GEM 373 CG

GENEVA BORDER CITY GEM 373 CG 5/88
INDOOR AIR QUALITY INVESTIGATION & EXPOSURE ASSESSMENT

NEW YORK STATE ELECTRIC & GAS CORPORATION
SUMMARY OF INDOOR AIR QUALITY INVESTIGATIONS AND EXPOSURE ASSESSMENT THE FORMER COAL GASIFICATION SITE AT GENEVA, NEW YORK

TECHNICAL REPORT

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EXECUTIVE SUMMARY

An indoor air quality survey was performed in various buildings on the Geneva site during April 1988. The purpose of the survey was to: 1) determine whether or not volatile fractions of gasification residuals are migrating into on-site buildings, and 2) evaluate potential heath risks associated with employee exposure to the volatile constituents.

Sampling results indicated that none of the selected compounds (benzene, naphthalene, and phenol) are present in the indoor air above detection limits. The detection limits for this study are slightly above the levels that are typically observed for indoor air. Therefore, the estimated risks are very close to "ambient" risks for indoor occupational settings.

The incremental lifetime cancer risk (benzene) calculated using the data collected from the on-site buildings all fall within currently acceptable ranges. The acceptable ranges are based on current US EPA guidelines. The calculated Hazard Index Ratios for non-carcinogens (naphthalene) entering the buildings are also within currently acceptable levels according to existing EPA guidelines. Therefore, the estimated and calculated risks to employees working in the buildings all fall within acceptable levels for the three compounds of interest.

1.0 INTRODUCTION

Analytical data collected during Task 2 and Task 3 of the Geneva site investigation indicated the presence of several volatile organic constituents in the soil near some of the site buildings. During the development of exposure scenarios for the Risk Assessment (Task 4), the possibility that soil gas containing these constituents could become entrapped in the buildings, exposing workers to elevated concentrations, was considered. Although data on total volatile organic compounds were available from measurements with a flame ionization detector (FID), no direct measurements of individual constituents in the buildings were made. Therefore, in order to evaluate these scenarios it was necessary to gather additional, constituent specific air quality data directly from these buildings. The following sections describe the rationale and methods used in this study and summarizes the analytical data. These data are evaluated and discussed from a risk assessment perspective in the text of the Task 4 Report (Section 7.3) and in Sections 4, 5 and 6 of this report.

2.0 SAMPLING PROGRAM

The sampling program detailed below was conducted by TRC during April 10-13 and 23, 1988.

2.1 Selection of Constituents

Three volatile or semi-volatile constituents were selected as analytes. Each is from a separate chemical class of the Chemicals of Interest presented in Section 4.3. The criteria for selection of Chemicals of Interest are discussed in that section. The selected compounds include:

Benzene - a potentially carcinogenic volatile compound

Naphthalene - the most volatile of the polynuclear aromatic hydrocarbons

Phenol - selected from the group of Chemicals of Interest evaluated with respect to systemic health effects.

2.2 Sampling Locations

Two buildings at the Geneva site are located close to the areas where the above referenced constituents were detected in the subsurface soil. The Service Building/Garage facility is considered in Exposure Scenarios 1 and 2 and the Corporate Meter Building (former purifier building) in Scenario 3. In order to provide background data, a similar NYSEG Service Building/Garage facility located in Auburn, NY was also sampled. The Auburn facility is not located at a former coal gasification site.

Within each building, samplers were placed in one "high potential area" and one "typical work area". High potential areas are those where the highest concentrations of volatiles would be expected to be present such as basement areas, etc. The typical work areas selected are frequented by workers, and are generally away from the points where volatiles would be expected to be entering the building from the subsurface soil.

At the Geneva site, the garage attached to the main office building was chosen as having the highest potential for volatiles in the air. The "typical work" location was an office on the second floor of the building. In the meter lab, the high potential sampling location was in the meter storage area, across from the meter wash room. The typical work area was an office near the east doorway in that building (across from the "coffee room").

At the Auburn facility, only the office/garage building was sampled. A location inside the loading area, where utility equipment is loaded onto trucks, was selected as having the highest potential for the presence of organic volatiles. The typical work area selected was in a copying cubicle of the upstairs offices.

2.3 Sampling and Analytical Methods

Modified National Institute of Occupational Safety and Health (NIOSH) Methods 1500, 5515, and 3502 were used to sample for benzene, naphthalene and phenol respectively. Method 1500 requires the use of 100 milligram/50 milligram (100 mg/50 mg) charcoal tubes at a known sampling rate between 0.01 and 0.2 liters per minute (l/min) for a total volume of 30 liters. Breakthrough volume for this method is 45 liters. To obtain a lower detection limit, a larger sampling medium (400 mg/200 mg) and greater total volume (72 liters) were used. The sample was collected for 24 hours at a sampling rate of 0.05 liters per minute (l/min) for a total volume of 72 liters.

Method 5515 uses a 2 microgram, 37-millimeter teflon filter and a 100 mg/50 mg XAD-2 collection tube. The pump sampled for 24 hrs at 0.5 l/min for a total volume of 720 liters. Method 3502 uses a "midget bubbler" with a 0.1 N sodium hydroxide (NaOH) sampling medium. The sample was drawn for 24 hours at a 0.1 l/min flow rate, for a total volume of 144 liters.

3.0 ANALYTICAL RESULTS

The samples were analyzed by Galson Technical Services, Inc. of East Syracuse, New York. An explanation of the sample identification numbers is given in Table 1.

The analytical results, summarized in Tables 2 through 4, indicate that none of the analytes were found above the detection limits.

TABLE 1

EXPLANATION OF SAMPLE IDENTIFICATION NUMBERING SYSTEM

SAMPLE (*) NUMBER	LOCATION (SITE,BUILDING,AREA)
AUBHI11	AUBURN, SERVICE/GARAGE, HIGH POTENTIAL
AUBLO11	AUBURN, SERVICE/GARAGE, TYPICAL WORK AREA
AUBFB2 (**)	AUBURN, FIELD BLANK
GENOH11	GENEVA, SERVICE/GARAGE, HIGH POTENTIAL
GENOL11	GENEVA, SERVICE/GARAGE, TYPICAL WORK AREA
GENFB2	GENEVA, FIELD BLANK
GENMH11	GENEVA, METER BUILDING, HIGH POTENTIAL
GENML11	GENEVA, METER BUILDING, TYPICAL WORK AREA

(*) Number in sample ID indicates date of sampling
(e.g., 11 = 4/11/87)

(**) Number in field blank sample ID indicates
day of sampling program
(e.g., 2 = 2'nd day of sampling)

TABLE 2

ANALYTICAL DATA – AUBURN SERVICE BUILDING/GARAGE

DATE	SAMPLE NUMBER	BENZENE				NAPHTHALENE				PHENOL			
		VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]
4/11/87	AUBHI11	71.75	<6	<0.04	<0.01	717.5	<20	<0.03	<0.005	143.5	<130	<0.9	<0.2
	AUBLO11	71.70	<6	<0.04	<0.01	717.0	<20	<0.03	<0.005	143.4	<130	<0.9	<0.2
	AUBFB2	NA	<6	NA	NA	NA	<20	NA	NA	NC			
4/12/87	AUBHI12	66.15	<6	<0.04	<0.01	661.5	<20	<0.03	<0.006	132.3	<130	<1.0	<0.3
	AUBLO12	65.8	<6	<0.05	<0.01	658.0	<20	<0.03	<0.006	131.6	<130	<1.0	<0.3
	AUBFB3	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA
4/23/87	AUBHI23	73.75	<6	<0.08	<0.02	737.5	<20	<0.03	<0.005	147.5	<130	<0.9	<0.2
	AUBLO23	73.60	<6	<0.08	<0.02	736.0	<20	<0.03	<0.006	147.2	<130	<0.9	<0.2
	AUBFB4	NA	<6	NA	NA	NA	<20	NA	NA	NC			

NA = Not Applicable

NC = Blank for this constituent not collected at this site on the indicated date.

1 Micrograms

2 Milligrams per cubic meter

3 Parts per million

TABLE 3

ANALYTICAL DATA - GENEVA SERVICE BUILDING/GARAGE

DATE	SAMPLE NUMBER	BENZENE				NAPHTHALENE				PHENOL			
		VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M3[2]	PPM[3]
4/10/87	GENOL10	75.25	<6	<0.04	<0.01	752.5	<20	<0.03	<0.005	150.5	<130	<0.9	<0.2
4/11/87	GENOH11	72.90	<6	<0.04	<0.01	729.0	<20	<0.03	<0.005	145.8	<130	<0.9	<0.2
	GENOL11	62.25	<6	<0.05	<0.02	622.5	<20	<0.03	<0.006	124.5	<130	<1.0	<0.3
	GENFB2	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA
4/12/87	GENOH12	65.95	<6	<0.04	<0.01	659.5	<20	<0.03	<0.006	131.9	<130	<1.0	<0.3
	GENOL12	65.85	<6	<0.05	<0.01	658.5	<20	<0.03	<0.006	131.7	<130	<1.0	<0.3
	GENFB3	NA	<6	NA	NA	NA	<20	NA	NA	NC			
4/23/87	GENOH23	66.15	<6	<0.09	<0.03	661.5	<20	<0.03	<0.006	132.3	<130	<1.0	<0.3
	GENOL23	66.0	<6	<0.09	<0.03	660.0	<20	<0.03	<0.006	132.0	<130	<1.0	<0.3
	GENFB4	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA

NA = Not Applicable

NC = Blank for this constituent not collected at this site on the indicated date.

1 Micrograms

2 Milligrams per cubic meter

3 Parts per million

TABLE 4

ANALYTICAL DATA - GENEVA METER BUILDING

DATE	SAMPLE NUMBER	BENZENE				NAPHTHALENE				PHENOL			
		VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]	VOLUME (LITERS)	TOTAL UG[1] (DETECTION LIMIT)	MG/M^3[2]	PPM[3]
4/11/87	GENMH11	73.3	<6	<0.04	<0.01	733.0	<20	<0.03	<0.005	146.6	<130	<0.9	<0.2
	GENML11	73.85	<6	<0.04	<0.01	738.5	<20	<0.03	<0.005	147.7	<130	<0.9	<0.2
	GENFB2	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA
4/12/87	GENMH12	67.85	<6	<0.04	<0.01	678.5	<20	<0.03	<0.006	135.7	<130	<1.0	<0.3
	GENML12	68.25	<6	<0.04	<0.01	682.5	<20	<0.03	<0.006	136.5	<130	<1.0	<0.3
	GENFB3	NA	<6	NA	NA	NA	<20	NA	NA	NC			
4/23/87	GENMH23	66.35	<6	<0.09	<0.03	663.5	<20	<0.03	<0.006	132.7	<130	<1.0	<0.3
	GENML23	65.9	<6	<0.09	<0.03	664.0	<20	<0.03	<0.006	131.8	<130	<1.0	<0.3
	GENFB4	NA	<6	NA	NA	NA	<20	NA	NA	NA	<130	NA	NA

NA = Not Applicable

NC = Blank for this constituent not collected at this site on the indicated date.

1 Micrograms

2 Milligrams per cubic meter

3 Parts per million

4.0 EXPOSURE ASSESSMENT

The data gathered during the investigation discussed above has allowed a more accurate evaluation of the potential risks from inhalation exposure associated with working in the buildings at the Geneva site. The results of risk calculations conducted with these data are summarized in the following sections.

4.1 Development of Exposure Scenarios

The most critical aspect of a technically sound exposure assessment is the identification of exposure routes together with the identification of human and non-human receptors. Based on the Preliminary Risk Assessment, discussions with NYSEG, and a review of information for the site and surrounding areas, twelve Exposure scenarios were developed for the purpose of estimating risks. Five of these (Scenarios 1 through 5) relate to indoor exposures received by on-site workers performing routine work in various buildings on the site. Here, the number of scenarios reflect the different buildings or building areas on-site. These include: the Service Building, the garage in the Service Building, the Corporate Meter Building, the Compressor Building, and the East Office Building.

The five scenarios developed for indoor exposure risks to on-site workers are very similar. All of the above share the same exposure routes; that of volatile soil gases from the surrounding soils moving through the foundations and floors of the buildings into work spaces. Work pools varying from 6 to 50 people in each of the buildings are involved.

4.2 Indoor Air Exposures

A major methodological difficulty encountered in assessing risks involved estimating the potential indoor air concentrations of chemicals associated

with migration of soil gas into the buildings from the surrounding soils. The potential for this transport route was considered greatest for Scenarios 1, 2, and 3 and involved the Service Building, the garage in the Service Building, and the Corporate Meter Building. Therefore, to reduce uncertainty associated with estimating exposure point concentrations, indoor air monitoring was carried out in these buildings as described in the above sections. These data were used together with the soil/soil gas models to estimate or bound indoor air exposure point concentrations for these three scenarios. The models alone were used for Scenarios 4 and 5 which involve the Compressor Building and East Office Building. These two buildings are located in areas that exhibit much lower soil contamination than the Service or Corporate meter Buildings.

The concentrations of the chemicals benzene and naphthalene are presented below to illustrate the levels of some of the more important chemicals estimated for indoor air.

Location	Benzene (mg/m^3)[1]	Naphthalene (mg/m^3)[1]
Service Building	<0.055(a)	0.0016 (c)
Garage in Service Building	<0.055(a)	<0.03 (a)
Corporate Meter Building	<0.060(a)	0.00018(b)
Compressor Building	0.039(c)	0.00044(c)
East Office Building	0.005(c)	0.00044(c)

(a) Based on measured values;
(b) Based on models but using measured data for benzene to scale results;
(c) Based on models alone.
1 Milligrams per cubic meter

Information on typical benzene concentration in air are available from various studies. Singh et al. (1983) measured the concentrations in outdoor air in 10 cities throughout the country. The average for these ten cities was 0.0126 mg/m^3.

The Singh results are all for outdoor air. Results of U.S. Environmental Protection Agency Total Exposure Assessment Methodology (TEAM) study have shown that indoor air is a greater source of these same chemicals and that their presence is related to routine daily activities in the home or office. In the case of benzene, the arithmetic mean concentrations measured by personal monitors (predominantly indoor air) were .031 mg/m^3 and .027 $\mu g/m^3$ for night and day, respectively, while outdoor air had concentrations of 0.0086 $\mu g/m^3$ and 0.0095 $\mu g/m^3$ for night and day. The TEAM study also reported on the maximum concentrations of benzene detected in their study. These were 0.51 $\mu g/m^3$ and 0.27 $\mu g/m^3$ for night and day exposures, respectively.

In comparison to the results of the TEAM study the following observations are made:

1) Measured concentrations for benzene in the Service Building are less than the maximum levels reported for the TEAM indoor air study; concentrations measured in the Service Building during April 1988 were less than 0.055 $\mu g/m^3$. Such levels would be judged to fall into the general range of indoor air concentrations; however, it is noted that the actual concentrations of benzene in the Service Building was not obtained; all data were below the detection limit which - for this study - was slightly above the levels that are typically observed in indoor air. Thus, the data are used to provide a bound on exposure and risk estimates.

2) Estimated exposure concentrations for the other buildings are similar to average concentrations reported for the TEAM study.

3) Given that some of the exposures are similar to typical indoor air conditions found indoors, the estimated risks associated with benzene in these buildings may actually be very close to "ambient" risks for indoor occupational settings.

5.0 PRESENTATION OF RISK

5.1 Risks to On-Site Workers in Various Buildings

Scenarios 1 through 5 estimate health risks associated with routine work within the various buildings at the Geneva site. The source of Exposure to Chemicals of Interest in all these cases is the entrainment of soil gas into the buildings. Exposure estimates were derived by making measurements of the concentrations of chemicals in indoor air and/or by using models.

The incremental lifetime cancer risks for the five indoor air scenarios are presented in Figure 5-1. The figure indicates that estimated risks for Scenarios 1 through 5 (within all buildings) fall within the 1.0E-4 to 1.0E-7 range. Risk estimates are presented in sceintific notation. Thus; a lifetime risk of 1.04E means a lifetime incremental risk of one in ten thousand; a lifetime risk of $1.04E^{-7}$ means a risk of one in ten million. The above levels are generally considered acceptable depending on site-specific conditions (exposed population size and age, level of certainty). It should be noted that the estimated levels of benzene in indoor air are all less than (i.e., within) the OSHA standard for occupational exposure to this chemical. This standard is currently one-part-per-million averaged over an 8-hour workday (Federal Register December 10, 1985, Vol. 50, No. 237, pp. 50512-50586). On a part-per-million basis, the measured indoor air concentration of benzene in the Service Building was less than 0.02 ppm, on average.

Hazard Index Ratios for non-carcinogens entering the buildings from soil gas are illustrated in Figure 5-2. The results indicate that the ratio for Scenario 2 is slightly greater than the "1" benchmark but less than 10. The scenario is associated with work in the Garage in the Service Building. Exposure point concentrations are based on the application of predictive models and scaled based on measurements for naphthalene. However, it must be

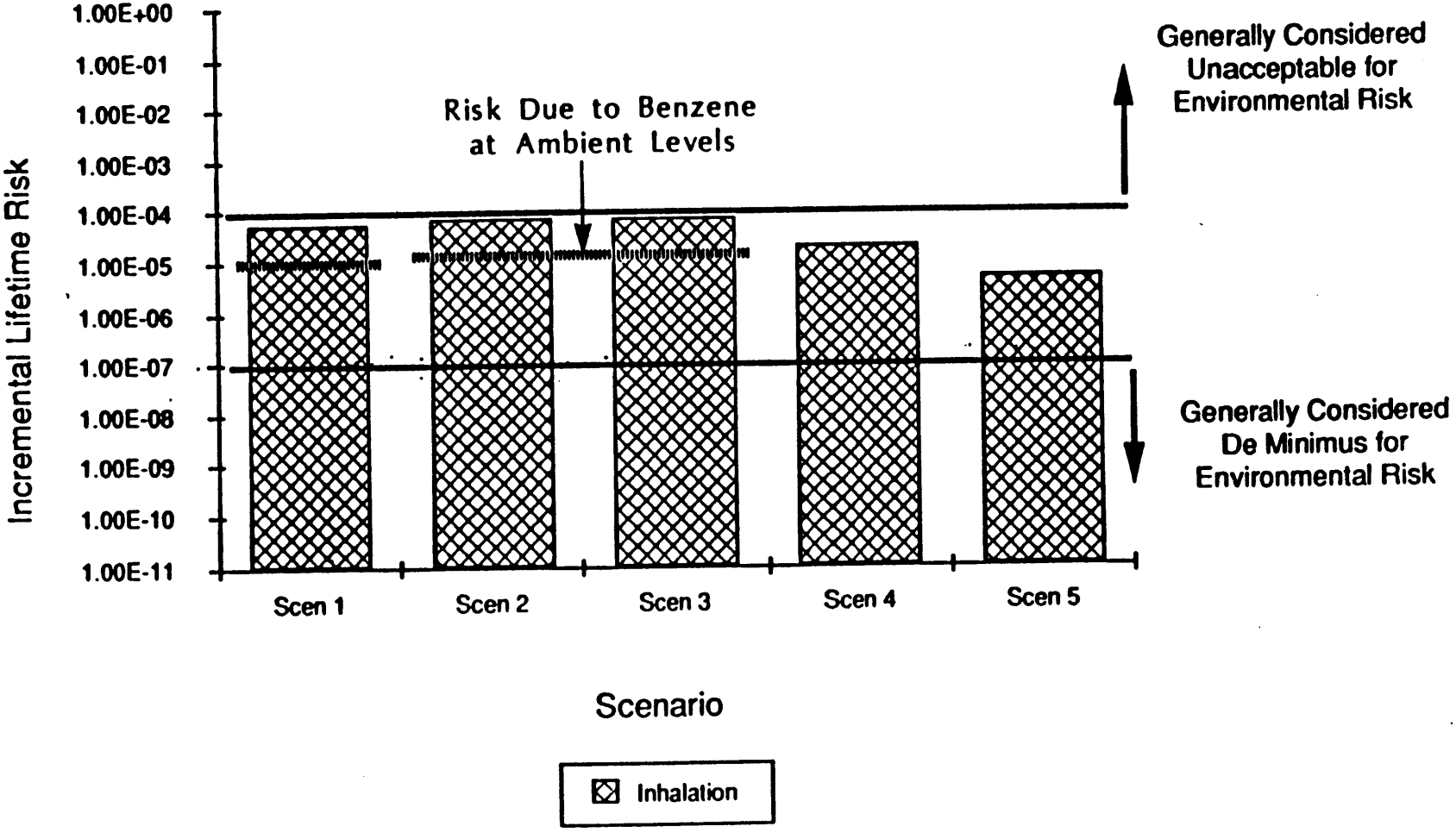

Figure 5-1. Incremental Lifetime Cancer Risks Associated with Indoor Exposures.

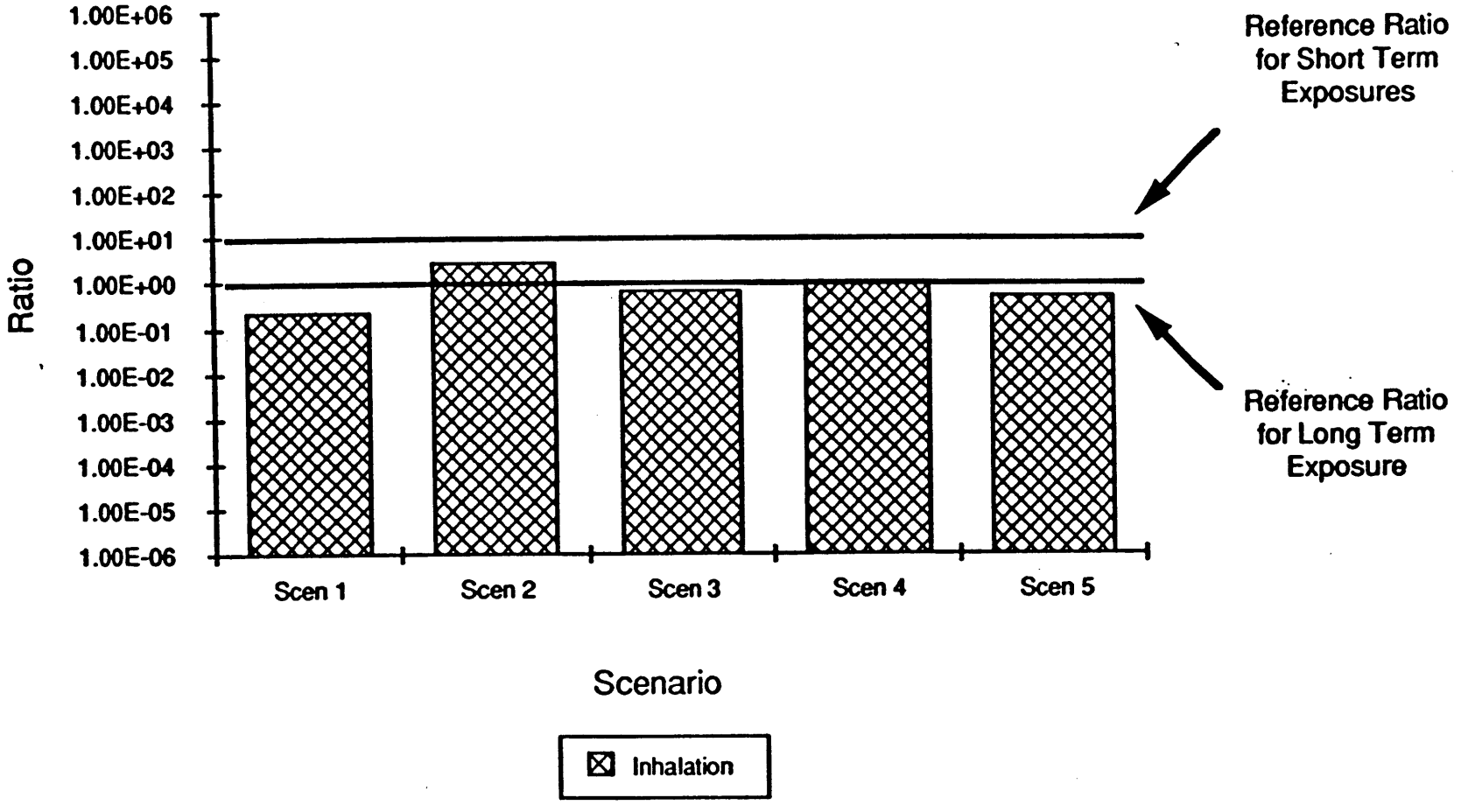

Figure 5-2. Hazard Index Ratios Associated with Indoor Exposures.

noted that the naphthalene concentrations were all below a detection limit of 0.03 $\mu g/m^3$. Therefore, the estimated hazard index ratio should be viewed as an upper bound. Because the resultant ratio value is close to "1", risks are judged to be low. The calculated Hazard Index Ratios for all other indoor scenarios were less than "1". Therefore, risks associated with these scenarios would be judged to be low (i.e., within acceptable levels).

6.0 SUMMARY

Air quality data was gathered from various buildings at the Geneva site in order to evaluate exposure scenarios. The results of the risk calculations conducted with these data are as follows:

- Measured concentrations for benzene in the Service Building are less than the maximum levels reported for the EPA TEAM indoor air study and as such fall into the general range for indoor air.
- Estimated exposure concentrations for benzene within the other buildings are similar to average concentrations reported for the EPA TEAM study.
- The estimated risks associated with benzene in the buildings may actually be very close to "ambient" risks for indoor occupational settings.
- The incremental lifetime cancer risks associated with scenarios 1-5 (within all buildings) fall within the 1.E-4 to 1.0E-7 range. These levels are generally considered acceptable depending on site-specific conditions.
- The hazard index ratios for non-carcinogens for scenarios 1-5 are below or close to "1", the risks are judged to be low (within acceptable levels).

The results of the risk calculations indicate that the risks to employees working in the building are low and fall within accepted levels and guidelines.