and CDFs

Compound	TEF
Mono-, Di-, and Tri-CDDs	0
2,3,7,8-TCDD	1
Other TCDDs	0
2,3,7,8-PeCDD	0.5
Other PeCDDs	0
2,3,7,8-HxCDD	0.1
Other HxCDDs	0
2,3,7,8-HpCDD	0.01
Other HpCDDs	0
OCDD	0.001
Mono-, Di-, and Tri-CDFs	0
2,3,7,8-TCDF	0.1
Other TCDFs	0
1,2,3,7,8-PeCDF	0.05
2,3,4,7,8-PeCDF	0.5
Other PeCDFs	0
2,3,7,8-HxCDF	0.1
Other HxCDFs	0
2,3,7,8-HpCDF	0.01
Other HpCDFs	0
OCDF	0.001

Source: EPA, 1989.

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Ted W. Simon, Pd.D., DBAT, Toxicologist
BRAC Team Risk Assessor
United States Environmental Protection Agency
Region IV, Office of Health Assessment
345 Courtland Street, N.E.
Atlanta, GA 30365

DATE: July 25, 1995

1. COMMENT: Page 2, paragraph 2

"Plume Estimation. The details of the air dispersion model, ICSTST2, were not presented. The modeling predicted the location of SITE 2. It would be helpful to collect data at several other sampling locations for the purposes of (1) ensuring that SITE 2 does not present the highest level of emission; and (2) to validate the model."

ANSWER: A discussion regarding modeling is presented in the emissions study prepared by the Navy Facilities Engineering Services Center; Part A of the final report. Air monitoring was also conducted at SITE 1, which was used as a background (upwind) site during the emission study for modeling purposes. Modeling was conducted purposively to predict the location of maximum plume impact, this was Site 2. Sampling results determined that although Site 1 was upwind from NAF Atsugi it was still impacted by the incinerator emissions due to its close proximity to the incinerator. The results for Site 1 and Site 2 were plugged into the model to back calculate potential stack emissions; therefore validating the model.

2. COMMENT: Page 2, paragraph 3

"Risk from dibenzodioxins/dibenzofurans. All the dioxins and furans (and PCBs to some extent) interact with the Aryl Hydrocarbon (AH) receptor. The normal function of the AH receptor is steroid recognition by cells. The Toxic Equivalency Factors (TEFs) indicate the strength of binding of individual congeners to the AH receptor relative to that of 2,3,7,8-TCDD. It is generally best to sum the products of the concentrations and TEFs of the congeners to arrive at an equivalent concentration of 2,3,7,8-TCDD."

ANSWER: In the final report, a table will be included indicating the risks posed by total TCDD and TCDF developed by taking the average concentration of each congener, determining its toxic equivalent concentration by multiplying it by its TEF, and then summing the toxic equivalent concentration of each congener.

3. COMMENT: Page 2, paragraph 4

"Source of water for off-base residents. Because of the potential for off-base residents south of the Jinkanpo complex to be exposed to contaminated groundwater, the description of the water supply of the area should be expanded to enable the reader to gauge the likelihood of such exposure."

ANSWER: We agree. An expanded discussion will be presented in the final report concerning what is known about the current source of drinking water on- and off-base. As in the draft report, concerns will be raised about the groundwater pathway.

4. COMMENT: Page 3, paragraph 5

"Valence State of Chromium. The assumption was made that all chromium present in the emissions sis in the form of chromium III. The basis for this assumption should be presented. Note that chromium III is not carcinogenic whereas chromium VI is carcinogenic."

ANSWER: Chromium VI results were not reported because they were non-detect; however, an uncertainty exists as to whether it was non-detect because it was not present in the air or if the sampling method was inappropriate for reporting levels of Chromium VI. This was addressed in the uncertainty section of the final report.

5. COMMENT: Page 3, paragraph 6

"Analyses for future sampling. Any future environmental sampling should have 20% of the samples from each medium analyzed for all TCL/TAL chemicals. This will increase the likelihood that all hazardous substances present will be detected."

ANSWER: We agree. In the final report we will recommend that future sampling efforts involving data collection for soil, air and groundwater include analysis of TCL/TAL for 20% of the samples.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region III
841 Chestnut Street
Philadelphia, Pennsylvania 19107

FAX TRANSMITTAL

July 27, 1995

TO:	Charles W. Grosse
FAX NUMBER:	8-804-444-7261
PHONE:	-7575 x403
FROM:	Roy Smith
FAX NUMBER:	215-597-9890
SUBJECT:	Peer review of screening risk assessment
PAGES:	3

Message: As requested, I have reviewed the Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility, Atsugi, Japan. This was a fast-track review which did not include checking the veracity of the risk-based concentrations or any calculated ratios or sums. Instead I concentrated on the larger questions which Ms. Walker laid out in her cover memo.

1. Methodology. The methods used are appropriate for a preliminary, screening level health risk assessment. They are similar to methods used in this Region to (1) determine if sites should be scored under the Hazard Ranking System for potential inclusion on the CERCLA National Priorities List, and (2) select potential contaminants of concern and exposure routes for inclusion in baseline health risk assessments. The use of these methods here is reasonable, provided the document clearly distinguishes between preliminary screening and complete risk calculations.

2. Conclusions. The results appear to be over-interpreted. The analysis includes four significant conservative assumptions, beyond the usual protective methodology that EPA uses in its full baseline risk assessments. These are: (1) on-base personnel were assumed to be exposed for 30 years, (2) exposure was assumed to occur at the location which dispersion modeling results suggested would be most contaminated, (3) the exposure concentration was assumed to be the maximum measured at that location,

and (4) the hazard quotients for individual contaminants were summed without regard to toxic mechanism or target organ.

Of these conservative assumptions, only the first (which would raise risk estimates by a factor of about 6) is acknowledged in the discussion of uncertainties. However, assumptions (2) and (3) have a potential impact which is greater. True exposure concentrations are probably substantially less. Of course, it is unknown whether they are acceptable. Assumption (4) may raise the true hazard index by a factor of 2 or 3, but this is just a guess.

In the broad sense, these issues pertain directly to how screening results should be interpreted. EPA uses analyses like this to rule out further action. If risks calculated under such protective assumptions are acceptable, we feel justified in assuming that the site does not pose a significant health risk. However, EPA usually interprets unacceptable screening-level risk results mainly as an indication that a more complete, realistic risk assessment is needed.

It is particularly important that the on-base personnel who experience these exposures are informed of the extreme conservatism of these calculations. As the document is currently written, lay people are highly likely to decide that they are definitely being exposed to toxic chemicals which will probably make them sick or eventually give them cancer. The results suggest only that this might be so, not that it is. I strongly recommend that the document text be revised to give these people a more accurate idea of what the results mean, and what they do not mean.

3. Recommendations. I concur with the conclusion that the facility emissions are a potential source of unacceptable health risk. It's reasonable to begin negotiations with the owners to reduce the emissions, and the recommended soil and groundwater sampling should be conducted. However, I would also recommend that 24-hour air samples be taken in areas where on-base residents, especially children, actually spend time. These results, in combination with air dispersion modeling, should be used to develop long-term inhalation risk estimates that match the chronic time scale of the RBCs. The systemic hazard index should be divided by target organ.

There are two reasons to do this additional inhalation work. First, the facility owners are likely to be aware of the preliminary nature of the current assessment, and argue (justifiably) that the risks are overstated. A more complete and representative assessment will be much more persuasive. Second, this more complete assessment will assure on-base personnel that while the exposures may be unacceptable the probability of actual harm is still fairly low.

4. Would EPA recommend immediate steps for a similar situation in the U.S.? First, I admit that I'm not a risk manager, so I don't actually make decisions of this type for EPA. The following statements are, therefore, merely my opinion of what EPA would do. The opinion is an informed one, based on seven years of CERCLA experience, but still just an opinion.

EPA would probably take these results seriously enough to turn the site over to the CERCLA Emergency Removal program for immediate evaluation. The EPA risk assessor would recommend that the Removal program conduct the air sampling, modeling, and revised risk estimates described above as soon as possible. This would happen within weeks, funded either under one of our existing contracts or by the facility owner. If upper bound excess cancer risk exceeded 10^{-4} or the systemic hazard index exceeded one, EPA would probably issue a removal order to reduce the emissions to acceptable levels. However, it is unlikely that EPA would issue such an order solely on the basis of the screening risk assessment.

I hope you find these comments useful in deciding what actions to take with this site. Please let me know if you need any further assistance.

Best regards,
Roy Smith

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Roy Smith
United States Environmental Protection Agency
Region III
Philadelphia, Pennsylvania 19107

DATE: July 27, 1995

1. COMMENT: Page 1, Item 2

"2. Conclusions. The results appear to be over interpreted. The analysis includes four significant conservative assumptions, beyond the usual protective methodology that EPA uses in its full baseline risk assessments. These are: (1) on-base personnel were assumed to be exposed for 30 years, (2) exposure was assumed to occur at the location which dispersion modeling results suggested would be most contaminated, (3) the exposure concentration was assumed to be the maximum measured at that location, and (4) the hazard quotients for individual contaminants were summed without regard to toxic mechanism or target organ."

ANSWER: While we agree that conservative assumptions were used in estimating the risks posed by the emissions from the Jinkanpo incinerators, we felt justified in using these assumptions for the following reasons:

Assumption 1 - *On-base personnel were assumed to be exposed for 30 years.* Although base personnel may not reside on base for more than 5 years, Japanese citizens frequent the base and live off base in areas immediately adjacent to it. Therefore, it was reasonable to assume that individuals in the Japanese community may live in the area for 30 years. The final report includes a table with calculated cancer risks for varying resident exposure durations of 30, 25, 20, 15, 10, 6 and 3 years.

Assumptions 2 and 3 - *Exposure was assumed to occur at he location which dispersion modeling results suggested would be most contaminated; and the exposure concentration was assumed to be the maximum measured at that location.* Actual ambient air sampling data (which included Site 2) were collected upwind and downwind from the incinerators, along with meteorological data for the air dispersion modeling to predict the location of the highest concentrations of pollutants emitted by the Jinkanpo incineration facility, to focus our efforts on the air sampling strategy. Therefore, the location of highest contamination was not an assumption. It was determined by actual data with the support of air dispersion modeling. Maximum exposure concentrations were used to calculate the risk because preliminary risk calculations indicated that the 95% was actually higher than the maximum. To ensure that the results are not being over interpreted we also calculated the risk for site 1, which was sampled as background for the emissions inventory, but not used as background for the human health risk evaluation due to its close proximity to the incinerator complex. The results as shown in the final report indicated in site 1 that the chemicals concentrations were lower than site 2. The estimated cancer and non-cancer risks for site 1 were slightly lower than site 2.

Assumption 4 - *The hazard quotients for individual contaminants were summed without regard to toxic mechanism or target organ.* We summed the Hazard Quotients (HQs) for all non-carcinogenic compounds per guidance provided in the EPA guidance document *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* that states that this is appropriate for a screening level approach. However, we agree that since there are as many as four chemicals having HQs above unity and in the absence of a target organ evaluation it is more appropriate to separately address their values. Individual HQs will not be summed in the final report.

2. COMMENT: Page 2, Item 2, first paragraph

"Of these conservative assumptions, only the first (which would raise risk estimates by a factor of about 6 is acknowledged in the discussion of uncertainties. However, assumptions (2) and (3) have a potential impact which is greater. True exposure concentrations are probably substantially less. Of course, it is unknown whether they are acceptable. Assumption (4) may raise the true hazard index by a factor of 2 or 3, but this is a guess.

ANSWER: The final report addresses each of the assumptions by providing additional data which clarifies some of the uncertainties not addressed in the draft report. In some cases additional calculations were performed to provide clarification. In other cases, the uncertainty section was expanded to address assumptions resulting in an increase or decrease in the risk.

3. COMMENT: Page 2, item 2, second paragraph

"In a broad sense, these issues pertain directly to how screening results should be interpreted. EPA uses analyses like this to rule out further action. If risks calculated under such protective assumptions are acceptable, we feel justified in assuming that the site does not pose a significant health risk. However, EPA usually interprets unacceptable screening-level risk results mainly as an indication that a more complete realistic risk assessment is needed."

ANSWER: Yes, we agree. However, because the risk calculations performed under these protective assumptions are designed to protect sensitive populations such as children and the elderly, an unacceptable screening level risk for the air pathway alone, justifies the assumption that the site poses a significant health risk, at least for these sensitive populations. A more complete realistic risk assessment would certainly provide more accurate risk numbers. However, we believe that there is sufficient data to suggest a potential risk to these sensitive populations. Other media such as soil and water, and food chain have not yet been sampled. Elevated results of particulate matter (dust) suggest that soil, groundwater, surface water and food chain may be contaminated with metals and dioxins which are associated with particulate matter in fly ash fallout. Deposition of fly ash fallout over the past 10 years of the incineration complex's operation may have caused contamination of surface soil by metals and dioxins. We feel that exposure through these media could actually drive the risk to even higher levels.

4. COMMENT: Page 2, item 2, third paragraph

"It is particularly important that on-base personnel who experience these exposures are informed of the extreme conservatism of these calculations. As the document is currently written, lay people are highly likely to decide that they are definitely being exposed to toxic chemicals which will probably make them sick or eventually give them cancer. The results suggest only that this might be so, not that it is. I strongly recommend that the document text be final to give these people a more accurate idea of what the results mean, and what they do not mean."

ANSWER: The final report describes the conservative assumptions made to estimate the risk, but also explains that the reason for using conservative assumptions to estimate the risk is to protect sensitive populations, such as children and the elderly. As mentioned above, another reason is that, because the risk contribution from soil and water pathway exposures has not yet been estimated, the overall risk may be underestimated. For example, PM_{10} results for particulate matter (dust) were not included in the risk calculations, because there is no RBC value for particulate matter. The PM_{10} results indicate that particulate matter in ambient air is above 50 ug/m3, the annual average for the EPA National Ambient Air Quality Standards (NAAQS). This suggests that other media may be contaminated with metals and dioxins as a result of deposition of fly ash fallout. Although metal concentrations in ambient air were below the NAAQS, deposition of fly ash fallout containing metals over the past 10 years of operation by the incineration complex, may create an increase of metals concentrations in surface soil, surface water and food chain. Knowing that dioxins are also associated with particulate matter, and that elevated levels of dioxins were detected in ambient air at NAF Atsugi, there is a potential for accumulation of dioxins in surface soil, surface water and food chain (farm animals and fresh produce). Children, particularly pica children at the day care center, the youth center and the elementary school would be more likely to be exposed to metals and dioxin through the deposition of particulate matter on surface soil.

5. COMMENT: Page 2, item 3, first and second paragraph

"I concur with the conclusion that the facility emissions are a potential source of unacceptable health risk. It's reasonable to begin negotiations with the owners to reduce the emissions, and the recommended soil and groundwater sampling should be conducted. However, I would also recommend that 24-hour air samples be taken in areas where on-base residents, especially children, actually spend time. These results, in combination with air dispersion modeling, should be used to develop long-term inhalation risk estimates that match the chronic time scale of the RBCs. The systemic hazard index should be divided by target organ.

There are two reasons to do this additional inhalation work. First, the facility owners are likely to be aware of the preliminary nature of the current assessment, and argue (justifiably) that the risks are overstated. A more complete and representative assessment will be much more persuasive. Second, this more complete assessment will assure on-base personnel that while the exposures may be unacceptable the probability of actual harm is still fairly low."

ANSWER: This is a screening risk assessment. We agree that 24 hours air sampling at locations where on-base residents especially children actually spend time, certainly will provide more accurate risk numbers and will decrease the uncertainty in the risk assessment. However, because incineration operations are conducted around the clock at the Jinkanpo Incineration Complex, and the daycare center, elementary school and youth center are located less than 0.5 miles from the incineration complex, it is reasonable to assume that the concentrations detected in 4-hour sampling periods are not over representative and do not over estimate the risk. Therefore, it is reasonable to assume that concentrations indicated in 4-hour sampling matches the chronic time scale of the RBCs.

We recognize that the RBCs are derived taking into account chronic exposure of 30 years. As mentioned previously, this has been accounted for in the uncertainty analysis section of the report. Long-term inhalation impacts have been calculated in part A of the final report, and they also indicate a potential health risk to residents living at or near NAF Atsugi. The final report includes two parts, Part A and Part B. Part A is a report on the emissions inventory, an emission rate analysis, ambient air sampling data, and a comparison with air emission standards and guidelines for diagnosing potential health impacts due to the emissions from the incineration complex. This investigation in Part A was conducted by the Navy Engineering Facilities Services

Center. Part B is the Preliminary Health Risk Evaluation conducted by our office, the Navy Environmental Health Center.

Regarding the systemic hazard index, we summed the Hazard Quotients (HQs) for all non-carcinogenic compounds per guidance provided in the EPA guidance document *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* that states that this is appropriate for a screening level approach. However, we agree that since there are as many as four chemicals having HQs above unity, in the absence of a target organ evaluation it is more appropriate to separately address their values. Individual HQs will not be summed in the final report.

While we agree that the incineration facility owners may argue that the risk may be overstated, and that a more complete risk assessment will give a more accurate estimation of the human health risk, we believe there is sufficient data to indicate that a potential risk to human health exists at NAF Atsugi due to the emissions from the Jinkanpo incinerators. We actually expect the overall risk to increase when other media are sampled and other pathways are included in the complete risk assessment.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF RESEARCH AND DEVELOPMENT
National Center for Environmental Assessment
Washington, DC 20460

August 9, 1995

NCEA Washington Office (8602))

MEMORANDUM

SUBJECT: Review of Risk Assessment for NAF-Atsugi, Japan

FROM: Charles Ris Charles Ris
Environmental Scientist,
National Center for Environmental Assessment-Washington
(Mail Code 8602)

TO: Charles Grosse
U.S Navy Environmental Health Center
Norfolk, VA

Your FAX dated July 20, requested additional EPA risk assessment review of the Preliminary Health Risk Evaluation of the Jinkanpo Incineration Complex. Given that Matthew Lorber, an exposure assessment expert from this office, will also provide comments, I will focus on the health aspects and the larger question of full hazard characterization. I have not cross checked to see that correct values were lifted from the RBC reference.

1. I repeat Mr. Lorber's observation that the approach used in the July 1995 Atsugi evaluation is specific to a screening evaluation, one which either screens-out or in a potential health hazard. Yet, there is an implication from reading the Atsugi evaluation that more than a screen-in conclusion is also being made, a conclusion that there is a bona-fide health risk to the NAF population. In order to support the latter type of conclusion, however, another level of evaluation must be demonstrated or factors discussed. The exposure assessment must be strengthened somewhat so as to quantify, as best practicable, the magnitude of exposure and who (what types of people, how many, under what exposure pattern) is getting exposed. This allows for a more refined estimate of acute or cumulative/annual average exposure values and sets the stage for developing conclusions about acute or lifetime hazard. In effect this moves the evaluation from screening into the next stage of population based risk estimation. Some of these factors are already mentioned, for example, it is mentioned that a five year presence on the NAF base environs rather than 30 years as assumed in the RBC method is more realistic. A related question might be, how many personnel are getting an additional exposure by virtue of where they reside in addition to being on base and/or are there exposures to some contaminants from NAF sources because of base activities. The role of uncertainties

regarding exposure estimation is also an important to discuss when reaching for a public health impact conclusion.

The toxicity hazards and the related exposure specific risk estimates that portray the possible impact upon humans from individual chemicals are not ironclad or absolute. To put a lot of emphasis on a possible additive cancer risk of 6.6×10^{-3} for all the carcinogens may be useful for screening purposes but includes a considerable range of uncertainty. The uncertainties amount to an admission that for many (but not all) of the chemicals found at Atsugi the fundamental cancer risk estimates underpinning the RBC values are not likely to be underestimate risk and in fact the true risk may be lower and may be negligible for some agents. This is a fundamental underlying uncertainty with carcinogens risk assessment, and especially those RBC values which are based upon animal studies with an EPA weight-of-evidence of "Probable or Possible" human carcinogen. When these individual risks are then added together across many compounds, the uncertainties remain.

2. Another thought on the theme of strengthening the exposure aspect is to consider some limited testing of humans to see if, in fact, pollutant uptake is happening, i.e., exposure is becoming a dose. The point is not to use the test results to back calculate exposure but to establish that human uptake is actually happening, rather than inferring this from models. A strategy for doing this would be carefully developed, and would likely focus on what chemicals can be observed in blood, urine or hair samples for example, chemicals that would be unique to the Utsugi incineration source. The later criteria may be tricky because of other base activities/sources of contamination or location of the off-base residence or even normal household activities (i.e., solvents in the house).

3. The indiscriminate adding of hazard quotients for noncancer toxicity (i.e., 92.46) is not the correct way to approach the question of multiple exposure to noncarcinogens. Matt Lorber mentioned this as well. Only in the case where the noncancer critical effect is the same or similar for two or more chemicals should the quotients be added. On the surface this is easy to ascertain because if the chemical is in the EPA IRIS system the critical effects are listed and one can easily compare across chemicals. The IRIS system, however, only talks about the most critical effect and so secondary effects are generally not described in IRIS yet they may be nearly as pertinent. This aspect could be searched out by a toxicologist using references other than IRIS.

4. Given the screening conclusions about Chromium III, I did go back to the RBC tables to see what the screening level was, i.e., 0.0021 ug/m^3. This seemed unusually low given that Cr III is not generally thought of as being highly toxic compared to Cr VI or other agents. In checking further and with Dr. Roy Smith, I can not confirm that this is a good value or where it came from, even though it is in the RBC table. This needs more scrutiny before the Cr III case is carried further.

5. There is another aspect of the Atsugi situation which is not now mentioned and may be worth introducing to the evaluation. This has to do with children. If uptake is occurring, the exposure of children may well be a more serious matter in terms of lifetime hazard/risk than exposure of adults. The child is in a more rapid state of physiologic development and hence is generally thought to be more sensitive to toxicity, though the manifestation may not be apparent for many years. This concept is difficult to demonstrate with environmental contaminants except in a few cases, i.e., vinyl chloride, but the notion prevails in the health community that this is likely the case. For vinyl chloride, animal data suggests that exposure as a child is just as effective at influencing lifetime cancer risk as is exposure for the entire adult years.

It would seem from the screening evaluation that the situation at Atsugi has the potential to be a public health problem if enough exposure is occurring. A more complete understanding of the potential for hazard/risk needs to be ascertained to firmly anchor the magnitude of the public health problem. Such a pursuit would strengthen the case for seeking corrective action.

cc Matthew Lorber, NCEA-Washington
William Farland, NCEA
Roy Smith, EPA Region III

ANSWERS TO PEER REVIEWERS OF THE HUMAN HEALTH PRELIMINARY RISK EVALUATION OF THE JINKANPO INCINERATION COMPLEX ACTIVITIES AT THE NAVAL AIR FACILITY, ATSUGI, JAPAN

REVIEWER: Charles Ris
United States Environmental Protection Agency
Office of Research and Development
National Center for Environmental Assessment
Washington , DC 20460

DATE: August 9, 1995

1. COMMENT: Page 1, item 1, first paragraph

"1. I repeat Mr. Lorber's observation that the approach used in the July 1995 Atsugi evaluation is specific to a screening evaluation, one which either screens-out or indicates a potential health hazard. Yet, there is an implication from reading the Atsugi evaluation that more than a screen-in conclusion is also being made, a conclusion that there is a bona-fide health risk to the NAF population. In order to support the latter type of conclusion, however, another level of evaluation must be demonstrated or factors discussed. The exposure assessment must be strengthened somewhat so as to quantify, as best practicable, the magnitude of exposure and who (what types of people, how many, under what exposure pattern) is getting exposed. This allows for a more refined estimate of acute or cumulative/annual average exposure values and sets the stage for developing conclusions about acute or lifetime hazard. In effect this moves the evaluation from screening into the next stage of population based risk estimation. Some of these factors are already mentioned, for example, it is mentioned that a five year presence on the NAF base environment rather than 30 years as assumed in the RBC method is more realistic. A related question might be, how many personnel are getting an additional exposure by virtue of where they reside in addition to being on base and/or are there exposures to some contaminants from sources because of base activities. The role of uncertainties regarding exposure estimation is also an important to discuss when reaching for public health impact conclusion.

ANSWER: This comment implies that another level of evaluation, i.e., a more refined estimate of acute or cumulative/annual average exposure must be demonstrated or factors discussed to support the conclusion that there is a bona-fide health risk to the NAF population. As described in the report, the methodology used in this screening human health evaluation follows EPA Region IV guidance which applies Region III RBC values to calculate the cancer risk and hazard index for each chemical and the aggregate cancer and non-cancer risk. RBCs are risk assessments run in reverse. For a single contaminant in a single medium, under standard default exposure assumptions, the RBC corresponds to the target risk of 10-6 or hazard quotient of 1. Both, Region III and Region IV guidance uses methodology established on the EPA Risk Assessment Guidance for Superfund (RAGS). The standard default parameters used to calculate the RBCs for the air pathway established in RAGS are: averaging exposure time of 70 years for carcinogens, 30 years for non-carcinogens for adults and 6 years for children 1-6 years, exposure frequency of 350 days/year, inhalation factor, age adjusted of 11.6 m3/y/kg-d, body weight of 70 kg for adult, and 15 kg for children 1-6 years and, inhalation rate for adult 20 m^3/d. These are default values generally used by risk assessors and can be applied to the human health risk evaluation at NAF Atsugi, except for the exposure time of 30 years which may be overly conservative for temporary housing or base with limited tours of duty. Aside from using RAGS methodology and calculating the risk for different exposure times, another level of evaluation or a more refined way to estimate the risk would involve additional sampling, which we are recommending to determine the risk through other pathways. Because we have used acceptable conservative risk assessment methodology, which indicated an unacceptable risk to sensitive populations, we feel that the current available data is sufficient to support our conclusion, that there is a potential health concern to on- and off-base residents at NAF Atsugi, without further refinement of the screening risk evaluation.

2. COMMENT: Page 2, item 1, second paragraph

"The toxicity hazards and the related exposure specific risk estimates that portray the possible impact upon humans from individual chemicals are not ironclad or absolute. To put a lot of emphasis on a possible additive cancer risk of 6.6 X 10-3 for all the carcinogens may be useful for screening out purposes but includes a considerable range of uncertainty. The uncertainties amount to an admission that for many (but not all) of the chemicals found at Atsugi the fundamental cancer risk estimates underpinning the RBC values are not likely to be underestimate risk and in fact the true risk may be lower and may be negligible for some agents. This is a fundamental underlying uncertainty with carcinogens risk assessment, and especially those RBC values which are based upon animal studies with an EPA weight of evidence of "Probable or Possible" human carcinogen. When these individual risks are then added together across many compounds, the uncertainties remain."

ANSWER: Despite the uncertainty associated with carcinogens risk assessment, which are based on animal cancer studies, support for putting a lot of emphasis on a possible additive cancer risk of 6.6 X 10-3 is found in the National Contingency Plan (NCP). The NCP states that "the excess upper bound lifetime cancer risk to an individual of between 10-4 and 10-6 is acceptable for known or suspected carcinogens." This citation goes on to state that "the 10^{-6} risk level shall be used as the point of departure for determining remediation goals for alternatives when ARARS are not available or are not sufficiently protective because of the presence of multiple contaminants at a site or multiple pathways of exposure." Since it is difficult to study humans over their lifetime, we rely on animal studies to determine the carcinogenicity of most chemicals. In the absence of sufficient data, (such as soil, water and food chain), worst case and upper bound assumptions are used in the risk assessment.

Additionally, at Atsugi, there are many uncertainties that underestimate the risk. Examples of the uncertainties that underestimate the risk are: non-carcinogenic effects of carcinogens not considered; non-detect concentrations assumed as zero concentrations; concentrations of photo reactive chemicals may have been decreased by sunlight during daytime sampling; PM-10 results for lead and particulate matter not included in the risk calculation; health effects from Criteria Air Pollutants (NO_2, CO, SO_2) were not sampled and not included in the risk evaluation; only the air pathway was evaluated; potential surface soil, surface water, and food chain contamination by accumulated deposition of metals and dioxin associated with particulate matter in fly ash fallout was not evaluated; possible groundwater contamination from poor management of hazardous waste solvents was not evaluated.

3. COMMENT: Page 2, item 2

"Another thought on the theme of strengthening the exposure aspect is to consider some limited testing of humans to see if, in fact, pollutant uptake is happening, i.e., exposure is becoming a dose. The point is not to use the test results to back calculate exposure but to establish that human uptake is actually happening, rather than inferring this from models. A strategy for doing this would be carefully developed, and would likely focus on what chemicals can be observed in blood, urine or hair samples for example, chemicals that would be unique to the Atsugi incineration source. The later criteria may be tricky because of other base activities/sources of contamination of the off-base residence or even normal household activities (i.e., solvents in the house)."

ANSWER: In conjunction with the environmental risk assessment, our occupational and environmental medicine specialists have conducted a preliminary medical evaluation of the air sampling data collected at NAF Atsugi. In addition, we have begun collection of medical data from patients treated at Naval Hospital Yokosuka and Branch Medical Clinic Atsugi in collaboration with our Medical Department colleagues assigned to those facilities.

Review of the air sampling data indicates the respirable (breathable) particulate matter (PM_{10}) levels at NAF Atsugi somewhat exceed those allowed in the U.S. under EPA regulations. The Atsugi PM_{10} levels are above the average for many, but not all U.S. cities. Significantly elevated PM_{10} levels are known to be associated with an increased risk of upper respiratory conditions, including asthma, in susceptible adults and children. Although we did not have access to the population data necessary to calculate rates of disease, our preliminary assessment of the number and pattern of upper respiratory illness cases seen at Branch Clinic Atsugi did not appear substantially different than those reported by Naval Hospital Yokosuka. In the final report we will recommend that additional medical data be collected from Branch Clinic Atsugi and other comparable medical treatment facilities.

4. COMMENT: Page 2, item 3

"The indiscriminate adding of hazard quotients for non-cancer toxicity (i.e., 92.46) is not the correct way to approach the question of multiple exposure to noncarcinogens. Matt Lorber mentioned this as well. Only in the case where the non-caner critical effect is the same or similar for two or more chemicals should the quotient be added. On the surface this is easy to ascertain because if the chemical is in the EPA IRIS system the critical effects are listed and one can easily compare across chemicals. The IRIS system, however, only talks about the most critical effect and so secondary effects are generally not described in IRIS yet they may be nearly as pertinent. This aspect could be searched out by a toxicologist using reference other than IRIS."

ANSWER: We summed the Hazard Quotients (HQs) for all non-carcinogenic compounds per guidance provided in the EPA guidance document *Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual, Part A* that states that this is appropriate for a screening level approach. However, we agree that since there are as many as four chemicals having HQs above unity and in the absence of a target organ evaluation it is more appropriate to separately address their values. Individual HQs will not be summed in the final report.

5. COMMENT: Page 2, item 4

"4. Given the screening conclusions about Chromium III, I did go back to the RBC tables to see what the screening level was, i.e., 0.0021 ug/m3. This seemed unusually low given that Cr III is not generally thought of as being highly toxic compared to Cr VI or other agents. In checking further with Dr. Roy Smith, I can not confirm that this is a good value or where it came from, even though it is in the RBC table. This needs more scrutiny before the Cr III case is carried further."

ANSWER: We recognize that the RBC value Region III developed for chromium III is based on an oral reference concentration, rather than an inhalation reference concentration value. However, considering that this is the last inhalation reference concentrations for chromium that was developed by IRIS, HEAST, (before being withdrawn), the oral reference concentrations used by Region III to calculate the RBC's for chromium III currently represent the most-up-to-date reference concentration available to estimate the risk posed by Cr III.

6. COMMENT: Page 3, item 5

"5. *There is another aspect of the Atsugi situation which is not mentioned and may be worth introducing to the evaluation. This has to do with children. If uptake is occurring, the exposure of children may well be a more serious matter in terms of lifetime hazard/risk than exposure of adults. The child is in a more rapid state of physiological development and hence is generally thought to be more sensitive to toxicity, though the manifestation may not be apparent for many years. This concept is difficult to demonstrate with environmental contaminants except in a few cases, i.e., vinyl chloride, but the notion prevails in the health community that this is likely the case. For vinyl chloride, animal data suggests that exposure as a child is just as effective at influencing lifetime cancer risks as is exposure for the entire adult years.*

It would seem from the screening evaluation that the situation at ATSUGI has the potential to be a public health problem if enough exposure is occurring. A more complete understanding of the potential for hazard/risk needs to be ascertained to firmly anchor the magnitude of the public health problem. Such a pursuit would strengthen the case for seeking corrective action."

ANSWER: We agree. The concern for child exposure through the soil pathway was addressed in the draft report, that children could be exposed through ingestion and inhalation of surface soil potentially contaminated with metals and dioxin associated with fly ash fallout deposition from the incineration complex's emissions. Child exposure through the air pathway was not separately addressed because the risk calculations built in the RBCs already takes child exposure into account by including an age-adjusted factor in the risk equation. The final report will address varying exposure durations for the adult and child receptors; furthermore, child cancer risk calculations will be presented for 3-year and 6-year child residents. In the final report, a recommendation is made to conduct additional sampling to further determine the magnitude of public health concerns.

NATIONAL RESEARCH COUNCIL
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DATE: October 2, 1995

FROM: Margaret E. McVey

COMMENTS:

Attached is the Committee on Toxicology (COT) review of the Navy Environmental Health Center risk assessment report concerning the Navy Air Facility, Atsugi, Japan. We will send the COT roster of members and the COT chairman's signature tomorrow.

Pages 8 — the end I hope

# of pages including cover sheet: 17

NATIONAL RESEARCH COUNCIL

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October 2, 1995

Admiral F. G. Sanford
Assistant Chief, Operational Medicine and Fleet Support
Bureau of Medicine and Surgery
Department of the Navy
2300 E Street NW
Washington, D.C. 20372-5300

Dear Admiral Sanford:

This letter report was prepared by the National Research Council's (NRC) Committee on Toxicology (COT) in response to your letter of August 3, 1995, which was forwarded to the Council by Colonel Francis O'Donnell, U.S. Army Office of the Surgeon General, on August 21, 1995. In your letter, you requested that the NRC provide an independent review of a report entitled *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility (NAF) Atsugi, Japan* (NEHC 1995), which was prepared by the Navy's Environmental Health Center (NEHC).

The Jinkanpo Incineration Complex operates as a private waste-combustion and disposal facility equipped with four incinerators located approximately 100 yards outside the NAF Atsugi fence. It is reported to be emitting many carcinogenic and noncarcinogenic pollutants, including benzene, chloroform, furans, dioxins, methylene chloride, chromium and other metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), and particulate matter. The NEHC report provides a preliminary health risk evaluation for NAF Atsugi personnel and their families exposed to the pollutants.

Given the estimated magnitude of the potential health threats to Navy personnel and their families at the NAF Atsugi, you requested that the NRC review the NEHC preliminary risk assessment on an expedited basis, and you asked the NRC to determine whether a more detailed review would be appropriate at a later date. Specifically, you requested that the NRC review the following issues:

a. the scientific methods used to assess risk;

b. the credibility of the calculated degree of risk; and

c. whether a health or epidemiological study is warranted.

You also stated that if the credibility of the risk evaluation is sufficient to conclude that the operation of the incinerator may result in substantial public health concerns, the NRC should make recommendations concerning

a. interim precautions to safeguard the health of high-risk residents and workers until concerns are resolved; and

b. modifications to or termination of incinerator operations.

SUMMARY

The NEHC used U.S. Environmental Protection Agency's (EPA) Region III Risk-based Concentrations (RBCs) (EPA, 1995) for ambient air to identify which quantified chemicals in the air samples were of potential concern. Following the EPA guidelines, the NEHC considered unacceptable any cancer risks greater than 1×10^{-4} (i.e., 1 in 10,000) and a noncancer hazard index exceeding 1. (A hazard index is the factor by which levels of noncarcinogenic substances exceed acceptable levels.) The NEHC (1995) report estimates that the excess risk of cancer from exposure to pollutants from the incinerator complex is 6.6×10^{-3} and that the hazard index for noncarcinogenic substances in the air is 92.

Our independent review of the air-sampling data from NAF Atsugi indicates that the levels of volatile organic compounds (VOCs) and chromium in the air may be unacceptably high. Considering only the inhalation pathway, we found that the NEHC risk assessment may have overestimated the carcinogenic risks by one to as much as two orders of magnitude and the noncancer hazards by up to one order of magnitude. Thus, the cancer risks from inhalation of contaminants might approximate the level considered unacceptable (1×10^{-4}) rather than two orders of magnitude higher, and the noncancer hazard index may exceed the value of 1 by approximately one order of magnitude instead of two orders of magnitude. The NEHC (1995) report did not provide information necessary to estimate risks from other exposure pathways, however; therefore, the total cancer risks, as well as noncancer hazards, from all exposure pathways might exceed acceptable levels.

We conclude that the NEHC (1995) report contains sufficient and compelling evidence to warrant public-health concern and to justify further evaluation of the problem. Levels of several toxic chemicals, including benzene and chromium, and airborne particulate matter were found at the NAF Atsugi to be near or above levels considered to pose unacceptable cancer and noncancer risks.

Given the likelihood of unacceptable risks at the NAF Atsugi, we recommend that all of the interim measures proposed by NEHC (1995), as described on pages 11 to 12 of this letter, should be implemented to reduce the potential exposure of Navy personnel and their families to emissions of chromium and VOCs from the incinerator complex. Given the uncertainties inherent in the risk-assessment process, the limited air-sampling data available for the risk assessment, and the incomplete reporting of some aspects of the risk assessment in the NEHC (1995) report, we further recommend that the Navy conduct additional sampling of the air, other environmental media, and blood lead levels in children, to form the basis of a more comprehensive risk assessment. We consider it premature to recommend a health or epidemiological study at this time; however, a study of the actual exposure levels of people on the base would be a useful component of a more comprehensive risk assessment.

The remainder of this letter details our review of the *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the NAF Atsugi, Japan* and describes our recommendations in more detail.

REVIEW OF THE NEHC RISK ASSESSMENT REPORT

We reviewed the NEHC (1995) risk-assessment report and addressed the three issues identified by the Navy:

a. the scientific methods used to assess risk;

b. the credibility of the calculated degree of risk; and

c. whether a health or epidemiological study is warranted.

Review of the Scientific Methods Used to Assess Risk

This section first presents a brief summary of key aspects of the NEHC risk assessment methods and then presents our review of the methods.

Summary of NEHC risk assessment methods

Based on air-dispersion modeling documented in other reports concerning NAF Atsugi, the Navy collected air samples at a location in NAF Atsugi predicted to have the highest concentrations of chemicals released from the Jinkanpo Incineration Complex. Twelve samples collected over a period of three months were analyzed for inorganic and organic contaminants. The NEHC used EPA's Region III RBCs for ambient air to identify which quantified chemicals in the air samples were of potential concern. Following the EPA guidelines, the NEHC considered unacceptable any cancer risks greater than 1 x 10^{-4} (i.e., 1 in 10,000) and a noncancer hazard index exceeding 1.

Numerous chemical carcinogens were detected in the samples, and the maximum concentrations measured for five of them (i.e., methylene chloride, chloroform, benzene, 2,3,4,7,8-PeCDF, and 1,2,3,4,5,7,8-HxCDF) were considered by the NEHC to pose unacceptable risks (i.e., cancer risk greater than 10^{-4}). The maximum measured levels of three noncarcinogens (i.e., chromium III, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene) exceeded the EPA Region III RBCs for ambient air. Particulate matter (PM_{10}) concentrations exceeded the U.S. national ambient air-quality standards (NAAQS).

The Navy also collected air samples from a "background" or reference location (i.e., a location unaffected by the incinerator complex), but concluded that the location was too close to the incinerator complex and also could have been contaminated by other sources; thus the results from that site were not used in this risk evaluation.

COT review of NEHC risk-assessment methods

As a preliminary assessment, we believe that the NEHC (1995) report is limited with respect to certain important factors related to environmental fate and transport and toxicological implications of exposure to the contaminants released from the incineration complex. Nonetheless, the NEHC (1995) report properly describes the potential problems that are of concern and indicates that potential health hazards might be associated with emissions from several sources at the complex, including (1) incinerator stacks; (2) fugitive dusts from waste and fly ash storage areas; (3) solvent wastes poured on solid wastes on the ground; and (4) possible contamination of soil, surface and ground water, and river sediments from these operations.

Although the details of the exposure-assessment method are not fully presented in the NEHC (1995) report, we believe that the air sampling and analysis support the preliminary risk assessment. The sampling sites were selected on the basis of air-dispersion modeling, and the sampling was performed using established EPA methods. Appropriate quality-assurance measures seem to have been employed for the air sampling and analysis. However, the lack of appropriate reference sampling locations makes it difficult to attribute the measured contaminants solely to the incinerator complex. Also, it is important to indicate the averaging period over which the air samples are taken. The Navy should specify if the air samples were taken (averaged) during the hours when the incinerator complex was active (e.g., during the day) or at other times of the day. Also, the extent to which the measurements reflect the "fumigation" conditions (as described on page 7 of the NEHC 1995 report), should be described. Non-detects in the tables in the appendix should be accompanied by some indication of analytical detection limits

We cannot evaluate the incinerator emissions characterization or the air-dispersion modeling, because the three supporting studies identified in the NEHC (1995) report (references a, b, and c), which are not publicly available, were not included in the materials that the Navy sent to the NRC for review. Thus, we cannot comment on details of the selection of the sampling sites or how specific contaminants were selected for analysis. Because spot checks on air contamination have revealed the chemicals of potential concern, we believe that a more complete monitoring of just those chemicals would provide more evidence of the need for corrective action at the incinerator complex. We recommend that the ambient air also be tested for ozone, nitrogen dioxide, carbon monoxide, and sulfur dioxide. In addition, if earlier sampling did not include mercury or cadmium, those substances should be included in the analysis. Moreover, sampling of air in zones where Navy personnel and their families work and live would provide better estimates of actual exposure levels than air monitoring at the fence-line.

The NEHC (1995) report evaluated only the inhalation pathway, but it indicated that other exposure pathways might also be of concern for the airbase personnel and their families. The chemicals of potential concern might be ingested from contaminated food and water and absorbed from dermal contact with the soil and water. We believe that some sampling of soil and water (and food, if any is grown on base or marketed to the base from potentially contaminated sites) is needed to obtain scientifically defensible data on the concentrations of contaminants in those specific media and to compare these concentrations with reference-site concentrations. It is important to obtain measurements of surface soil contaminant concentrations for possible fly ash fallout, particularly in areas where children might be exposed, such as the elementary school, child-development center, and the youth-center playgrounds.

We recommend that the Navy identify appropriate reference location(s) for sampling to compare with the sampling data from areas affected by the incinerator complex. Sampling data from reference locations are needed to distinguish what levels of contamination can be attributed to the incinerator complex rather than other potential sources. The Navy should also describe the conditions at the reference locations that make them suitable (e.g., upwind of the complex, different industrial history and use). The data collected from the original background site, which the NEHC subsequently considered not to be an appropriate reference location, would also be useful information to include in the risk assessment.

Additional factors to consider in the risk assessment include the persistence of the contaminants, their mobility in the environment, the frequency of detection, potential degradation products, and the potential for the substances to bioaccumulate, particularly in the aquatic ecosystems. In particular, NEHC should consider the potential for lead from the incinerator complex to have accumulated over time in soils and on other surfaces of the NAF Atsugi to which children and pregnant women might be exposed.

It also is important to consider the potential for contaminants in the soil to reach ground water. Contaminants that are relatively immobile (e.g., lead and cadmium), are unlikely to pose a threat to ground water; but contaminants that are relatively soluble in water (e.g., trichloroethylene) or that do not sorb strongly to soils (e.g., benzene) are likely to leach from surface soils into ground water, and might travel under Navy facility buildings, where they could diffuse through soil and volatilize into the basements of NAF buildings.

Credibility of the Calculated Degree of Risk

We believe that use of the maximum concentration detected in a series of a dozen measurements as the basis for the preliminary risk assessment is prudent and acceptable as a screening approach. However, some measure of the time-weighted exposures in addition to the maximum exposure would be more compelling evidence that regulatory or other remedial action needs to be taken. In addition, a better understanding of the effects of wind direction and speed and the effects of the terrain on the dispersion of contaminants from the incinerator complex throughout the year would be useful.

We suggest that the Navy be more cautious in its presentation of risk results. Statements such as that on page 13 of the NEHC (1995) report ("The total cancer risk for carcinogens of 6.62×10^{-3} means that there is an increased risk of 7 cancer cases per 1,000 people over the normal lifetime cancer risk rate") can be misleading. Both cancer and noncancer risks estimated using the methods that NEHC employed are not as certain as such statements imply. To be credible, all risk estimates should be accompanied by descriptions of the assumptions and uncertainties that are associated with them.

In presenting the results of a more comprehensive risk assessment, we remind NEHC that the human health benchmark values of a cancer risk of 1×10^{-4} and a hazard index of 1 recommended by EPA as indicating "unacceptable" risks are for regulatory purposes, not for judgments regarding the advisability of public health studies or intervention. Thus, NEHC may want to identify other risk levels as "unacceptable" at this particular facility or want to discuss their results and judgments without reference to risk benchmark values.

The remainder of this section summarizes our comments on the credibility of the estimated cancer risks and hazard index calculated for the inhalation exposure route.

Cancer risks

The NEHC used several cautious assumptions and methods to estimate cancer risks in its preliminary assessment:

(a) a 70-year exposure duration, the basis for the EPA Region III RBCs (instead of the maximum 5-year duration for most base residents)[1];

(b) fence-line air concentrations (instead of concentrations in occupied areas);

(c) maximum concentration found for all sampling times (instead of a value more likely to reflect the average concentration of each contaminant over time); and

(d) adding upper limits of risk estimates for individual chemical components (instead of using the statistical upper limit for the sum of risks).

The combination of these cautious assumptions is likely to have resulted in an overestimate of cancer risks via the inhalation pathway. A set of more realistic assumptions is described below.

(a) Using a 5-year exposure duration – the maximum duration for most base residents – rather than the 70-year duration, would result in a reduction of the estimate of lifetime average daily dose (LADD) by a factor of 14. Depending on the age of individuals exposed for 5 years and the mechanism of action of the carcinogen, using the LADD to estimate cancer risks could over- or underestimate risk; however, the underestimate of risk would not exceed a factor of 2 to 5 (Murdoch et al., 1992; Goddard et al., 1995). Thus, using a 5-year exposure duration and considering the possibility of underestimating risk using the LADD, the cancer risk estimate can be divided by a factor of 3 (i.e., 14/5) to 7 (i.e., 14/2).

(b) The NEHC (1995) report indicates that air concentrations at the areas where exposures are likely to occur (child-development center, youth center, elementary school, and golf course) are likely to be one-fourth of the concentrations measured at the fence. Presumably, concentrations at the housing areas, which appear on the map of NAF Atsugi to be even

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[1] The NEHC (1995) report indicated that a 30-year exposure period was assumed for both the cancer and noncancer risk assessments. However, the Region III RBCs for carcinogenic substances assume a 70-year exposure period, and we could not identify any adjustment from a 70- to a 30-year exposure period for the estimates of cancer risk in the NEHC (1995) report. We therefore concluded that, in effect, a 70-year exposure period was used for the cancer risk assessment.

further from the incinerator complex (NEHC, 1995), are lower. Hence, the cancer risk estimates also can be divided by factor of 4.

(c) The NEHC preliminary risk assessment used the maximum concentrations observed during the dozen different sampling times over 3 months. Maximum concentrations for each contaminant would not occur simultaneously all of the time; hence, this approach would significantly overestimate the average concentration of each contaminant at the fence-line. In general, the most appropriate air concentration to estimate exposure levels when evaluating chronic health effects would be the average air concentration to which individuals are exposed over time. The air concentrations measured during the 3-month sampling period for the Navy assessment, however, might not be representative of all incineration weather conditions over several years. Thus, using an upper 90th percentile concentration for each contaminant would ensure that risks are not underestimated. (Even this approach is cautious, because not all of the contaminants would be simultaneously at or above the 90th percentile concentrations all of the time.) If the 90th percentile concentrations were used instead of the maximum concentrations measured, the cancer risk estimate could be divided by a factor of about 2.

(d) In the absence of information on potential synergistic or antagonistic effects of different carcinogens, EPA assumes that cancer risks are additive. EPA unit risk estimates for cancer represent upper-bound (approximately 95 percent) confidence limits on a cancer risk estimate derived from experimental or epidemiological data. To avoid overestimating cancer risks by adding upper-bound risk estimates for more than one chemical, some statistical adjustment is advisable. Gaylor and Chen (1995) extended the results of Slob (1994) and Bogen (1994) to provide an estimate of the upper-bound cancer risk for simultaneous exposure to k carcinogenic chemicals as

$$\text{Risk} = (R_1^2 + R_2^2 + \ldots R_k^2)^{1/2}$$

If one uses this formula, instead of adding the upper-bound risk estimates for each chemical, the estimate of cancer risk at the NAF Atsugi would be reduced by a factor of about 2.

Using the alternative assumptions outlined above, the combined overestimation factor would be approximately 50 to 100.

There are additional uncertainties in the assessment that might result in over- or underestimates of cancer risk from the inhalation pathway, notably:

- The 90th percentile measured air concentrations might overestimate the average annual air concentration, which is the more relevant measure for estimating cancer risks in the absence of information on the mechanism of action;

- If air samples were taken only during the times that the incinerator complex was active (e.g., during the day), and do not represent 24-hour average concentrations, cancer risk could have been significantly overestimated;

- The difference between fence-line and exposure-point concentrations is not exactly 4 but on the order of 4 and must vary depending on source emissions and weather conditions;

- The populations at risk include children who could be more vulnerable and who have higher breathing rates per unit body weight than do adults, who are assumed to breath 20 m^3 per 70 kg;

- In the absence of information to the contrary, cancer risks from different chemicals are assumed to be additive; the potential for synergistic or antagonistic effects among carcinogens has not been included; and

- Individuals staying at NAF Atsugi for more than the normal five-year tour of duty would have correspondingly higher risks.

In addition, we are concerned that there is no mention of the possibility that chromium VI (an EPA class "A" carcinogen) is emitted. We did not find analytic justification to eliminate chromium VI as a chemical of concern, only a statement indicating that, in air, it may react with particulate matter or gaseous pollutants to form chromium III (NEHC, 1995; page 11).

We emphasize again that other "indirect" exposure pathways may be significant and need to be evaluated. For example, the recent EPA (1994a) report on dioxin-like compounds indicates that indirect exposures (e.g., from ingesting soils or home-grown food) can be from one to two orders of magnitude higher than direct inhalation exposures.

Noncancer risks

Assumptions (b) and (c) used in the NEHC (1995) cancer risk assessment also were used in the NEHC risk assessment for noncancer effects from inhalation of air contaminants. Using the more realistic assumptions instead would result in a hazard index approximately one order of magnitude higher than the value of 1 considered to be acceptable, instead of the two orders of magnitude exceedance estimated by NEHC.

The contaminant primarily responsible for this risk is chromium III, and to a lesser extent 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene.

The EPA (1995) Region III inhalation RBC for chromium III of 0.0021 $\mu g/m^3$ is based on a reference dose (not air concentration) that used to be included in IRIS, but was withdrawn for re-evaluation. A minimal risk level recommended by the ATSDR (1993) for subchronic and chronic inhalation of chromium (0.02 $\mu g/m^3$) is based on a 2.5-year occupational exposure study in humans and is approximately one order of magnitude higher than the EPA Region III RBC for chromium III. Using the ATSDR minimal risk level instead of the RBC for chromium III would reduce the hazard index still further, to about half an order of magnitude. Thus, the RBC for chromium III should be carefully reviewed because of its significance to the noncancer hazard evaluation. COT recommends further that the study used by ATSDR to set a minimal risk level be carefully evaluated to determine whether the presence of chromium VI in addition to chromium III in the workplace could have confounded the results.

The bases for the EPA Region III RBCs for the two trimethylbenzenes are the EPA-ECAO Regional Support provisional oral RfD values (1,2,4-trimethylbenzene oral RfD = 0.0005 mg/kg-day; 1,3,5-trimethylbenzene oral RfD = 0.0004 mg/kg-day). These values are more than three orders of magnitude lower than the EPA Region III RBCs for mixed xylenes of 2.0 mg/kg-day based on oral RfD values reported in EPA's HEAST database. Given the similarity of trimethylbenzenes and xylenes, we recommend that NEHC carefully evaluate the basis for the EPA-ECAO provisional values for the trimethylbenzenes.

The noncancer effects of benzene were not included in the NEHC (1995) risk assessment. The EPA Region III RBC tables include an RfD for the inhalation of benzene of 0.00171 mg/kg-day based on noncancer effects. Assuming a 70 kg adult breathing 20 m^3 of air daily, the air concentration corresponding to the benzene RfD would be 0.0060 mg/m^3. The maximum benzene concentration measured in the 12 Navy-sampling events was 0.084 mg/m^3, and the 90th percentile concentration was 0.049 mg/m^3, suggesting that the noncancer effects of benzene might be significant. Adding the benzene hazard quotient to the hazard index for noncancer effects, would bring the hazard index back up to approximately one order of magnitude above 1.

As for the cancer risk assessment, there are several uncertainties in the noncancer risk assessment that might under- or overestimate the potential for adverse health effects from inhalation of air-borne contaminants, including:

- The 90th percentile measured air concentrations might overestimate average air concentrations, over even relatively short (e.g., several weeks) periods of time;

- If air samples were taken only during the times that the incinerator complex was active (e.g., during the day), and do not represent 24-hour average concentrations, chronic noncancer risk could have been overestimated;

- The difference between fence-line and exposure-point concentrations is not exactly 4 but on the order of 4 and must vary depending on source emissions and weather conditions;

- Toxic effects are assumed to be additive; the potential for synergistic or antagonistic effects not been considered; and

- The populations at risk include children who could be more vulnerable and who have higher breathing rates per unit body weight than do adults, who are assumed to breath 20 m^3 per 70 kg.

In addition, EPA (1994b) has recently raised significant issues regarding the developmental effects of chlorinated dioxins and furans, which are thought to arise because of their hormone-like properties. We recommend that NEHC review this matter.

The NEHC (1995) report indicates that the maximum concentrations of particulate matter of 10 microns or less (PM10) measured in the air near the incinerator complex exceeded U.S. NAAQS. NEHC should add a discussion of the potential health impacts of the observed levels of PM10, particularly for sensitive subpopulations (e.g., asthmatics, older individuals). NEHC also should consider the possibility of synergistic effects from simultaneous exposures to elevated levels of particulate matter and the other air contaminants.

Finally, we emphasize that other "indirect" exposure pathways may be significant and need to be evaluated. These include exposure of children to lead and other contaminants that may have accumulated over the years in soils and on other surfaces and exposure of adults and children to contaminants in food grown downwind of the incinerator complex.

Summary of COT Review of the NEHC Risk Assessment Methods and Results

We conclude that the NEHC (1995) report contains sufficient and compelling evidence to warrant public-health concern and to justify further evaluation of the problem. Levels of several toxic chemicals, including benzene and chromium, and airborne particulate matter were found at the NAF Atsugi to be near or above levels considered to pose unacceptable cancer and noncancer risks.

Is a Health Study Warranted?

It would be premature to recommend a health or epidemiological study to be conducted at the NAF Atsugi. A more comprehensive risk assessment, as described under the "Recommendations" section below, would be a preferable next step. A study of the actual exposures of people on the base would be a useful component of a more comprehensive risk assessment.

The NEHC should consider developing an exposure monitoring protocol using personal dosimeters, which in conjunction with monitoring air where people live and work and recording personnel activity patterns might provide better evidence of the levels of exposure to contaminants from the incinerator complex than area-air monitoring alone. The proposed exposure monitoring protocol should be reviewed by a group outside of the Navy before implementation. If data from the exposure monitoring indicates that risks appear to be significant, then it might be appropriate to consider a health study, with body burden measurements included.

To evaluate lead exposures in children, blood lead levels could be determined and compared with EPA guidance levels. Should blood lead levels exceed EPA guidelines, it would be necessary to develop a blood-lead-level-monitoring protocol that would help identify the extent to which elevated blood lead levels could be attributed to the incinerator complex.

RECOMMENDATIONS

We reviewed the NEHC's recommendations for action. This section first presents the NEHC recommendations and then presents our comments on those recommendations, as well as additional recommendations.

Recommendations by the Navy Environmental Health Center

The NEHC (1995) report listed six recommendations:

(1) Consider installation of antipollution devices at the Jinkanpo incinerators.

(2) Seek alternative waste management practices to replace the current practice of pouring waste solvents onto waste piles.

(3) Conduct surface soil sampling at the child development center, the youth center, and the elementary school playgrounds and at the golf course to determine surface soil contamination. Educate NAF Atsugi residents about potential surface soil contamination due to particulate matter fallout. Samples should be analyzed for metals, dioxins, and furans.

(4) Until surface soil concentrations are defined, implement measures to prevent possible adverse exposures. Health education for day care workers about prevention of exposure and recognition of pica behavior (eating dirt) in children is indicated.

(5) Conduct ground-water sampling of drinking water wells used during the winter months to determine if the ground water is contaminated. Samples should be analyzed for VOCs, semivolatile organic compounds (SVOCs), and metals.

(6) Provide a copy of the NEHC (1995) report to the Navy's occupational medicine staff so that they can determine the need for a health or epidemiological study and can provide consultation and reference material to the health care providers at NAF Atsugi regarding the evaluation of residents with health complaints. In addition, the Navy's occupational medicine staff will determine whether continuous emissions monitoring devices should be installed near the Jinkanpo Incineration Complex until engineering controls are implemented at the complex.

The National Research Council Committee on Toxicology Recommendations

We agree that the NEHC recommendations are justified by the level of pollution in ambient air on the NAF Atsugi, as documented in the NEHC (1995) report. Although we agree that some degree of risk of adverse health effects might exist at the NAF Atsugi, limitations in the preliminary risk assessment might make it difficult to develop a strong case for action to reduce emissions from the incinerator complex, especially because the Navy has not measured reference-site concentrations or breathing zone concentrations or determined other potential sources of contamination.

We recommend that (1) the interim measures suggested by the NEHC (1995) should be implemented to reduce the potential exposure of Navy personnel and their families, especially children, to emissions from the incinerator complex and that (2) the Navy conduct additional sampling of the air, other environmental media, and human blood to form the basis of a more comprehensive risk assessment. Those recommendations are described below.

Adopt interim measures to reduce exposures of base personnel

Most of the air contaminants that exceeded the EPA criteria are VOCs, which are expected to be largely combusted during incineration. This suggests that VOCs measured at the NAF Atsugi fence-line might result largely from the practice of pouring liquid waste on piles of solid waste resting directly on the ground. That practice is not allowed in the United States, and is likely to contaminate air, soil, and water. The VOC disposal methods should be brought into line with accepted international practices.

The incinerator might be the source of chromium contamination; efforts should be undertaken to reduce the chromium emissions from the incinerator. Based on the results of the spot checks on air contamination, it is not possible to know if other incinerator-derived pollutants might be present at other times. Therefore, the best approach would be to consider the upgrading of the whole incinerator process, particularly if the VOCs of potential concern are being emitted from the incinerators. Newer, more efficient incinerators could be considered to replace the existing less efficient units. Installation of anti-pollution devices should be coupled with installation of "stack" air monitoring devices (source testing) with constant printouts of emissions.

Until actions are taken to reduce emissions, the Navy could reduce potential exposure of Navy personnel and their families to the airborne contaminants by reducing the level and duration of exposure. From May through August, when the prevailing winds are south to north and "fumigation" conditions tend to prevail on a daily basis (as described on page 7 of the NEHC 1995 report), it might be advisable to monitor air contaminant levels to advise action for potentially sensitive subpopulations (e.g., children, pregnant women), for example, to stay indoors. During other times of year, when weather conditions (e.g., temperature inversion) might inhibit dispersion of air contaminants away from the incinerator complex and the NAF, it might also be advisable for Navy personnel and their families to stay indoors with windows and doors closed. That measure would be most effective if air cleaners using carbon adsorption and filtration are used indoors. (Indoor air cleaners using electrostatic precipitation or producing ozone by electrical discharge are not recommended.) However, if the ground water is contaminated by VOCs and travels under occupied Navy buildings, VOCs could reach high levels in indoor air by diffusion through soil into basements, even through cement slabs. Thus, before the Navy recommends that personnel stay indoors, it should assess ground-water movement from areas of soil contamination or monitor indoor air for VOCs. To reduce the duration of exposure, the tour of duty at the Atsugi base could be limited to the standard tour until the problems with the incinerator are resolved.

We agree with the NEHC (1995) recommendation to conduct surface soil sampling at the playgrounds and at the golf course to determine surface soil contamination. Until surface soil concentrations are determined, the COT agrees that measures should be implemented to prevent possible adverse exposures to soil contaminants. Health education for day-care workers about prevention of exposure and recognition of pica behavior in children is indicated. Recognition of pica behavior and action to prevent this type of exposure is very important in preventing adverse health effects. In particular, the potential for lead accumulation in soils and on surfaces to which children may be exposed needs to be evaluated. Educating residents about potential surface soil contamination due to particulate matter fallout also should help to minimize exposures to contaminants in the soils.

Depending on what actions might be taken at the incinerator complex, some mechanism or indicators to measure the progress of the pollution control program should be established, preferably installation of continuous emissions monitors near the incinerator complex. Periodic sampling of water and soil also would be useful in assessing the reduction in emissions and waste generation at the incinerator complex.

Conduct a more comprehensive risk assessment

The NEHC (1995) report recognizes certain uncertainties in the assessment of the health risks at NAF Atsugi. As indicated above, the NEHC analyses included several cautious assumptions, and the preliminary estimate of total risk from inhalation of contaminants might have been somewhat overcautious. However, risks from other exposure pathways were not evaluated and could be significant. Efforts should be made to reduce those uncertainties by obtaining data that would better characterize the actual exposures of Navy personnel and their families from all environmental media, including sampling for lead in the blood of children. Sampling data are needed from reference locations to distinguish what levels of contamination can be attributed to the incinerator complex rather than to other potential sources. These and other suggestions for reducing uncertainties in the risk assessment are described in more detail in the section entitled "Review of the NEHC Risk Assessment Report". We believe that a more comprehensive risk assessment could assist in determining what actions are needed to reduce emissions at the incinerator complex.

Depending on available information, the Navy might also consider estimating risks to nearby Japanese populations.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. *Toxicological Profile for Chromium, Update*. U.S. Department of Health and Human Services, Public Health Service, ATSDR Atlanta, GA. TP-92/08.

Bogen, K.T. 1994. A note on compounded conservatism. *Risk Analysis* 14:379-381.

Environmental Protection Agency (EPA). 1994a. *Estimating Exposure to Dioxin-like Compounds*, 3 Volumes. Washington, DC: Office of Research and Development. EPA/600/6-88/005Ca,b,c.

Environmental Protection Agency (EPA). 1994b. *Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds; Volume I of III.* Washington, DC: Office of Research and Development. EPA/600/BP-92/001a.

Environmental Protection Agency (EPA), Region III. 1995. *Risk-based Concentration Table, January to June 1995*. Philadelphia, PA; March.

Gaylor, D.W. and Chen, J.J. 1995. A simple upper limit for multiplicative factors and for the sum of risks of the components in a mixture. *Risk Analysis*, submitted, 1995.

Goddard, M.J., Murdoch, D.J., and Krewski, D. Temporal aspects of risk characterization. *Inhalation Toxicology* 7:1005-1018.

Jones, T.D. 1995. Use of bioassays in assessing health hazards from complex mixtures: A rash analysis. Chemosphere 31:2475-2484.

Murdoch, D.J., Krewski, D., and Wargo, J. 1992. Cancer risk assessment with intermittent exposure. *Risk Analysis* 12:569-577.

Navy Environmental Health Center (NEHC). 1995. *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility, Atsugi, Japan*. Norfolk, VA; July.

Slob, W. 1994. Uncertainty analysis in multiplicative models. *Risk Analysis* 14:571-576.

ACRONYMS

BEST	Board on Environmental Studies and Toxicology
COT	Committee on Toxicology
DoD	Department of Defense
NAF	Naval Air Facility
NEHC	Navy Environmental Health Center
NRC	National Research Council
RBC	Risk-based Concentrations
SVOC	semivolatile organic compound
EPA	(United States) Environmental Protection Agency
VOC	volatile organic compound

Sincerely yours,

Margaret E. M[illegible] Ph.D. for

Rogene F. Henderson, PhD, Chairman
Committee on Toxicology

Attachment:
Roster of National Research Council Committee on Toxicology

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Board on Environmental Studies and Toxicology
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NAS
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Facsimile Transmission

TO: *CAPT D. A. Macys MSC, USN* / (804) 444-7575 x 450

FAX #: (804) 444-7261

DATE: October 2, 1995

FROM: Margaret E. McVey

COMMENTS:

Attached is the Committee on Toxicology (COT) review of the Navy Environmental Health Center risk assessment report concerning the Navy Air Facility, Atsugi, Japan. We will send the COT roster of members and the COT chairman's signature tomorrow.

pages 1 – 8

# of pages including cover sheet: 17

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Pages 8 — the end I hope

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October 2, 1995

Admiral F. G. Sanford
Assistant Chief, Operational Medicine and Fleet Support
Bureau of Medicine and Surgery
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2300 E Street NW
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Dear Admiral Sanford:

This letter report was prepared by the National Research Council's (NRC) Committee on Toxicology (COT) in response to your letter of August 3, 1995, which was forwarded to the Council by Colonel Francis O'Donnell, U.S. Army Office of the Surgeon General, on August 21, 1995. In your letter, you requested that the NRC provide an independent review of a report entitled *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility (NAF) Atsugi, Japan* (NEHC 1995), which was prepared by the Navy's Environmental Health Center (NEHC).

The Jinkanpo Incineration Complex operates as a private waste-combustion and disposal facility equipped with four incinerators located approximately 100 yards outside the NAF Atsugi fence. It is reported to be emitting many carcinogenic and noncarcinogenic pollutants, including benzene, chloroform, furans, dioxins, methylene chloride, chromium and other metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), and particulate matter. The NEHC report provides a preliminary health risk evaluation for NAF Atsugi personnel and their families exposed to the pollutants.

Given the estimated magnitude of the potential health threats to Navy personnel and their families at the NAF Atsugi, you requested that the NRC review the NEHC preliminary risk assessment on an expedited basis, and you asked the NRC to determine whether a more detailed review would be appropriate at a later date. Specifically, you requested that the NRC review the following issues:

a. the scientific methods used to assess risk;

b. the credibility of the calculated degree of risk; and

c. whether a health or epidemiological study is warranted.

You also stated that if the credibility of the risk evaluation is sufficient to conclude that the operation of the incinerator may result in substantial public health concerns, the NRC should make recommendations concerning

a. interim precautions to safeguard the health of high-risk residents and workers until concerns are resolved; and

b. modifications to or termination of incinerator operations.

SUMMARY

The NEHC used U.S. Environmental Protection Agency's (EPA) Region III Risk-based Concentrations (RBCs) (EPA, 1995) for ambient air to identify which quantified chemicals in the air samples were of potential concern. Following the EPA guidelines, the NEHC considered unacceptable any cancer risks greater than 1×10^{-4} (i.e., 1 in 10,000) and a noncancer hazard index exceeding 1. (A hazard index is the factor by which levels of noncarcinogenic substances exceed acceptable levels.) The NEHC (1995) report estimates that the excess risk of cancer from exposure to pollutants from the incinerator complex is 6.6×10^{-3} and that the hazard index for noncarcinogenic substances in the air is 92.

Our independent review of the air-sampling data from NAF Atsugi indicates that the levels of volatile organic compounds (VOCs) and chromium in the air may be unacceptably high. Considering only the inhalation pathway, we found that the NEHC risk assessment may have overestimated the carcinogenic risks by one to as much as two orders of magnitude and the noncancer hazards by up to one order of magnitude. Thus, the cancer risks from inhalation of contaminants might approximate the level considered unacceptable (1×10^{-4}) rather than two orders of magnitude higher, and the noncancer hazard index may exceed the value of 1 by approximately one order of magnitude instead of two orders of magnitude. The NEHC (1995) report did not provide information necessary to estimate risks from other exposure pathways, however; therefore, the total cancer risks, as well as noncancer hazards, from all exposure pathways might exceed acceptable levels.

We conclude that the NEHC (1995) report contains sufficient and compelling evidence to warrant public-health concern and to justify further evaluation of the problem. Levels of several toxic chemicals, including benzene and chromium, and airborne particulate matter were found at the NAF Atsugi to be near or above levels considered to pose unacceptable cancer and noncancer risks.

Given the likelihood of unacceptable risks at the NAF Atsugi, we recommend that all of the interim measures proposed by NEHC (1995), as described on pages 11 to 12 of this letter, should be implemented to reduce the potential exposure of Navy personnel and their families to emissions of chromium and VOCs from the incinerator complex. Given the uncertainties inherent in the risk-assessment process, the limited air-sampling data available for the risk assessment, and the incomplete reporting of some aspects of the risk assessment in the NEHC (1995) report, we further recommend that the Navy conduct additional sampling of the air, other environmental media, and blood lead levels in children, to form the basis of a more comprehensive risk assessment. We consider it premature to recommend a health or epidemiological study at this time; however, a study of the actual exposure levels of people on the base would be a useful component of a more comprehensive risk assessment.

The remainder of this letter details our review of the *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the NAF Atsugi, Japan* and describes our recommendations in more detail.

REVIEW OF THE NEHC RISK ASSESSMENT REPORT

We reviewed the NEHC (1995) risk-assessment report and addressed the three issues identified by the Navy:

a. the scientific methods used to assess risk;

b. the credibility of the calculated degree of risk; and

c. whether a health or epidemiological study is warranted.

Review of the Scientific Methods Used to Assess Risk

This section first presents a brief summary of key aspects of the NEHC risk assessment methods and then presents our review of the methods.

Summary of NEHC risk assessment methods

Based on air-dispersion modeling documented in other reports concerning NAF Atsugi, the Navy collected air samples at a location in NAF Atsugi predicted to have the highest concentrations of chemicals released from the Jinkanpo Incineration Complex. Twelve samples collected over a period of three months were analyzed for inorganic and organic contaminants. The NEHC used EPA's Region III RBCs for ambient air to identify which quantified chemicals in the air samples were of potential concern. Following the EPA guidelines, the NEHC considered unacceptable any cancer risks greater than 1×10^{-4} (i.e., 1 in 10,000) and a noncancer hazard index exceeding 1.

Numerous chemical carcinogens were detected in the samples, and the maximum concentrations measured for five of them (i.e., methylene chloride, chloroform, benzene, 2,3,4,7,8-PeCDF, and 1,2,3,4,5,7,8-HxCDF) were considered by the NEHC to pose unacceptable risks (i.e., cancer risk greater than 10^{-4}). The maximum measured levels of three noncarcinogens (i.e., chromium III, 1,3,5-trimethylbenzene, and 1,2,4-trimethylbenzene) exceeded the EPA Region III RBCs for ambient air. Particulate matter (PM_{10}) concentrations exceeded the U.S. national ambient air-quality standards (NAAQS).

The Navy also collected air samples from a "background" or reference location (i.e., a location unaffected by the incinerator complex), but concluded that the location was too close to the incinerator complex and also could have been contaminated by other sources; thus the results from that site were not used in this risk evaluation.

COT review of NEHC risk-assessment methods

As a preliminary assessment, we believe that the NEHC (1995) report is limited with respect to certain important factors related to environmental fate and transport and toxicological implications of exposure to the contaminants released from the incineration complex. Nonetheless, the NEHC (1995) report properly describes the potential problems that are of concern and indicates that potential health hazards might be associated with emissions from several sources at the complex, including (1) incinerator stacks; (2) fugitive dusts from waste and fly ash storage areas; (3) solvent wastes poured on solid wastes on the ground; and (4) possible contamination of soil, surface and ground water, and river sediments from these operations.

Although the details of the exposure-assessment method are not fully presented in the NEHC (1995) report, we believe that the air sampling and analysis support the preliminary risk assessment. The sampling sites were selected on the basis of air-dispersion modeling, and the sampling was performed using established EPA methods. Appropriate quality-assurance measures seem to have been employed for the air sampling and analysis. However, the lack of appropriate reference sampling locations makes it difficult to attribute the measured contaminants solely to the incinerator complex. Also, it is important to indicate the averaging period over which the air samples are taken. The Navy should specify if the air samples were taken (averaged) during the hours when the incinerator complex was active (e.g., during the day) or at other times of the day. Also, the extent to which the measurements reflect the "fumigation" conditions (as described on page 7 of the NEHC 1995 report), should be described. Non-detects in the tables in the appendix should be accompanied by some indication of analytical detection limits.

We cannot evaluate the incinerator emissions characterization or the air-dispersion modeling, because the three supporting studies identified in the NEHC (1995) report (references a, b, and c), which are not publicly available, were not included in the materials that the Navy sent to the NRC for review. Thus, we cannot comment on details of the selection of the sampling sites or how specific contaminants were selected for analysis. Because spot checks on air contamination have revealed the chemicals of potential concern, we believe that a more complete monitoring of just those chemicals would provide more evidence of the need for corrective action at the incinerator complex. We recommend that the ambient air also be tested for ozone, nitrogen dioxide, carbon monoxide, and sulfur dioxide. In addition, if earlier sampling did not include mercury or cadmium, those substances should be included in the analysis. Moreover, sampling of air in zones where Navy personnel and their families work and live would provide better estimates of actual exposure levels than air monitoring at the fence-line.

The NEHC (1995) report evaluated only the inhalation pathway, but it indicated that other exposure pathways might also be of concern for the airbase personnel and their families. The chemicals of potential concern might be ingested from contaminated food and water and absorbed from dermal contact with the soil and water. We believe that some sampling of soil and water (and food, if any is grown on base or marketed to the base from potentially contaminated sites) is needed to obtain scientifically defensible data on the concentrations of contaminants in those specific media and to compare these concentrations with reference-site concentrations. It is important to obtain measurements of surface soil contaminant concentrations for possible fly ash fallout, particularly in areas where children might be exposed, such as the elementary school, child-development center, and the youth-center playgrounds.

We recommend that the Navy identify appropriate reference location(s) for sampling to compare with the sampling data from areas affected by the incinerator complex. Sampling data from reference locations are needed to distinguish what levels of contamination can be attributed to the incinerator complex rather than other potential sources. The Navy should also describe the conditions at the reference locations that make them suitable (e.g., upwind of the complex, different industrial history and use). The data collected from the original background site, which the NEHC subsequently considered not to be an appropriate reference location, would also be useful information to include in the risk assessment.

Additional factors to consider in the risk assessment include the persistence of the contaminants, their mobility in the environment, the frequency of detection, potential degradation products, and the potential for the substances to bioaccumulate, particularly in the aquatic ecosystems. In particular, NEHC should consider the potential for lead from the incinerator complex to have accumulated over time in soils and on other surfaces of the NAF Atsugi to which children and pregnant women might be exposed.

It also is important to consider the potential for contaminants in the soil to reach ground water. Contaminants that are relatively immobile (e.g., lead and cadmium), are unlikely to pose a threat to ground water; but contaminants that are relatively soluble in water (e.g., trichloroethylene) or that do not sorb strongly to soils (e.g., benzene) are likely to leach from surface soils into ground water, and might travel under Navy facility buildings, where they could diffuse through soil and volatilize into the basements of NAF buildings.

Credibility of the Calculated Degree of Risk

We believe that use of the maximum concentration detected in a series of a dozen measurements as the basis for the preliminary risk assessment is prudent and acceptable as a screening approach. However, some measure of the time-weighted exposures in addition to the maximum exposure would be more compelling evidence that regulatory or other remedial action needs to be taken. In addition, a better understanding of the effects of wind direction and speed and the effects of the terrain on the dispersion of contaminants from the incinerator complex throughout the year would be useful.

We suggest that the Navy be more cautious in its presentation of risk results. Statements such as that on page 13 of the NEHC (1995) report ("The total cancer risk for carcinogens of 6.62×10^{-3} means that there is an increased risk of 7 cancer cases per 1,000 people over the normal lifetime cancer risk rate") can be misleading. Both cancer and noncancer risks estimated using the methods that NEHC employed are not as certain as such statements imply. To be credible, all risk estimates should be accompanied by descriptions of the assumptions and uncertainties that are associated with them.

In presenting the results of a more comprehensive risk assessment, we remind NEHC that the human health benchmark values of a cancer risk of 1×10^{-4} and a hazard index of 1 recommended by EPA as indicating "unacceptable" risks are for regulatory purposes, not for judgments regarding the advisability of public health studies or intervention. Thus, NEHC may want to identify other risk levels as "unacceptable" at this particular facility or want to discuss their results and judgments without reference to risk benchmark values.

The remainder of this section summarizes our comments on the credibility of the estimated cancer risks and hazard index calculated for the inhalation exposure route.

Cancer risks

The NEHC used several cautious assumptions and methods to estimate cancer risks in its preliminary assessment:

(a) a 70-year exposure duration, the basis for the EPA Region III RBCs (instead of the maximum 5-year duration for most base residents)[1];

(b) fence-line air concentrations (instead of concentrations in occupied areas);

(c) maximum concentration found for all sampling times (instead of a value more likely to reflect the average concentration of each contaminant over time); and

(d) adding upper limits of risk estimates for individual chemical components (instead of using the statistical upper limit for the sum of risks).

The combination of these cautious assumptions is likely to have resulted in an overestimate of cancer risks via the inhalation pathway. A set of more realistic assumptions is described below.

(a) Using a 5-year exposure duration – the maximum duration for most base residents – rather than the 70-year duration, would result in a reduction of the estimate of lifetime average daily dose (LADD) by a factor of 14. Depending on the age of individuals exposed for 5 years and the mechanism of action of the carcinogen, using the LADD to estimate cancer risks could over- or underestimate risk; however, the underestimate of risk would not exceed a factor of 2 to 5 (Murdoch et al., 1992; Goddard et al., 1995). Thus, using a 5-year exposure duration and considering the possibility of underestimating risk using the LADD, the cancer risk estimate can be divided by a factor of 3 (i.e., 14/5) to 7 (i.e., 14/2).

(b) The NEHC (1995) report indicates that air concentrations at the areas where exposures are likely to occur (child-development center, youth center, elementary school, and golf course) are likely to be one-fourth of the concentrations measured at the fence. Presumably, concentrations at the housing areas, which appear on the map of NAF Atsugi to be even

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[1] The NEHC (1995) report indicated that a 30-year exposure period was assumed for both the cancer and noncancer risk assessments. However, the Region III RBCs for carcinogenic substances assume a 70-year exposure period, and we could not identify any adjustment from a 70- to a 30-year exposure period for the estimates of cancer risk in the NEHC (1995) report. We therefore concluded that, in effect, a 70-year exposure period was used for the cancer risk assessment.

further from the incinerator complex (NEHC, 1995), are lower. Hence, the cancer risk estimates also can be divided by factor of 4.

(c) The NEHC preliminary risk assessment used the maximum concentrations observed during the dozen different sampling times over 3 months. Maximum concentrations for each contaminant would not occur simultaneously all of the time; hence, this approach would significantly overestimate the average concentration of each contaminant at the fence-line. In general, the most appropriate air concentration to estimate exposure levels when evaluating chronic health effects would be the average air concentration to which individuals are exposed over time. The air concentrations measured during the 3-month sampling period for the Navy assessment, however, might not be representative of all incineration weather conditions over several years. Thus, using an upper 90th percentile concentration for each contaminant would ensure that risks are not underestimated. (Even this approach is cautious, because not all of the contaminants would be simultaneously at or above the 90th percentile concentrations all of the time.) If the 90th percentile concentrations were used instead of the maximum concentrations measured, the cancer risk estimate could be divided by a factor of about 2.

(d) In the absence of information on potential synergistic or antagonistic effects of different carcinogens, EPA assumes that cancer risks are additive. EPA unit risk estimates for cancer represent upper-bound (approximately 95 percent) confidence limits on a cancer risk estimate derived from experimental or epidemiological data. To avoid overestimating cancer risks by adding upper-bound risk estimates for more than one chemical, some statistical adjustment is advisable. Gaylor and Chen (1995) extended the results of Slob (1994) and Bogen (1994) to provide an estimate of the upper-bound cancer risk for simultaneous exposure to k carcinogenic chemicals as

$$\text{Risk} = (R_1^2 + R_2^2 + \ldots R_k^2)^{1/2}$$

If one uses this formula, instead of adding the upper-bound risk estimates for each chemical, the estimate of cancer risk at the NAF Atsugi would be reduced by a factor of about 2.

Using the alternative assumptions outlined above, the combined overestimation factor would be approximately 50 to 100.

There are additional uncertainties in the assessment that might result in over- or underestimates of cancer risk from the inhalation pathway, notably:

- The 90th percentile measured air concentrations might overestimate the average annual air concentration, which is the more relevant measure for estimating cancer risks in the absence of information on the mechanism of action;

- If air samples were taken only during the times that the incinerator complex was active (e.g., during the day), and do not represent 24-hour average concentrations, cancer risk could have been significantly overestimated;

- The difference between fence-line and exposure-point concentrations is not exactly 4 but on the order of 4 and must vary depending on source emissions and weather conditions;

- The populations at risk include children who could be more vulnerable and who have higher breathing rates per unit body weight than do adults, who are assumed to breath 20 m^3 per 70 kg;

- In the absence of information to the contrary, cancer risks from different chemicals are assumed to be additive; the potential for synergistic or antagonistic effects among carcinogens has not been included; and

- Individuals staying at NAF Atsugi for more than the normal five-year tour of duty would have correspondingly higher risks.

In addition, we are concerned that there is no mention of the possibility that chromium VI (an EPA class "A" carcinogen) is emitted. We did not find analytic justification to eliminate chromium VI as a chemical of concern, only a statement indicating that, in air, it may react with particulate matter or gaseous pollutants to form chromium III (NEHC, 1995; page 11).

We emphasize again that other "indirect" exposure pathways may be significant and need to be evaluated. For example, the recent EPA (1994a) report on dioxin-like compounds indicates that indirect exposures (e.g., from ingesting soils or home-grown food) can be from one to two orders of magnitude higher than direct inhalation exposures.

Noncancer risks

Assumptions (b) and (c) used in the NEHC (1995) cancer risk assessment also were used in the NEHC risk assessment for noncancer effects from inhalation of air contaminants. Using the more realistic assumptions instead would result in a hazard index approximately one order of magnitude higher than the value of 1 considered to be acceptable, instead of the two orders of magnitude exceedance estimated by NEHC.

The contaminant primarily responsible for this risk is chromium III, and to a lesser extent 1,3,5-trimethylbenzene and 1,2,4-trimethylbenzene.

The EPA (1995) Region III inhalation RBC for chromium III of 0.0021 $\mu g/m^3$ is based on a reference dose (not air concentration) that used to be included in IRIS, but was withdrawn for re-evaluation. A minimal risk level recommended by the ATSDR (1993) for subchronic and chronic inhalation of chromium (0.02 $\mu g/m^3$) is based on a 2.5-year occupational exposure study in humans and is approximately one order of magnitude higher than the EPA Region III RBC for chromium III. Using the ATSDR minimal risk level instead of the RBC for chromium III would reduce the hazard index still further, to about half an order of magnitude. Thus, the RBC for chromium III should be carefully reviewed because of its significance to the noncancer hazard evaluation. COT recommends further that the study used by ATSDR to set a minimal risk level be carefully evaluated to determine whether the presence of chromium VI in addition to chromium III in the workplace could have confounded the results.

The bases for the EPA Region III RBCs for the two trimethylbenzenes are the EPA-ECAO Regional Support provisional oral RfD values (1,2,4-trimethylbenzene oral RfD = 0.0005 mg/kg-day; 1,3,5-trimethylbenzene oral RfD = 0.0004 mg/kg-day). These values are more than three orders of magnitude lower than the EPA Region III RBCs for mixed xylenes of 2.0 mg/kg-day based on oral RfD values reported in EPA's HEAST database. Given the similarity of trimethylbenzenes and xylenes, we recommend that NEHC carefully evaluate the basis for the EPA-ECAO provisional values for the trimethylbenzenes.

The noncancer effects of benzene were not included in the NEHC (1995) risk assessment. The EPA Region III RBC tables include an RfD for the inhalation of benzene of 0.00171 mg/kg-day based on noncancer effects. Assuming a 70 kg adult breathing 20 m^3 of air daily, the air concentration corresponding to the benzene RfD would be 0.0060 mg/m^3. The maximum benzene concentration measured in the 12 Navy-sampling events was 0.084 mg/m^3, and the 90th percentile concentration was 0.049 mg/m^3, suggesting that the noncancer effects of benzene might be significant. Adding the benzene hazard quotient to the hazard index for noncancer effects, would bring the hazard index back up to approximately one order of magnitude above 1.

As for the cancer risk assessment, there are several uncertainties in the noncancer risk assessment that might under- or overestimate the potential for adverse health effects from inhalation of air-borne contaminants, including:

- The 90th percentile measured air concentrations might overestimate average air concentrations, over even relatively short (e.g., several weeks) periods of time;

- If air samples were taken only during the times that the incinerator complex was active (e.g., during the day), and do not represent 24-hour average concentrations, chronic noncancer risk could have been overestimated;
- The difference between fence-line and exposure-point concentrations is not exactly 4 but on the order of 4 and must vary depending on source emissions and weather conditions;
- Toxic effects are assumed to be additive; the potential for synergistic or antagonistic effects not been considered; and
- The populations at risk include children who could be more vulnerable and who have higher breathing rates per unit body weight than do adults, who are assumed to breath 20 m^3 per 70 kg.

In addition, EPA (1994b) has recently raised significant issues regarding the developmental effects of chlorinated dioxins and furans, which are thought to arise because of their hormone-like properties. We recommend that NEHC review this matter.

The NEHC (1995) report indicates that the maximum concentrations of particulate matter of 10 microns or less (PM10) measured in the air near the incinerator complex exceeded U.S. NAAQS. NEHC should add a discussion of the potential health impacts of the observed levels of PM10, particularly for sensitive subpopulations (e.g., asthmatics, older individuals). NEHC also should consider the possibility of synergistic effects from simultaneous exposures to elevated levels of particulate matter and the other air contaminants.

Finally, we emphasize that other "indirect" exposure pathways may be significant and need to be evaluated. These include exposure of children to lead and other contaminants that may have accumulated over the years in soils and on other surfaces and exposure of adults and children to contaminants in food grown downwind of the incinerator complex.

Summary of COT Review of the NEHC Risk Assessment Methods and Results

We conclude that the NEHC (1995) report contains sufficient and compelling evidence to warrant public-health concern and to justify further evaluation of the problem. Levels of several toxic chemicals, including benzene and chromium, and airborne particulate matter were found at the NAF Atsugi to be near or above levels considered to pose unacceptable cancer and noncancer risks.

Is a Health Study Warranted?

It would be premature to recommend a health or epidemiological study to be conducted at the NAF Atsugi. A more comprehensive risk assessment, as described under the "Recommendations" section below, would be a preferable next step. A study of the actual exposures of people on the base would be a useful component of a more comprehensive risk assessment.

The NEHC should consider developing an exposure monitoring protocol using personal dosimeters, which in conjunction with monitoring air where people live and work and recording personnel activity patterns might provide better evidence of the levels of exposure to contaminants from the incinerator complex than area-air monitoring alone. The proposed exposure monitoring protocol should be reviewed by a group outside of the Navy before implementation. If data from the exposure monitoring indicates that risks appear to be significant, then it might be appropriate to consider a health study, with body burden measurements included.

To evaluate lead exposures in children, blood lead levels could be determined and compared with EPA guidance levels. Should blood lead levels exceed EPA guidelines, it would be necessary to develop a blood-lead-level-monitoring protocol that would help identify the extent to which elevated blood lead levels could be attributed to the incinerator complex.

RECOMMENDATIONS

We reviewed the NEHC's recommendations for action. This section first presents the NEHC recommendations and then presents our comments on those recommendations, as well as additional recommendations.

Recommendations by the Navy Environmental Health Center

The NEHC (1995) report listed six recommendations:

(1) Consider installation of antipollution devices at the Jinkanpo incinerators.

(2) Seek alternative waste management practices to replace the current practice of pouring waste solvents onto waste piles.

(3) Conduct surface soil sampling at the child development center, the youth center, and the elementary school playgrounds and at the golf course to determine surface soil contamination. Educate NAF Atsugi residents about potential surface soil contamination due to particulate matter fallout. Samples should be analyzed for metals, dioxins, and furans.

(4) Until surface soil concentrations are defined, implement measures to prevent possible adverse exposures. Health education for day care workers about prevention of exposure and recognition of pica behavior (eating dirt) in children is indicated.

(5) Conduct ground-water sampling of drinking water wells used during the winter months to determine if the ground water is contaminated. Samples should be analyzed for VOCs, semivolatile organic compounds (SVOCs), and metals.

(6) Provide a copy of the NEHC (1995) report to the Navy's occupational medicine staff so that they can determine the need for a health or epidemiological study and can provide consultation and reference material to the health care providers at NAF Atsugi regarding the evaluation of residents with health complaints. In addition, the Navy's occupational medicine staff will determine whether continuous emissions monitoring devices should be installed near the Jinkanpo Incineration Complex until engineering controls are implemented at the complex.

The National Research Council Committee on Toxicology Recommendations

We agree that the NEHC recommendations are justified by the level of pollution in ambient air on the NAF Atsugi, as documented in the NEHC (1995) report. Although we agree that some degree of risk of adverse health effects might exist at the NAF Atsugi, limitations in the preliminary risk assessment might make it difficult to develop a strong case for action to reduce emissions from the incinerator complex, especially because the Navy has not measured reference-site concentrations or breathing zone concentrations or determined other potential sources of contamination.

We recommend that (1) the interim measures suggested by the NEHC (1995) should be implemented to reduce the potential exposure of Navy personnel and their families, especially children, to emissions from the incinerator complex and that (2) the Navy conduct additional sampling of the air, other environmental media, and human blood to form the basis of a more comprehensive risk assessment. Those recommendations are described below.

Adopt interim measures to reduce exposures of base personnel

Most of the air contaminants that exceeded the EPA criteria are VOCs, which are expected to be largely combusted during incineration. This suggests that VOCs measured at the NAF Atsugi fence-line might result largely from the practice of pouring liquid waste on piles of solid waste resting directly on the ground. That practice is not allowed in the United States, and is likely to contaminate air, soil, and water. The VOC disposal methods should be brought into line with accepted international practices.

The incinerator might be the source of chromium contamination; efforts should be undertaken to reduce the chromium emissions from the incinerator. Based on the results of the spot checks on air contamination, it is not possible to know if other incinerator-derived pollutants might be present at other times. Therefore, the best approach would be to consider the upgrading of the whole incinerator process, particularly if the VOCs of potential concern are being emitted from the incinerators. Newer, more efficient incinerators could be considered to replace the existing less efficient units. Installation of anti-pollution devices should be coupled with installation of "stack" air monitoring devices (source testing) with constant printouts of emissions.

Until actions are taken to reduce emissions, the Navy could reduce potential exposure of Navy personnel and their families to the airborne contaminants by reducing the level and duration of exposure. From May through August, when the prevailing winds are south to north and "fumigation" conditions tend to prevail on a daily basis (as described on page 7 of the NEHC 1995 report), it might be advisable to monitor air contaminant levels to advise action for potentially sensitive subpopulations (e.g., children, pregnant women), for example, to stay indoors. During other times of year, when weather conditions (e.g., temperature inversion) might inhibit dispersion of air contaminants away from the incinerator complex and the NAF, it might also be advisable for Navy personnel and their families to stay indoors with windows and doors closed. That measure would be most effective if air cleaners using carbon adsorption and filtration are used indoors. (Indoor air cleaners using electrostatic precipitation or producing ozone by electrical discharge are not recommended.) However, if the ground water is contaminated by VOCs and travels under occupied Navy buildings, VOCs could reach high levels in indoor air by diffusion through soil into basements, even through cement slabs. Thus, before the Navy recommends that personnel stay indoors, it should assess ground-water movement from areas of soil contamination or monitor indoor air for VOCs. To reduce the duration of exposure, the tour of duty at the Atsugi base could be limited to the standard tour until the problems with the incinerator are resolved.

We agree with the NEHC (1995) recommendation to conduct surface soil sampling at the playgrounds and at the golf course to determine surface soil contamination. Until surface soil concentrations are determined, the COT agrees that measures should be implemented to prevent possible adverse exposures to soil contaminants. Health education for day-care workers about prevention of exposure and recognition of pica behavior in children is indicated. Recognition of pica behavior and action to prevent this type of exposure is very important in preventing adverse health effects. In particular, the potential for lead accumulation in soils and on surfaces to which children may be exposed needs to be evaluated. Educating residents about potential surface soil contamination due to particulate matter fallout also should help to minimize exposures to contaminants in the soils.

Depending on what actions might be taken at the incinerator complex, some mechanism or indicators to measure the progress of the pollution control program should be established, preferably installation of continuous emissions monitors near the incinerator complex. Periodic sampling of water and soil also would be useful in assessing the reduction in emissions and waste generation at the incinerator complex.

Conduct a more comprehensive risk assessment

The NEHC (1995) report recognizes certain uncertainties in the assessment of the health risks at NAF Atsugi. As indicated above, the NEHC analyses included several cautious assumptions, and the preliminary estimate of total risk from inhalation of contaminants might have been somewhat overcautious. However, risks from other exposure pathways were not evaluated and could be significant. Efforts should be made to reduce those uncertainties by obtaining data that would better characterize the actual exposures of Navy personnel and their families from all environmental media, including sampling for lead in the blood of children. Sampling data are needed from reference locations to distinguish what levels of contamination can be attributed to the incinerator complex rather than to other potential sources. These and other suggestions for reducing uncertainties in the risk assessment are described in more detail in the section entitled "Review of the NEHC Risk Assessment Report". We believe that a more comprehensive risk assessment could assist in determining what actions are needed to reduce emissions at the incinerator complex.

Depending on available information, the Navy might also consider estimating risks to nearby Japanese populations.

REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). 1993. *Toxicological Profile for Chromium, Update*. U.S. Department of Health and Human Services, Public Health Service, ATSDR Atlanta, GA. TP-92/08.

Bogen, K.T. 1994. A note on compounded conservatism. *Risk Analysis* 14:379-381.

Environmental Protection Agency (EPA). 1994a. *Estimating Exposure to Dioxin-like Compounds*, 3 Volumes. Washington, DC: Office of Research and Development. EPA/600/6-88/005Ca,b,c.

Environmental Protection Agency (EPA). 1994b. *Health Assessment Document for 2,3,7,8-Tetrachlorodibenzo-p-Dioxin (TCDD) and Related Compounds; Volume I of III.* Washington, DC: Office of Research and Development. EPA/600/BP-92/001a.

Environmental Protection Agency (EPA), Region III. 1995. *Risk-based Concentration Table, January to June 1995*. Philadelphia, PA; March.

Gaylor, D.W. and Chen, J.J. 1995. A simple upper limit for multiplicative factors and for the sum of risks of the components in a mixture. *Risk Analysis*, submitted, 1995.

Goddard, M.J., Murdoch, D.J., and Krewski, D. Temporal aspects of risk characterization. *Inhalation Toxicology* 7:1005-1018.

Jones, T.D. 1995. Use of bioassays in assessing health hazards from complex mixtures: A rash analysis. Chemosphere 31:2475-2484.

Murdoch, D.J., Krewski, D., and Wargo, J. 1992. Cancer risk assessment with intermittent exposure. *Risk Analysis* 12:569-577.

Navy Environmental Health Center (NEHC). 1995. *Human Health Preliminary Risk Evaluation of the Jinkanpo Incineration Complex Activities at the Naval Air Facility, Atsugi, Japan*. Norfolk, VA; July.

Slob, W. 1994. Uncertainty analysis in multiplicative models. *Risk Analysis* 14:571-576.

ACRONYMS

BEST	Board on Environmental Studies and Toxicology
COT	Committee on Toxicology
DoD	Department of Defense
NAF	Naval Air Facility
NEHC	Navy Environmental Health Center
NRC	National Research Council
RBC	Risk-based Concentrations
SVOC	semivolatile organic compound
EPA	(United States) Environmental Protection Agency
VOC	volatile organic compound

Sincerely yours,

Margaret E. McVey Ph.D. for

Rogene F. Henderson, PhD, Chairman
Committee on Toxicology

Attachment:
Roster of National Research Council Committee on Toxicology