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03 JAN 1995

From: Officer in Charge, Navy Environmental and Preventive Medicine Unit No. 2
To: CAPT D. H. Trump, MC, USN, MED-24B, Bureau of Medicine and Surgery, 2300 E St NW, Washington, DC 20372-5300

Subj: REPORT ON PURPLE TEE SHIRT EPISODE AMONG SEABEES IN JUBAIL, SAUDI ARABIA, DURING OPERATION DESERT STORM

Encl: (1) Subject report

1. Late in 1993, as part of the widening effort to evaluate illnesses among veterans of the Persian Gulf War, MG R. R. Blanck, MC, USA asked me to investigate on-site an episode involving members of Naval Mobile Construction Battalion 24. On 19 March 1991 several members of this battalion were exposed to a noxious cloud which, notably, turned parts of their tee shirts a mottled purple color. It was more difficult to obtain permission to enter Saudi Arabia than I had anticipated, however last August an industrial hygienist and myself made the trip. The report has been sent to MG Blanck. A copy is enclosed for your information. It has been reviewed by the American Embassy in Saudi Arabia.

2. We could find no cause for the episode, but feel it most likely was due to a local chemical spill in the motor pool where the event took place. For reasons presented in the report, we do not feel the cloud originated in one of the industrial plants surrounding the battalion. We did not take soil samples, since there would be no way to determine if any contamination which might have been found was actually present in 1991.

3. If there are any questions, please feel free to contact me at 804 444-7671. Fax is 804 444-1191; DSN prefix 564-.

S. W. BERG

PURPLE TEE SHIRTS

ENVIRONMENTAL EVALUATION OF AN INCIDENT AMONG SEABEES AT CAMP 13, JUBAIL, DURING OPERATION DESERT STORM

SUMMARY

1. A two member preventive medicine team visited Saudi Arabia in August 1994 to evaluate possible environmental agents which might have caused military tee shirts to turn a mottled purple color on 19 March 1991. The shirts were worn by some members of Naval Mobile Construction Battalion 24, stationed in Jubail Industrial City. Extensive interviews were conducted with members of the Royal Commission for Jubail and Yanbu and representatives of selected industries surrounding the Seabee camp. The plants were briefly toured, and the city itself visited at length. Jubail monitors for air, water, and atmospheric pollution, and successfully enforces the strictest standards of emission control and pollution prevention. Although three theoretical emission sources were identified - ammonia from a fertilizer plant, hydrogen sulfide from a chemical plant, and unknown chemicals from other plants - it is extremely unlikely any of them could have been responsible for an event as localized, and affecting as few people, as the one of concern. It is more likely the etiology was a small local chemical spill within the motor pool area itself.

BACKGROUND

1. Since November 1992 members of Navy Environmental and Preventive Medicine Unit No. 2 (NEPMU2) have been conducting an epidemiologic survey of illness in members of Naval Mobile Construction Battalion (NMCB) 24, a reserve battalion divided into several detachments in the southeastern U.S. A majority of members have a variety of symptoms which they attribute to service in Saudi Arabia during Operation Desert Shield/Storm (ODS/S). NMCB 24 had its base camp at Camp 13, (Haii 13), in Madinat Al-Jubail Al-Sinaiyah (Jubail Industrial City, hereafter Jubail). A detachment was located at King Abdul-Azziz Naval Base, south of Jubail.

2. In the early afternoon of 19 March 1991 several members of NMCB 24 working in the alpha yard (motor pool) immediately west of Camp 13 proper experienced an unseen cloud of noxious fumes which irritated their eyes, nose, and throat, and turned their military tee shirts a mottled purple color, particularly in areas damp with sweat. The tops of some individuals' boots also turned purple. The cloud apparently quickly dissipated. Eight individuals were evaluated at the medical department, advised to shower and change uniforms, and then returned to work. The symptoms resolved quickly without treatment.

3. Interviews with some of those affected, conducted November 1992, determined that the aroma of the irritant was not easily characterized, although some described it as bleach-like. The Admin Log notes a "chlorine odor" and a "battery acid smell." Those interviewed were clear the odor was not the familiar smell of ammonia from the near-by fertilizer plant. (One individual, not at the motor pool at the time of the incident, recalled in December 1994 that the initial reports identified an ammonia odor. He may have confused these with clearly documented reports of an ammonia odor which began three days later.)

4. The prevailing winds at the time were from the southeast, which would have blown fumes from the fertilizer plant away from Camp 13. However several other chemical plants were located southeast of Camp 13. An analysis by the U.S. Army Natick Research, Development and Engineering Center revealed that, "Color changes ranging from yellow to orange to purple were experienced on exposure [of tee shirt material] to acids and oxidizers. No color change was observed on exposure to ammonia fumes."

5. The incident has never been satisfactorily explained, and Major General R. R. Blanck, MC, Commander Walter Reed Army Medical Center asked that NEPMU2 attempt to investigate the matter on scene. A team consisting of CAPT S. W. Berg, MC, Officer in Charge and a preventive medicine officer and epidemiologist, and LCDR A. M. Qureshi, MSC, an industrial hygiene officer, travelled to Saudi Arabia 3-15 August 1994, to evaluate the site of the incident and the environmental controls in place at the time. Opportunity was taken to explore certain other questions which had arisen regarding possible ODS/S-related illnesses.

METHODS

1. The team interviewed members of the Royal Commission for Jubail and Yanbu, particularly members of the Health Services Department concerned with monitoring health and environmental quality. Several industries, (chemical plants plus one steel mill), were selected because they had been mentioned by members of NMCB 24, or because they were representative of industries surrounding Camp 13 which might release industrial pollutants. Industry representatives were interviewed, and, usually, a short tour of the plant was undertaken. The focus was on identifying possible sources of exposure to various industrial chemicals, or determining that such exposure was unlikely. Statements regarding these matters were taken at face value, since the team had no authority to examine documents. However the Royal Commission did provide a record (enclosure 1) of air pollution monitoring conducted from August 1990 through July 1991, the year of ODS/S.

2. A total of seven days was spent in Jubail. A detailed itinerary and list of individuals and companies interviewed is

provided in enclosure (2).

3. The Royal Commission arranged interviews based on the team's list of companies it wished to interview, and provided an escort to guide the team around Jubail. Team members also spent a considerable amount of their free time driving around Jubail in an attempt to develop a better appreciation of the nature of the city and its industries. Camp 13 proper was inspected by car, and the alpha yard (motor pool) inspected on foot.

4. All individuals interviewed were gracious, hospitable, and spoke with the team as long as it wished. Although the team was not in a position to verify independently anything it was told, it has no reason to believe the individuals interviewed were anything but completely frank and open. This impression is reinforced by the fact that Jubail was built de novo, and from the very beginning was intended to, and does, meet the highest standards of environmental control and pollution prevention. Everyone interviewed pointed this out, took tremendous pride in the fact, and repeatedly asserted their commitment to these standards. The seriousness with which various organizations took our mission was reflected by the fact that among those interviewed were the Director General and Deputy Director General for Community Affairs of the Royal Commission, the Vice President and Program Manager of Saudi Arabian Bechtel, and the President or Vice President of three of the companies visited.

5. Soil samples were not collected because they would have little meaning when collected over three years after ODS/S. Contaminants present at the time could have dissipated, and contaminants present currently could have been deposited after ODS/S.

FINDINGS

Jubail Industrial City

1. Jubail was constructed on a site of essentially uninhabited, unused desert seacoast about five km north of old Jubail, beginning about 15 years ago. It, and Yanbu on the Red Sea, were designed as model industrial cities, intended to exploit more comprehensively Saudi Arabia's natural petroleum resources. The industrial area of Jubail encompasses an area approximately 9 km x 9 km, located about 1-2 km west of the Arabian Gulf. The strip next to the Gulf contains temporary housing and other non-industrial facilities. Permanent housing is located about 2 km north of the industrial area, and encompasses a somewhat larger area.

2. The original elevation, close to sea level, was raised almost 2 m with sand brought in from the desert. An infrastructure of roads, electrical power, potable and industrial cooling water, and industrial and sanitary waste water collection and treatment

facilities was established. Sanitary landfill and hazardous waste disposal facilities were established and maintained in accordance with the highest standards. (In 1996 a hazardous waste incinerator is scheduled to come online, obviating the need for the hazardous waste disposal site.)

3. Industrial companies were solicited to establish plants, primarily chemical plants. However permission to build the plant was contingent upon the company's submitting a detailed plan of its pollution control measures (Environmental Evaluation Report, EER) in order to ensure the company would meet the Royal Commission's strict standards for pollution control and prevention. Several particularly pollution-prone industries, notably paper mills, were turned down because they could not meet the standards.

4. No evidence of disregard for the environmental standards, established by the Meteorological and Environmental Protection Agency (MEEPA) or the Royal Commission, was noted by the team. Both agencies set their standards at least as stringent as those of the U.S. Environmental Protection Agency (EPA), and heavy penalties can be levied on offenders. In recognition of its successful environmental programs, the Royal Commission received the United Nation's Sasakawa Award in 1988. The team was impressed at how clean Jubail is. As shown in enclosure (1), during the year in which ODS/S took place, monitored air pollutants were well within the standard, with two exceptions discussed in the next paragraphs.

5. Jubail is approximately 250 km south of Kuwait. When the Kuwaiti oil wells were burning, smoke from the fires was present in Jubail. Elevated levels of non-methane organic carbon (NMOC) were noted during Desert Storm and the post-combat period, January-April 1991, with an overall downward trend in the levels. The source of the NMOC has not been definitively determined, however its temporal association with the ignition and subsequent extinguishing of the oil well fires suggests it was related to the burning oil wells.

6. NMOC is the non-methane fraction of total hydrocarbon measurement in a sample. It consists of small hydrocarbon carbon chains (<C10 - C12). While not a health hazard itself, NMOC can be a precursor to environmental pollutants which may cause health problems. In the presence of oxides of nitrogen (NOx) and sunlight, it can create oxidants such as ozone (O3), an environmental concern. It is important to note that both the NOx and ozone levels consistently stayed below the permissible limit during the entire year in question, despite excessive levels of NMOC. Because NMOC is not considered a health hazard, the EPA has not established a threshold level for it. New York State has established a level, and it is apparently this NMOC standard which the Royal Commission adopted for its own use.

7. Royal Commission monitoring also identified elevated levels of suspended solids, composed of pure carbon, in early 1991. Levels

of suspended solids ranged from 350-700 micrograms/cubic meter. At the time, acceptable levels were $\leq$ 340. Since then the acceptable level has been reduced to $\leq$ 150. Levels of suspended solids diminished over time, roughly paralleling those of the elevated NMOC, and are similarly presumed to have come from the oil well fire smoke.

8. Interviews with environmental specialists at the Royal Commission and various industries indicated that all were deeply concerned with the health and safety of their employees and enforced the required environmental standards. Many pointed out that in addition to being desirable in its own right, admonitions to maintain an unpolluted environment can found in the Holy Quran. Most companies have well planed and well established environmental and personal monitoring systems, some of the most advanced laboratory equipment, and highly educated staffs. Monitoring records are maintained and routine medical surveillance is conducted where necessary. Contaminants capturing or filtration devices (such as scrubbers, bag houses etc.) are installed at air effluent points. Waste water and hazardous waste is strictly regulated.

Camp 13 and the Alpha Yard

9. Camp 13 encompassed Haii ("district") 13, a walled compound approximately 0.5 km square located in the north central part of the industrial area. The southern entrance to Camp 13 was on Tareeq ("road") 162. The "alpha yard" or motor pool area was located immediately west of Camp 13, across a two lane road. Its dimensions were no greater than a few hundred meters. This area (alpha yard) is open land, which stretches several kilometers to the south and west.

10. (Compass directions are given according to "plant north," which is approximately 45 degrees counterclockwise from true north. Thus Tareeq 162 runs east-west according to plant north, but northeast-southwest according to true north. Similarly the alpha yard is west of Camp 13 according to plant north, but southwest according to true north.)

11. Camp 13 proper (Haii 13) was constructed shortly before ODS/S as a labor housing area consisting of several small buildings and what appear to be house trailers. Prior to that time the land had been vacant. ODS/S intervened before the Camp could be used for its original purpose.

12. The Al-Jubail Fertilizer Company (SAMAD) is located 2 km east and north of Camp 13. The prevailing winds are usually from the north or northeast, and on a number of occasions residents of Camp 13 noted an ammonia smell which probably emanated from the plant. Interviews at the plant indicated ammonia is emitted on occasion, however the levels are well within acceptable limits. (The 19

March irritant, while difficult to describe by those involved, was specifically stated not to smell like ammonia by most of those interviewed.)

13. Other chemical plants are 2-8 km east and south of Camp 13. Petromin Shell, 8 km southeast of Camp 13, has been noted by some of its neighbors to release hydrogen sulfide gas on occasion, although there are no reports of its characteristic odor being detected in the Camp 13 area. Atmospheric monitoring for hydrogen sulfide during 1990-1991 revealed no levels above those acceptable to the EPA. Air monitoring station number 1 is located 2 km west of Camp 13, and would have detected hydrogen sulfide gas emitted from chemical plants southeast of Camp 13, since the wind during this episode was from the southeast.

14. The Saudi Iron and Steel Company (HADEED) steel plant is located 5 km south of Camp 13. Residents of Camp 13 had reported the plant was quiet, and apparently inactive during ODS/S. Interviews with company officials indicated that in fact it continued to operate at its normal capacity throughout ODS/S.

Industries Surrounding Camp 13

15. NATIONAL METHANOL COMPANY (IBN SINA)

The company's primary product is methanol. Production of methyl tertiary butyl ether (MTBE) is a recent addition and will not be discussed in this report. Negligible amounts of emissions are released from this operation. The byproducts are essentially nitrogen and carbon dioxide. Higher alcohols produced during the operation are distilled. Water effluent is monitored by the Royal Commission for a variety of physical and chemical parameters. Copper and nickel used as catalysts in the production of methanol are sold instead of being disposed as hazardous waste. A central team is organized to respond to hazardous material spills. The company has recently received international recognition for its health and safety program.

16. AL-JUBAIL FERTILIZER COMPANY (SAMAD)

The company employs 412 persons to produce urea pellets coated with a polymer, which is sold as fertilizer. Nitrogen is extracted from liquified air, and hydrogen from "water gas," to produce ammonia, which is combined with carbon dioxide to produce urea. No acids are used. The company has a daily production of 1850 metric tons (MT) and has been in business since 1979. It has experienced occasional ammonia releases at levels less than 25 ppm. (Ammonia has a permissible exposure limit of 25 ppm but a smell threshold of only 5 ppm.) All employees receive annual physical examinations at the Al-Fanateer Hospital. No health problems have been noted. The company continued its normal operation and production during ODS/S, however it made a concerted effort to minimize the on-hand

inventory. There is no record of any emergency relating to chemical discharge now or during ODS/S.

17. SAUDI IRON AND STEEL COMPANY (HADEED)

The company employs 3000 persons and has a daily production of 12,000 MT. The plant is configured similarly to the George Town Steel Mill in North Carolina, however, since it uses natural gas instead of fossil fuel its premises are much cleaner. The primary product is steel bars. The product is mostly marketed in the Middle Eastern countries, however, there is some amount of export to the U.S., Taiwan and China. Similar to the SAMAD, the company continued its normal operation and production during ODS/S, however it made a concerted effort to minimize on-hand inventory. The company controls its emissions of metal fumes and dust by means of in-line scrubbers and bag houses.

18. ARABIAN PETROCHEMICAL COMPANY (PETROKEMYA)
NATIONAL PLASTIC COMPANY (IBN HAYYAN) - now a subsidiary

The 1200 workers of this company produce a variety of chemical products (ethylene, butene, olefins and ethylene glycol) from petroleum base. Ethylene is used to produce various density polyethylene, polyvinyl chloride (PVC) and polystyrene. In 1993 the company added production of benzene. The company has no reports of chemical releases in its history. The company continued its operation during ODS/S, however it reduced its inventory. PETROKEMYA has an elaborate personal and environmental monitoring system. The company has continuously received safety "Awards of Honor" since 1989.

18a. Workers receive physical examinations every 12-18 months, depending on age. Specific medical examinations are conducted depending on the type of stressor, e.g. the vinyl chloride monomer (VCM) workers receive x-rays of fingers, liver function tests and physical examinations on an annual bases. There have been no abnormal results to date. Employees are encouraged to report the slightest safety and health hazard and are given a generous amount of sick leave.

18b. The company has a small VCM incinerator which is furnished with a scrubber. Alarms are installed to sound if the incinerator system trips and the effluent is then automatically routed to a waste tank. Emissions are routinely monitored by environmental and personal monitoring. Exposure to VCM is controlled to below 1.0 ppm. The company follows the most stringent of the standards among EPA, OSHA, ACGIH and the Royal Commission. Personal monitoring is conducted for exposure to ethylene dichloride, betadiene, benzene and VCM. Representative samples are collected daily. The company occasionally has to flare hydrocarbons (simple chains, e.g. methane and ethane) to the atmosphere, combustion products of which are carbon dioxide and water. Solid polymer waste is containerized and

sent to the Royal Commission's waste handling facility.

19. THE ROYAL COMMISSION OF JUBAIL AND YANBU

The Royal Commission takes great pride in having established and managing a well planed, comprehensive monitoring system for atmospheric, ground water, sea water, and waste water pollutants. Data from monitoring stations are routinely collected and relayed to the Royal Commission. A well qualified staff, equipped with the most sophisticated, state-of-the-art equipment monitors, compiles and analyzes the data on a routine basis. The air and water monitoring systems are further addressed below.

19a. Water Monitoring. Ten sea (gulf) water monitoring stations and several industry effluent monitoring stations are strategically located throughout the city. Water is monitored by the Royal Commission for total organic content (TOC), temperature, pH and total dissolved solids, as well as industry-specific pollutants at the industry effluent monitoring stations. Standards are established by the Royal Commission and are comparable to those of the U.S. EPA. The Royal Commission has established a full-service Industrial Waste Treatment Plant (IWTP) and a Sewage Waste Treatment Plant (SWTP). Sanitary waste water is treated to a near potable quality but is reused only for irrigation purposes. It is also tested for heavy metals on a quarterly basis. The Royal Commission has a history of rejecting the types of plants that may cause excessive water pollution, e.g. paper mills.

19b. Atmospheric Monitoring. Seven air monitoring stations are strategically located throughout the city, each carefully chosen to best represent the status of air pollution in the area. Enclosure (3) is a schematic identifying their locations. These sampling stations are fenced in and have a trailer and a sampling tower. The sampling towers have sensors located at 10, 50 and 90 meters height. All stations are designed to continuously monitor the atmosphere for 10 contaminants: sulphur dioxide, hydrogen sulfide, 3 oxides of nitrogen, ozone, non-methane organic carbon (NMOC), carbon monoxide, inhalable suspended particulates (ISP PM10), and (after ODS/S) lead. Acceptable environmental standards are established by the Royal Commission and are comparable to those of the U.S. EPA. An eighth station is located at King Abdul-Azziz Naval base 20 km south of the city; the ninth unit is a portable one.

19c. Atmospheric Monitoring Station No.1. This is a typical sampling station. It is described because it is located nearest to the site of Camp 13 (approximately 2 km west), and was visited by the team. The station is designed to monitor continuously the 10 atmospheric contaminants noted above. The entire process is electronically automated. Data gathered by the station are entered into a computer and transmitted, via a radio-link, to a central monitoring station at the Royal Commission building every 5

minutes. The data are compiled on an hourly, daily, monthly and yearly basis and compared to the Royal Commission's standards. Enclosure (1) is a compilation of such data for the period August 1990 to July 1991. (Note that the acceptable quality criteria on page 1 of enclosure (1) are stated in parts per million (ppm) while the data on the following pages are reported in ppb (billion) - 1/1000th of the unit on page 1.) No excursion from the standards was noted on the day of the purple tee shirt incident, or throughout 1990-1991.

King Abdul-Azziz Naval Base

20. A small detachment of NMCB 24 was stationed at this base, about 20 km south of Jubail, in support of air operations. Although these individuals were not involved in the purple tee shirt incident, the base was visited in an attempt to understand the overall environment in which the battalion was stationed. Both the base commander and the chief of operations and maintenance were interviewed, and the site itself visited.

21. The detachment was sited within 100-300 m of the far end of the airstrip, away from hangers and maintenance facilities, and next to a soccer stadium. All waste materials are removed from the base, except for dead trees which are retained for mulch. Toxic wastes are removed to the hazardous waste storage facility in Jubail. A construction dump is approximately 300 m north of the stadium, however this contains only clean materials used for various construction projects. A refuse dump apparently had been established during ODS/S a few hundred meters east of the stadium (on the other side from the airstrip) and noted at the end of ODS/S to contain 55 gallon drums and used batteries. This had been removed at the time the team visited. One of the Royal Commission's nine atmospheric monitoring stations is located on the base.

CONCLUSIONS

1. Jubail Industrial City has continually enforced standards of pollution and emission control equal to or exceeding the strictest standards found in the U.S. It has done so since its inception, throughout ODS/S, and to the present.

2. Air monitoring during the year of ODS/S revealed seven of nine monitored pollutants were continuously within U.S. EPA standards. NMOC and inhalable suspended particulates (composed of pure carbon) were transiently elevated from January-April 1991, presumably from the Kuwaiti oil well fires. There appear to be no health risks associated with these elevated levels.

3. There is no evidence that the land under Camp 13 and the adjacent alpha yard was or is contaminated. Specifically, the land was never used as a "toxic waste dump," despite rumors to the contrary.

4. Three potential emission sources - ammonia from Al-Jubail Fertilizer Company, hydrogen sulfide from Petromin Shell, unknown chemicals from other plants east and south of Camp 13 - theoretically might have been responsible for the purple tee shirts. However given the distances from the sources to the alpha yard (motor pool), any such emissions would have been expected to spread out and affect a great many individuals over a large area rather than targeting only a few of many individuals in the alpha yard and sparing individuals within the walls of immediately adjacent Camp 13.

5. Similarly, any such emissions would have been expected to produce the reported symptoms, i.e. irritated eyes, nose, and throat, in numerous individuals rather than an only a few in the alpha yard (motor pool).

6. Emissions of hydrogen sulfide, sulfuric acid, or nitric acid would have been detected by the monitoring system as hydrogen sulfide, or oxides of sulfur or nitrogen.

7. The investigation did not reveal an etiological agent for the purple tee shirts and associated symptoms. Given the limited area and number of people involved the event may have been due to a small local spill of an unknown chemical within the alpha yard (motor pool) itself.

Enclosures:

1. Air Quality Data from August 1990 to July 1991
2. Itinerary and Persons Interviewed
3. Map: Jubail Atmospheric Monitoring Network (JAMN)
4. Primary Industries at Jubail
5. Primary and Downstream Industries Relationship
6. Report on Dead Animals
7. Illnesses in Saudi Military Personnel and Dependents

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December 1994

Kingdom of Saudi Arabia

Royal Commission for Jubail and Yanbu

Directorate General for Jubail Project

Madinat Al-Jubail Al-Sinaiyah

AIR QUALITY DATA FROM AUGUST 1990 TO AUGUST 1991

Enclosure (1)

THE ROYAL COMMISSION AMBIENT AIR QUALITY CRITERIA

Pollutant	Average Period	Concentration Limit (ppm)	No. of Allowable Excesses
SO_2	1 hour	0.49	2/month/site
	3 hours	0.30	none
	24 hours	0.15	1/year/site
	365 days	0.32	none
H_2S	1 hour	0.30	2/month/site
	24 hours	0.15	none
NO_2	1 hour	0.35	2/month/site
	24 hours	0.21	none
	365 days	0.05	none
O_3	1 hour	0.12	none
NMOC	0600-0900	0.25	none
CO	1 hour	35.0	2/month/site
	8 hours	9.0	2/month/site
ISP PM_{10}	24 hours	150 ug/m^3	none
	365 days	50 ug/m^3	none
Pb	3 months	1.5 ug/m^3	none

U.S. EPA AMBIENT AIR QUALITY STANDARDS

Pollutant	Average Period	Concentration Limit (ppm)
SO_2	1 hour	N.A.
	3 hours	N.A.
	24 hours	0.14
	365 days	0.03
H_2S	1 hour	N.A. (0.03-Calif.)
	24 hours	N.A.
NO_2	1 hour	N.A.
	24 hours	N.A.
	365 days	0.053
O_3	1 hour	0.12
NMOC	0600-0900	N.A. (0.24-N.Y.)
CO	1 hour	35.0
	8 hours	9.0
ISP PM_{10}	24 hours	150 (ug/m^3)
	365 days	50 (ug/m^3)
Pb	3 months	1.5 (ug/m^3)

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - AUG 90

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	0.1	0.5	21
2	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--
3	0.	0.	0	0.	0.	23	1.	3.	15	7.	18.	15	8.	23.	15	24.	34.	19	0.00	0.01	21	0.2	0.3	11
4	0.	1.	22	0.	0.	0	1.	2.	17	2.	10.	19	3.	12.	19	24.	36.	20	0.00	0.00	0	0.1	0.3	19
5	0.	0.	0	0.	1.	24	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--
6	---	---	--	2.	9.	21	3.	25.	15	5.	31.	20	8.	32.	20	26.	35.	12	0.13	0.39	12	0.4	0.6	20
7	0.	0.	19	1.	4.	1	1.	4.	19	3.	20.	19	4.	24.	19	28.	38.	17	0.07	0.16	1	0.2	0.4	19
8	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--
9	1.	1.	18	2.	12.	24	1.	5.	24	5.	28.	21	5.	29.	21	34.	50.	10	0.17	0.23	21	0.2	0.7	21
10	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	0.15	0.23	1	---	---	--
11	1.	1.	10	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	0.14	0.20	3	---	---	--
12	0.	0.	19	1.	3.	22	1.	4.	9	2.	11.	19	3.	12.	19	37.	43.	18	0.08	0.15	11	0.3	0.4	19
13	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--
14	0.	0.	0	0.	2.	10	1.	2.	16	3.	10.	24	3.	10.	24	33.	45.	11	---	---	--	0.2	0.4	24
15	---	---	--	---	---	--	---	---	--	---	---	--	---	---	--	20.	27.	16	---	---	--	0.2	0.3	1
16	0.	1.	3	0.	0.	3	1.	3.	22	3.	12.	19	4.	14.	19	13.	20.	15	0.10	0.24	8	0.3	0.4	19
17	0.	1.	23	0.	1.	23	1.	2.	16	2.	22.	22	3.	23.	22	20.	29.	11	0.08	0.18	22	0.2	0.5	20
18	0.	1.	2	1.	5.	24	1.	2.	7	4.	18.	20	4.	18.	20	25.	39.	18	0.10	0.21	20	0.3	0.5	20
19	0.	0.	23	2.	9.	23	1.	5.	21	7.	43.	21	8.	49.	21	27.	44.	17	0.14	0.41	21	0.2	0.9	21
20	0.	1.	2	1.	2.	3	1.	4.	19	1.	7.	19	2.	11.	19	33.	45.	11	0.08	0.24	9	0.2	0.3	22
21	0.	1.	2	0.	3.	5	1.	3.	19	1.	9.	20	2.	11.	20	34.	48.	17	0.03	0.10	21	0.2	0.3	1
22	0.	0.	0	0.	0.	0	1.	5.	9	4.	16.	24	5.	17.	24	34.	50.	13	0.05	0.15	21	0.2	0.4	20
23	0.	0.	2	1.	22.	24	1.	4.	19	3.	9.	1	4.	12.	19	28.	40.	11	0.04	0.15	24	0.2	0.4	21
24	0.	0.	22	1.	13.	23	1.	1.	10	3.	13.	22	3.	14.	22	25.	40.	12	0.05	0.18	22	0.2	0.4	20
25	0.	1.	2	2.	16.	23	2.	6.	11	6.	27.	23	8.	31.	23	28.	48.	17	0.04	0.12	9	0.3	0.6	20
26	0.	0.	24	1.	3.	3	2.	6.	19	9.	31.	23	11.	38.	23	29.	44.	10	0.06	0.55	16	0.4	0.5	19
27	0.	1.	2	1.	3.	3	3.	14.	8	10.	27.	23	12.	36.	8	25.	46.	13	0.03	0.18	1	0.2	0.4	1
28	0.	0.	0	1.	7.	21	1.	5.	12	8.	24.	20	9.	24.	20	28.	45.	16	0.08	0.19	13	0.2	0.5	7
29	0.	1.	22	0.	2.	23	3.	9.	16	7.	27.	23	10.	30.	23	27.	41.	11	0.15	0.42	14	0.2	0.5	20
30	0.	1.	5	2.	7.	19	1.	6.	10	5.	24.	17	6.	29.	17	28.	40.	10	0.02	0.10	1	0.2	0.4	19
31	0.	1.	2	3.	7.	3	1.	4.	7	4.	13.	15	5.	16.	15	28.	61.	15	0.01	0.10	1	0.4	0.5	19
#	24	24		24	24		23	23		23	23		23	23		24	24		24	24		25	25	
Avg	0.	1.		1.	5.		1.	5.		5.	20.		6.	22.		28.	41.		0.08	0.20		0.2	0.5	
Max	1.	1.		3.	22.		3.	25.		10.	43.		12.	49.		37.	61.		0.17	0.55		0.4	0.9	
Min	0.	0.		0.	0.		1.	1.		1.	7.		2.	10.		13.	20.		0.00	0.00		0.1	0.3	

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - SEP 90

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	0.	1.	2	1.	15.	3	3.	25.	7	13.	23.	15	18.	41.	7	18.	45.	13	.02	.11	17	.4	.8	7
2	0.	0.	2	2.	17.	3	1.	5.	19	9.	19.	19	4.	21.	19	24.	37.	18	---	---	--	.2	.5	19
3	0.	2.	2	2.	17.	3	1.	7.	10	9.	31.	19	5.	31.	19	31.	45.	15	.00	.10	18	.3	.4	7
4	0.	1.	3	2.	19.	3	1.	0.	19	13.	30.	22	9.	37.	22	25.	41.	12	.12	.34	20	.2	.5	20
5	0.	1.	24	1.	16.	3	1.	6.	19	14.	34.	23	10.	33.	23	21.	36.	15	.03	.12	2	.2	.5	19
6	1.	1.	3	1.	16.	3	1.	3.	7	10.	26.	1	5.	22.	1	34.	52.	15	.05	.19	19	.2	.4	19
7	0.	0.	3	2.	4.	21	0.	2.	19	0.	24.	23	3.	20.	23	29.	30.	1	.17	.41	4	.2	.4	19
8	0.	0.	0	3.	19.	3	3.	20.	23	10.	40.	23	0.	59.	23	27.	39.	14	.19	.37	11	.1	.5	7
9	0.	1.	20	2.	16.	3	2.	11.	15	13.	30.	20	10.	30.	20	25.	30.	14	.09	.20	14	.2	.7	20
10	0.	2.	11	1.	4.	5	4.	13.	15	14.	37.	21	13.	39.	21	20.	34.	11	---	---	--	.2	.7	20
11	0.	0.	0	1.	3.	7	2.	0.	8	14.	29.	2	11.	30.	19	21.	34.	11	.12	.10	7	.3	.6	19
12	0.	3.	15	0.	2.	15	2.	12.	15	11.	26.	19	7.	23.	19	25.	30.	15	.13	.30	22	.3	.5	19
13	0.	1.	12	1.	20.	23	4.	12.	22	18.	40.	22	17.	50.	22	---	---	--	.39	.75	23	.2	.5	7
14	0.	1.	2	1.	12.	24	2.	10.	11	9.	23.	24	6.	19.	20	24.	33.	11	.60	1.11	24	.2	.4	20
15	0.	0.	2	0.	1.	1	4.	14.	15	10.	23.	1	0.	18.	1	20.	30.	16	.48	1.07	1	.2	.4	19
16	0.	1.	2	0.	0.	5	1.	9.	10	9.	19.	20	5.	15.	20	31.	43.	16	.00	.03	7	.3	.5	20
17	0.	1.	2	0.	0.	0	1.	4.	9	7.	20.	19	3.	10.	19	33.	45.	15	.01	.07	7	.2	.5	19
18	0.	2.	2	0.	2.	3	2.	0.	9	9.	31.	20	5.	32.	20	31.	40.	16	.00	.01	23	.3	.6	20
19	0.	1.	2	0.	1.	3	1.	5.	17	9.	21.	20	4.	19.	17	29.	39.	18	.00	.00	7	.2	.3	19
20	0.	2.	2	0.	2.	3	3.	20.	7	12.	20.	7	10.	45.	7	33.	52.	12	.00	.00	0	.2	.5	7
21	0.	1.	2	0.	2.	23	1.	3.	21	9.	18.	22	4.	16.	21	31.	46.	16	.00	.00	0	.3	.5	21
22	0.	2.	2	2.	3.	0	1.	3.	18	9.	14.	7	4.	11.	18	30.	43.	16	.01	.04	11	.3	.4	2
23	0.	2.	2	0.	0.	3	2.	0.	10	11.	33.	19	7.	33.	19	27.	30.	11	.12	.23	10	.3	.7	19
24	0.	0.	0	0.	1.	18	2.	13.	10	15.	43.	23	11.	30.	23	27.	39.	14	.04	.14	7	.2	.4	18
25	0.	1.	2	1.	5.	23	1.	5.	15	17.	47.	20	12.	44.	20	30.	62.	18	.03	.09	12	.3	.7	22
26	0.	1.	2	1.	3.	4	3.	11.	10	18.	29.	18	15.	35.	18	30.	57.	13	.03	.13	7	.3	.7	21
27	0.	1.	2	0.	2.	7	2.	15.	6	13.	25.	17	9.	31.	6	20.	30.	15	.02	.08	12	.3	.5	17
28	0.	1.	7	1.	3.	21	1.	2.	18	9.	10.	23	4.	11.	23	23.	30.	17	.02	.10	24	.2	.4	19
29	0.	1.	2	2.	6.	22	3.	16.	20	13.	42.	20	10.	53.	20	21.	34.	13	.02	.12	7	.3	1.1	20
30	0.	1.	5	0.	1.	1	3.	19.	20	15.	45.	20	12.	59.	20	16.	30.	16	.01	.10	7	.3	1.2	20
N	30	30		30	30		30	30		30	30		30	30		29	29		20	20		30	30	
Avg	0.	1.		1.	7.		2.	10.		12.	29.		8.	31.		26.	41.		.10	.23		.2	.6	
Max	1.	3.		3.	20.		4.	25.		18.	47.		17.	59.		34.	62.		.60	1.11		.4	1.2	
Min	0.	0.		0.	0.		0.	2.		7.	14.		3.	11.		16.	30.		.00	.00		.1	.3	

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - OCT 90

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	0.	1.	2	1.	7.	22	2.	11.	19	12.	30.	19	0.	43.	19	21.	29.	10	---	---	--	.1	.6	19
2	0.	1.	2	0.	2.	20	3.	21.	9	10.	20.	19	7.	26.	9	29.	41.	17	.00	.12	24	.2	.4	21
3	0.	1.	2	1.	1.	1	2.	6.	7	12.	25.	7	7.	25.	7	31.	30.	11	.05	.10	7	.3	.5	19
4	0.	2.	2	0.	1.	9	1.	5.	0	12.	35.	14	7.	31.	14	30.	79.	14	---	---	--	.3	.5	6
5	0.	1.	2	0.	0.	22	1.	2.	19	9.	10.	22	3.	13.	19	36.	60.	16	.02	.00	24	.4	.6	24
6	0.	1.	2	0.	2.	16	2.	15.	10	0.	24.	19	5.	21.	19	33.	41.	16	.00	.04	7	.3	.4	6
7	0.	0.	2	1.	2.	12	2.	26.	15	12.	36.	20	0.	32.	19	28.	42.	10	.03	.13	22	.2	1.0	20
8	0.	0.	24	2.	10.	22	3.	13.	10	10.	20.	19	6.	17.	19	26.	39.	17	.02	.11	7	.4	.6	19
9	0.	1.	2	0.	2.	22	5.	44.	19	10.	54.	19	17.	95.	19	19.	32.	12	.04	.13	7	.3	1.1	19
10	0.	0.	2	1.	10.	22	3.	22.	14	14.	41.	19	12.	41.	19	22.	30.	17	.10	.30	10	.3	1.0	19
11	0.	1.	23	1.	0.	24	3.	11.	23	11.	25.	23	9.	33.	23	25.	42.	16	.06	.16	23	.4	1.1	23
12	1.	2.	8	1.	3.	8	1.	4.	8	0.	23.	2	5.	19.	2	26.	42.	16	.06	.12	9	.4	.6	2
13	0.	0.	10	1.	2.	21	1.	5.	0	11.	21.	15	7.	19.	15	34.	67.	15	.04	.09	9	.4	.6	21
14	0.	0.	2	0.	2.	3	1.	6.	0	10.	32.	17	0.	32.	17	31.	54.	16	.02	.08	20	.3	.7	1
15	0.	1.	22	0.	2.	21	2.	10.	0	9.	15.	14	6.	19.	0	27.	65.	16	.04	.11	23	.3	.4	7
16	0.	1.	2	2.	0.	23	5.	21.	22	13.	31.	22	14.	51.	22	19.	40.	15	.04	.17	21	.4	.9	21
17	0.	1.	22	1.	3.	22	1.	5.	19	7.	16.	23	4.	13.	23	23.	34.	12	.02	.13	22	.3	.4	19
18	0.	1.	2	1.	2.	6	3.	14.	10	10.	24.	24	10.	24.	10	27.	43.	16	.06	.19	12	.3	.5	20
19	0.	1.	22	0.	2.	22	2.	4.	15	10.	10.	12	0.	10.	12	21.	40.	13	.06	.12	8	.3	.4	22
20	0.	1.	2	1.	3.	8	3.	12.	7	12.	20.	15	11.	34.	15	19.	53.	14	.09	.23	15	.3	.5	6
21	0.	0.	0	1.	3.	3	3.	21.	11	0.	20.	11	0.	40.	11	22.	42.	15	.07	.15	24	.2	.4	7
22	0.	1.	24	1.	4.	6	2.	6.	14	9.	22.	14	7.	26.	14	22.	40.	15	.05	.10	24	.2	.3	7
23	0.	2.	2	1.	4.	3	2.	7.	0	0.	15.	14	5.	15.	14	23.	42.	14	.05	.12	22	.3	.4	22
24	0.	0.	3	1.	2.	21	1.	4.	17	9.	23.	10	6.	26.	10	30.	50.	24	.00	.16	20	.3	.5	18
25	0.	1.	10	1.	4.	3	2.	12.	0	13.	25.	24	12.	26.	24	24.	54.	10	.13	.25	19	.4	.8	19
26	0.	1.	10	1.	6.	20	1.	5.	22	12.	35.	20	10.	36.	20	---	---	--	.11	.32	17	.2	.5	18
27	1.	1.	2	1.	2.	3	5.	30.	16	13.	32.	16	15.	63.	16	25.	50.	10	.07	.16	10	.2	.5	10
28	0.	1.	2	0.	3.	3	2.	13.	12	12.	34.	20	10.	30.	20	19.	35.	16	.05	.10	19	.3	.5	3
29	0.	1.	2	0.	1.	8	2.	12.	9	6.	16.	1	4.	17.	9	25.	30.	17	.17	.57	23	.3	.4	1
30	0.	1.	15	0.	0.	0	3.	12.	9	4.	9.	10	3.	11.	9	32.	37.	15	.11	.40	10	.3	.3	1
31	0.	0.	3	0.	0.	0	1.	4.	10	6.	17.	19	3.	19.	19	31.	42.	16	.07	.11	7	.2	.4	19
N	31	31		31	31		31	31		31	31		31	31		30	30		29	29		31	31	
Avg	0.	1.		1.	3.		2.	12.		10.	25.		0.	30.		26.	45.		.06	.17		.3	.6	
Max	1.	2.		2.	10.		5.	44.		18.	54.		17.	95.		30.	79.		.17	.57		.4	1.1	
Min	0.	0.		0.	0.		1.	2.		4.	9.		3.	11.		19.	29.		.00	.04		.1	.3	

Environmental Su. ey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - NOV 90

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	0.	0.	19	1.	6.	21	4.	15.	19	7.	32.	19	10.	47.	19	16.	26.	10	.09	.20	19	.3	1.0	19
2	0.	0.	0	2.	4.	24	2.	11.	22	7.	38.	21	9.	40.	21	20.	45.	16	.00	.15	22	.3	.7	21
3	0.	1.	23	0.	2.	1	2.	10.	9	12.	30.	24	14.	39.	24	26.	48.	17	.06	.11	14	.3	.6	23
4	0.	2.	2	0.	2.	22	4.	30.	11	10.	25.	22	14.	40.	11	24.	45.	14	.03	.10	7	.4	.6	1
5	0.	1.	22	0.	2.	23	4.	27.	22	9.	30.	22	14.	64.	22	22.	44.	13	.07	.30	22	.3	1.1	22
6	0.	1.	21	1.	3.	21	0.	74.	21	11.	42.	21	10.	116.	21	23.	42.	11	.17	.50	21	.4	2.0	21
7	0.	0.	0	0.	1.	14	3.	10.	0	11.	33.	24	13.	41.	24	23.	40.	16	.12	.10	20	.3	.5	19
8	0.	1.	21	1.	3.	21	2.	15.	1	11.	39.	21	13.	49.	1	22.	45.	17	.13	.19	21	.3	.6	21
9	1.	2.	2	1.	2.	3	0.	2.	0	6.	23.	2	7.	23.	2	36.	76.	15	.13	.21	16	.3	.5	5
10	1.	2.	2	2.	4.	20	2.	11.	0	10.	27.	20	12.	32.	7	25.	43.	3	.10	.21	10	.3	.5	7
11	0.	1.	24	1.	2.	1	2.	12.	23	9.	37.	23	10.	49.	23	20.	34.	15	.09	.21	23	.2	.8	23
12	1.	5.	13	1.	2.	19	3.	15.	24	9.	33.	24	12.	40.	24	21.	34.	17	.08	.14	23	.2	.6	24
13	0.	0.	0	1.	2.	0	7.	77.	0	6.	29.	0	12.	106.	0	23.	37.	16	.06	.13	24	.3	.0	0
14	0.	1.	11	0.	1.	17	1.	8.	15	1.	6.	10	2.	10.	15	33.	41.	14	.17	.04	15	.2	.3	12
15	0.	1.	2	4.	40.	0	2.	9.	9	2.	11.	19	3.	15.	19	35.	46.	13	.11	.27	0	.3	.4	19
16	0.	1.	11	0.	1.	15	1.	3.	16	0.	3.	7	1.	4.	7	38.	50.	14	.09	.15	14	.3	.3	1
17	0.	1.	15	1.	4.	23	2.	13.	17	2.	12.	10	3.	23.	17	35.	45.	16	.13	.21	15	.3	.4	7
18	1.	3.	9	1.	3.	7	3.	17.	17	5.	25.	10	0.	34.	10	32.	48.	14	.11	.20	19	.2	.4	10
19	0.	6.	10	1.	3.	20	4.	10.	9	9.	37.	19	13.	54.	19	25.	60.	12	.16	.24	13	.2	.5	19
20	1.	2.	12	1.	1.	1	2.	9.	19	6.	25.	19	0.	33.	19	25.	39.	15	.13	.10	7	.2	.5	19
21	0.	1.	2	2.	5.	9	2.	5.	0	11.	36.	22	13.	40.	22	27.	55.	15	.13	.21	22	.3	.6	22
22	0.	1.	4	1.	6.	22	4.	19.	9	14.	43.	22	10.	43.	22	33.	69.	16	.10	.20	4	.3	.8	22
23	0.	0.	23	1.	9.	4	2.	14.	23	0.	37.	23	10.	51.	23	32.	59.	16	.00	.30	23	.4	1.1	23
24	0.	0.	0	0.	2.	20	2.	13.	15	0.	20.	21	11.	31.	20	31.	49.	15	.00	.10	24	.3	.6	20
25	0.	0.	0	0.	2.	5	2.	0.	9	9.	21.	2	12.	20.	2	27.	46.	13	.11	.16	19	.3	.4	1
26	0.	0.	0	2.	0.	22	3.	13.	0	14.	35.	19	17.	46.	0	20.	51.	16	.13	.10	7	.4	.5	3
27	0.	0.	17	1.	4.	1	2.	7.	9	7.	29.	17	9.	35.	17	25.	40.	20	.00	.13	17	.3	.6	2
28	0.	1.	3	0.	2.	1	2.	6.	11	2.	10.	0	4.	16.	0	30.	40.	10	.05	.11	14	.2	.4	24
29	0.	0.	19	0.	1.	21	2.	7.	19	3.	11.	19	4.	10.	19	31.	39.	13	.07	.12	15	.2	.3	1
30	0.	0.	2	0.	2.	22	1.	9.	10	2.	11.	20	4.	12.	10	36.	45.	12	.15	.30	10	.1	.3	7
N	30	30		30	30		30	30		30	30		30	30		30	30		30	30		30	30	
Avg	0.	1.		1.	4.		3.	16.		7.	27.		10.	40.		27.	46.		.10	.23		.3	.6	
Max	1.	6.		4.	40.		0.	77.		14.	43.		10.	116.		30.	76.		.17	.04		.4	2.0	
Min	0.	0.		0.	1.		0.	2.		0.	3.		1.	4.		16.	26.		.03	.10		.1	.3	

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - DEC 90

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	0.	0.	11	1.	2.	12	2.	11.	9	5.	19.	10	7.	23.	10	36.	52.	15	.11	.15	13	.2	.4	7
2	0.	3.	10	1.	2.	4	2.	11.	0	7.	32.	19	9.	42.	19	31.	43.	13	.14	.22	22	.3	.6	20
3	0.	1.	10	1.	1.	3	2.	10.	14	9.	20.	19	11.	37.	19	29.	50.	15	.13	.23	7	.3	.6	19
4	0.	1.	17	1.	3.	23	4.	26.	0	20.	60.	23	24.	71.	23	25.	54.	15	.17	.30	23	.4	1.0	23
5	0.	1.	13	2.	4.	0	2.	21.	0	10.	22.	0	13.	43.	0	31.	51.	21	.16	.22	16	.3	.5	24
6	0.	0.	23	1.	6.	3	7.	31.	9	21.	47.	24	28.	69.	24	21.	43.	14	.19	.70	9	.4	1.0	24
7	0.	0.	2	0.	4.	0	2.	9.	0	12.	34.	21	15.	38.	22	22.	43.	14	.16	.24	0	.3	.6	1
8	0.	1.	14	1.	11.	1	2.	7.	9	9.	20.	1	11.	24.	19	28.	55.	16	.16	.22	17	.3	.5	19
9	1.	2.	13	1.	3.	23	2.	9.	15	9.	27.	23	11.	28.	23	32.	47.	16	.17	.23	14	.3	.4	7
10	1.	3.	17	1.	2.	23	4.	20.	19	21.	60.	19	25.	80.	19	21.	41.	16	---	---	--	.3	.7	19
11	1.	3.	13	2.	3.	13	3.	15.	15	6.	17.	4	9.	20.	4	30.	46.	12	.14	.17	16	.3	.4	7
12	0.	0.	7	2.	2.	10	2.	0.	19	6.	20.	19	0.	20.	19	31.	44.	13	.15	.22	7	.3	.5	7
13	0.	0.	2	1.	2.	5	5.	51.	21	13.	49.	21	19.	100.	21	27.	46.	12	.10	.25	21	.3	.7	19
14	0.	1.	16	1.	5.	1	4.	14.	2	17.	47.	20	20.	59.	20	21.	43.	16	.10	.32	19	.3	.5	2
15	0.	6.	11	2.	3.	4	3.	14.	15	4.	12.	1	7.	21.	15	26.	44.	14	.14	.19	12	.2	.3	7
16	0.	1.	22	1.	3.	3	2.	12.	10	5.	21.	10	6.	23.	10	34.	44.	16	.15	.20	11	.3	.4	10
17	0.	1.	2	0.	3.	21	3.	0.	9	11.	34.	19	14.	42.	19	21.	30.	10	.16	.22	21	.3	.6	19
18	0.	0.	0	0.	2.	3	3.	19.	7	11.	31.	19	14.	43.	7	32.	59.	14	.10	.23	12	.3	.5	1
19	0.	0.	2	0.	0.	1	2.	6.	10	3.	11.	19	5.	14.	19	---	---	--	.19	.23	14	.2	.2	1
20	0.	0.	11	0.	3.	22	5.	20.	20	17.	55.	24	22.	72.	20	22.	61.	12	.22	.35	20	.4	.7	24
21	0.	1.	11	1.	2.	14	1.	14.	1	5.	55.	1	6.	69.	1	13.	25.	16	.13	.20	13	.3	.9	1
22	1.	2.	20	2.	6.	22	14.	92.	20	20.	75.	20	34.	167.	20	22.	41.	12	.16	.41	20	.3	.8	20
23	1.	6.	11	1.	2.	4	1.	6.	0	3.	32.	1	4.	37.	1	30.	45.	13	.15	.22	14	.3	.3	1
24	1.	2.	15	0.	2.	0	5.	26.	19	16.	40.	19	21.	74.	19	22.	38.	15	.16	.25	19	.3	.7	24
25	1.	4.	15	0.	1.	21	4.	22.	1	7.	40.	1	11.	71.	1	24.	33.	19	.15	.39	11	.3	1.1	1
26	0.	0.	3	0.	1.	5	4.	11.	14	4.	15.	0	8.	22.	0	31.	41.	15	.11	.16	10	.3	.3	1
27	0.	1.	17	0.	0.	3	3.	16.	15	2.	12.	17	5.	22.	15	33.	43.	20	.10	.17	17	.2	.3	3
28	4.	21.	10	0.	1.	22	1.	5.	11	1.	9.	24	2.	9.	24	34.	49.	17	.14	.19	11	.2	.3	13
29	7.	34.	9	1.	2.	23	4.	19.	19	12.	43.	19	16.	63.	19	---	---	--	.15	.23	23	.3	.5	19
30	2.	0.	13	0.	2.	1	3.	17.	10	15.	42.	19	10.	56.	19	25.	45.	15	.16	.23	7	.4	.6	22
31	1.	6.	17	1.	10.	3	9.	32.	23	25.	55.	23	33.	87.	23	16.	36.	15	.17	.30	23	.4	.8	19
N	31	31		31	31		31	31		31	31		31	31		29	29		30	30		31	31	
Avg	1.	4.		1.	3.		4.	19.		11.	35.		14.	50.		27.	45.		.15	.26		.3	.6	
Max	7.	34.		2.	11.		14.	92.		25.	75.		34.	167.		36.	61.		.22	.70		.4	1.1	
Min	0.	0.		0.	0.		1.	5.		1.	9.		2.	9.		13.	25.		.10	.15		.2	.2	

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Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

19 FEB 91
8: 1:38

Final Data

FOR: Site - J1

Date - JAN 91

day	SO2 AVG PPB	SO2 MAX PPB	SO2 MX HR	H2S AVG PPB	H2S MAX PPB	H2S MX HR	NO AVG PPB	NO MAX PPB	NO MX HR	NO2 AVG PPB	NO2 MAX PPB	NO2 MX HR	NOX AVG PPB	NOX MAX PPB	NOX MX HR	O3 AVG PPB	O3 MAX PPB	O3 MX HR	NMOC AVG PPMC	NMOC MAX PPMC	NMOC MX HR	CO AVG PPM	CO MAX PPM	CO MX HR
1	3.	8.	15	2.	4.	15	6.	25.	8	29.	63.	18	35.	80.	18	26.	53.	13	0.16	0.70	21	0.7	1.0	9
2	0.	1.	15	2.	4.	8	5.	23.	8	18.	52.	2	23.	59.	2	29.	50.	15	0.10	0.52	7	0.4	0.9	2
3	0.	0.	0	0.	1.	15	2.	4.	9	1.	4.	8	2.	8.	9	23.	28.	17	0.00	0.00	0	0.2	0.3	6
4	0.	0.	0	1.	3.	11	3.	14.	20	5.	25.	22	8.	36.	20	23.	32.	15	0.07	0.20	22	0.3	0.4	20
5	0.	0.	0	1.	6.	3	2.	12.	8	6.	21.	8	8.	33.	8	23.	33.	23	0.11	0.17	20	0.3	0.6	7
6	0.	1.	3	1.	4.	19	2.	10.	19	5.	26.	19	7.	36.	19	27.	38.	16	0.10	0.20	15	0.2	0.4	19
7	0.	2.	24	1.	3.	22	5.	26.	24	11.	38.	23	16.	63.	24	21.	37.	15	0.13	0.48	24	0.3	0.6	23
8	0.	1.	13	1.	4.	1	4.	15.	10	18.	37.	22	23.	43.	10	20.	41.	17	0.12	0.22	24	0.3	0.6	7
9	0.	1.	14	1.	3.	5	5.	19.	10	17.	36.	4	23.	48.	4	20.	37.	12	0.07	0.21	7	0.4	0.5	4
10	0.	1.	16	1.	2.	16	2.	5.	10	5.	13.	2	7.	17.	18	28.	36.	16	0.04	0.07	14	0.3	0.4	7
11	1.	1.	11	1.	2.	4	2.	9.	23	7.	31.	23	9.	40.	23	22.	37.	17	0.10	0.19	23	0.2	0.7	23
12	0.	1.	13	1.	2.	21	3.	12.	11	12.	30.	19	15.	39.	19	24.	39.	13	------	------	--	0.3	0.5	19
13	0.	1.	3	1.	2.	1	3.	18.	12	12.	33.	12	15.	51.	12	22.	30.	22	------	------	--	0.3	0.6	17
14	1.	1.	12	1.	2.	15	1.	6.	11	1.	8.	11	2.	14.	11	24.	32.	24	0.10	0.16	17	0.2	0.3	10
15	0.	1.	5	1.	2.	4	1.	9.	15	1.	8.	19	2.	12.	15	31.	37.	13	0.11	0.16	8	0.2	0.2	1
16	0.	0.	2	0.	2.	23	4.	27.	24	11.	41.	22	15.	62.	24	22.	39.	13	------	------	--	0.2	0.5	23
17	1.	2.	22	0.	5.	5	3.	11.	9	13.	26.	6	16.	36.	9	20.	35.	18	------	------	--	0.2	0.4	6
18	1.	2.	2	1.	3.	23	2.	15.	6	11.	34.	6	13.	49.	6	22.	46.	14	------	------	--	0.3	0.4	6
19	0.	0.	16	1.	3.	18	1.	6.	19	7.	35.	18	8.	39.	18	21.	32.	11	0.01	0.21	24	0.3	0.5	19
20	1.	3.	6	1.	4.	6	2.	8.	11	3.	12.	24	5.	19.	8	---	---	--	------	------	--	0.3	0.4	8
21	2.	7.	7	1.	3.	9	2.	9.	16	4.	12.	1	6.	15.	1	18.	41.	16	1.14	3.59	7	0.3	0.4	7
22	0.	3.	2	0.	1.	21	2.	8.	8	2.	13.	8	4.	20.	8	27.	35.	16	0.08	0.85	2	0.3	0.4	8
23	0.	1.	2	0.	1.	3	2.	9.	9	1.	12.	8	3.	16.	8	36.	48.	24	------	------	--	0.2	0.3	7
24	.2.	7.	7	2.	3.	16	1.	2.	15	1.	5.	22	2.	6.	22	37.	48.	1	0.84	3.18	6	0.2	0.2	1
25	1.	4.	9	2.	3.	14	1.	2.	11	2.	9.	11	2.	11.	11	35.	45.	17	0.91	4.43	8	0.2	0.3	8
26	0.	1.	2	0.	4.	23	3.	13.	10	8.	36.	22	11.	48.	22	29.	42.	14	0.18	0.69	11	0.2	0.6	22
27	1.	2.	21	2.	3.	20	2.	10.	8	8.	22.	5	10.	31.	8	---	---	--	0.08	0.25	21	0.2	0.4	7
28	1.	2.	21	1.	2.	17	1.	4.	17	1.	6.	18	2.	9.	18	48.	56.	13	0.12	0.47	20	0.3	0.3	12
29	1.	2.	15	1.	3.	5	1.	5.	18	5.	22.	20	6.	23.	20	32.	43.	13	0.07	0.14	7	0.3	0.4	7
30	1.	4.	13	0.	1.	6	3.	9.	9	15.	34.	19	17.	37.	19	28.	51.	16	0.06	0.15	13	0.4	0.5	19
31	0.	1.	2	0.	3.	24	2.	10.	8	8.	31.	18	10.	37.	18	31.	49.	15	0.05	0.13	1	0.3	0.5	1
#	31	31		31	31		31	31		31	31		31	31		29	29		24	24		31	31	
Avg	1.	2.		1.	3.		3.	11.		8.	25.		11.	33.		27.	40.		0.20	0.72		0.3	0.5	
Max	3.	8.		2.	6.		6.	27.		29.	63.		35.	80.		48.	56.		1.14	4.43		0.7	1.0	
Min	0.	0.		0.	1.		1.	2.		1.	4.		2.	6.		18.	28.		0.00	0.00		0.2	0.2	

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

6 MAR 91
5:57: 9

Final Data

FOR: Site - J1

Date - FEB 91

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	0.	0.	0	1.	1.	10	1.	3.	8	1.	4.	1	1.	4.	1	35.	42.	17	0.02	0.06	6	0.2	0.2	1
2	1.	4.	6	0.	1.	3	2.	6.	12	4.	15.	19	6.	20.	7	31.	40.	13	0.13	0.75	6	0.2	0.3	7
3	2.	2.	6	0.	2.	19	1.	11.	10	4.	12.	8	5.	19.	10	29.	46.	15	0.07	0.21	6	0.2	0.3	8
4	2.	9.	13	1.	2.	19	1.	3.	20	1.	5.	20	2.	8.	20	29.	37.	16	0.04	0.12	13	0.2	0.3	18
5	0.	0.	24	1.	2.	23	2.	11.	9	1.	5.	8	3.	14.	9	37.	40.	3	0.04	0.15	24	0.2	0.3	7
6	0.	0.	2	1.	2.	7	2.	8.	8	6.	25.	20	8.	27.	20	30.	40.	13	0.05	0.10	7	0.3	0.5	19
7	0.	0.	0	0.	2.	3	2.	6.	10	4.	23.	8	6.	27.	8	33.	41.	23	0.02	0.04	18	0.2	0.4	7
8	0.	1.	6	0.	1.	19	1.	4.	19	0.	1.	9	1.	4.	9	37.	43.	15	0.03	0.18	6	0.2	0.2	1
9	1.	5.	13	1.	2.	6	1.	7.	9	5.	28.	19	6.	32.	19	30.	43.	16	0.17	0.95	10	0.2	0.4	20
10	1.	2.	12	0.	0.	0	1.	4.	11	2.	10.	23	3.	11.	23	39.	46.	15	0.03	0.07	24	0.2	0.3	13
11	1.	3.	12	0.	1.	15	2.	6.	9	7.	20.	21	8.	23.	18	32.	43.	13	0.03	0.11	7	0.1	0.5	7
12	0.	1.	23	1.	2.	21	1.	3.	8	3.	12.	23	4.	14.	20	37.	45.	15	0.07	0.15	22	0.2	0.4	21
13	3.	12.	9	2.	4.	5	1.	4.	18	5.	19.	19	6.	23.	19	32.	45.	16	0.15	0.42	20	0.3	0.5	7
14	1.	8.	21	2.	3.	18	1.	5.	18	6.	20.	19	7.	24.	19	33.	51.	17	0.23	1.08	21	0.3	0.4	7
15	0.	5.	24	1.	3.	1	2.	9.	21	8.	35.	21	10.	44.	21	30.	49.	17	0.20	1.58	24	0.3	0.8	21
16	1.	17.	12	1.	3.	3	4.	15.	4	---	---	---	20.	50.	4	26.	57.	16	0.15	1.51	1	0.3	0.5	8
17	0.	2.	12	0.	1.	11	1.	4.	15	10.	28.	19	11.	30.	18	29.	43.	13	0.03	0.06	21	0.3	0.4	3
18	1.	3.	19	1.	2.	20	4.	44.	8	10.	42.	8	14.	86.	8	24.	38.	17	------	------	--	0.3	0.8	8
19	3.	9.	11	1.	4.	15	6.	19.	7	11.	31.	7	16.	50.	7	28.	50.	14	0.24	0.99	10	0.3	0.6	7
20	0.	0.	0	1.	2.	10	3.	18.	10	9.	26.	10	12.	44.	10	28.	42.	16	0.11	0.24	15	0.3	0.5	10
21	1.	4.	11	2.	4.	23	4.	26.	7	3.	23.	7	6.	51.	7	29.	39.	16	0.08	0.47	11	0.2	0.5	7
22	0.	2.	14	1.	3.	21	2.	7.	24	6.	32.	24	8.	40.	24	23.	45.	17	0.08	0.30	24	0.2	0.5	21
23	0.	0.	0	2.	5.	11	6.	25.	16	19.	38.	16	25.	63.	16	9.	17.	2	0.09	0.26	19	0.3	0.6	16
24	0.	3.	15	2.	5.	8	7.	48.	8	13.	35.	9	20.	75.	8	18.	34.	13	0.09	0.35	14	0.3	0.5	6
25	0.	1.	16	1.	2.	8	4.	18.	8	11.	28.	8	15.	46.	8	26.	37.	16	0.03	0.08	12	0.4	0.6	20
26	0.	1.	2	0.	0.	1	2.	7.	10	7.	16.	16	10.	19.	16	31.	43.	12	0.02	0.09	24	0.2	0.6	22
27	0.	1.	2	1.	3.	11	2.	13.	15	8.	18.	15	10.	31.	15	31.	40.	14	0.04	0.12	1	0.3	0.5	13
28	2.	7.	11	2.	4.	13	2.	5.	9	1.	10.	8	3.	14.	8	29.	41.	24	0.11	0.72	10	0.3	0.4	2
#	28	28		28	28		28	28		27	27		28	28		28	28		27	27		28	28	
Avg	1.	4.		1.	2.		2.	12.		6.	21.		9.	32.		29.	42.		0.09	0.41		0.3	0.5	
Max	3.	17.		2.	5.		7.	48.		19.	42.		25.	86.		39.	57.		0.24	1.58		0.4	0.8	
Min	0.	0.		0.	0.		1.	3.		0.	1.		1.	4.		9.	17.		0.02	0.04		0.1	0.2	

Environmental Survey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

9 APR 91
17:46:19

Final Data

FOR: Site - J1

Date - MAR 91

	SO2			H2S			NO			NO2			NOX			O3			NMOC			CO		
day	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPB	MAX PPB	MX HR	AVG PPMC	MAX PPMC	MX HR	AVG PPM	MAX PPM	MX HR
1	1.	5.	23	1.	2.	16	1.	6.	11	3.	9.	21	4.	10.	21	31.	41.	20	0.16	0.69	23	0.3	0.3	1
2	0.	1.	1	1.	3.	14	5.	54.	16	8.	32.	21	13.	66.	16	26.	45.	14	0.14	0.62	23	0.3	0.7	21
3	0.	1.	23	1.	2.	3	7.	31.	19	18.	43.	19	25.	74.	19	17.	31.	17	0.16	0.39	17	0.4	1.1	19
4	0.	1.	13	0.	2.	1	3.	12.	18	9.	20.	1	12.	30.	18	25.	41.	14	0.04	0.18	1	0.3	0.4	8
5	0.	0.	2	2.	20.	12	1.	5.	18	4.	19.	18	5.	24.	18	29.	43.	13	0.02	0.08	9	0.3	0.5	21
6	0.	2.	23	1.	2.	18	2.	8.	15	4.	19.	20	6.	21.	20	30.	38.	12	0.04	0.33	23	0.3	0.7	20
7	0.	2.	4	0.	2.	23	1.	4.	17	2.	6.	18	2.	8.	18	35.	46.	14	0.07	0.20	4	0.3	0.4	19
8	0.	0.	15	0.	1.	3	2.	5.	11	7.	17.	22	9.	22.	11	29.	42.	14	0.12	0.21	23	0.3	0.3	1
9	1.	13.	15	1.	4.	22	3.	11.	12	14.	34.	13	17.	45.	13	30.	41.	18	0.08	0.20	13	0.3	0.5	13
10	0.	2.	17	2.	3.	15	2.	8.	9	5.	21.	2	7.	22.	2	30.	44.	13	------	------	--	0.3	0.7	2
11	0.	0.	4	1.	3.	3	2.	13.	7	5.	24.	7	8.	37.	7	39.	50.	16	0.00	0.01	23	0.3	0.5	7
12	0.	3.	22	0.	2.	22	2.	14.	22	9.	22.	20	12.	30.	22	28.	37.	18	------	------	--	0.3	0.5	20
13	2.	4.	11	2.	4.	20	2.	6.	12	15.	29.	17	17.	34.	17	32.	52.	16	------	------	--	0.4	0.5	12
14	1.	2.	7	0.	1.	22	3.	11.	10	5.	17.	22	9.	20.	22	26.	35.	12	0.04	0.18	23	0.2	0.3	7
15	0.	2.	3	1.	5.	7	8.	58.	12	9.	30.	23	17.	70.	12	24.	34.	16	0.06	0.20	1	0.3	0.4	7
16	1.	2.	6	1.	13.	16	7.	38.	14	12.	29.	7	19.	50.	14	25.	40.	13	0.04	0.15	2	0.3	0.5	7
17	0.	3.	10	2.	3.	12	3.	7.	15	11.	32.	22	14.	36.	22	26.	44.	13	0.07	0.15	22	0.3	0.4	19
18	1.	7.	14	2.	6.	1	8.	39.	8	22.	37.	8	30.	76.	8	18.	36.	20	0.10	0.19	7	0.4	0.7	22
19	1.	6.	15	0.	1.	21	2.	8.	9	17.	28.	18	19.	34.	8	31.	65.	16	0.07	0.19	15	0.4	0.7	5
20	0.	2.	10	1.	4.	22	1.	5.	18	8.	30.	18	9.	34.	18	---	---	--	------	------	--	0.3	0.5	23
21	0.	1.	23	1.	6.	24	5.	17.	21	12.	37.	21	17.	53.	21	37.	60.	5	0.11	0.25	23	0.2	0.3	20
22	1.	3.	15	1.	3.	1	3.	9.	14	12.	25.	22	15.	30.	22	22.	35.	12	------	------	--	0.2	0.4	22
23	0.	0.	0	0.	2.	21	4.	13.	15	13.	24.	14	16.	34.	15	25.	33.	20	0.05	0.13	24	0.3	0.5	14
24	0.	0.	0	0.	1.	1	5.	11.	10	8.	21.	8	13.	30.	10	23.	34.	3	0.06	0.12	11	0.3	0.3	1
25	0.	0.	0	0.	0.	21	4.	11.	7	4.	16.	11	8.	27.	7	30.	41.	16	------	------	--	0.3	0.4	7
26	0.	2.	9	2.	16.	22	5.	31.	21	12.	45.	21	17.	76.	21	26.	42.	17	------	------	--	0.3	0.6	21
27	0.	2.	22	2.	5.	22	11.	86.	22	19.	60.	22	30.	145.	22	16.	36.	16	------	------	--	0.3	1.2	21
28	0.	0.	23	1.	5.	8	9.	33.	8	20.	38.	23	29.	69.	8	15.	36.	16	------	------	--	0.4	0.6	20
29	0.	1.	22	---	---	--	8.	40.	22	17.	48.	22	25.	89.	22	16.	40.	16	------	------	--	0.3	0.7	22
30	0.	1.	22	---	---	--	10.	51.	19	22.	56.	19	33.	106.	19	16.	34.	14	------	------	--	0.3	0.8	19
31	0.	0.	3	0.	2.	1	4.	13.	20	14.	33.	22	18.	46.	20	21.	43.	13	------	------	--	0.3	0.7	20
#	31	31		29	29		31	31		31	31		31	31		30	30		19	19		31	31	
Avg	0.	2.		1.	4.		4.	21.		11.	29.		15.	47.		26.	41.		0.08	0.24		0.3	0.6	
Max	2.	13.		2.	20.		11.	86.		22.	60.		33.	145.		39.	65.		0.16	0.69		0.4	1.2	
Min	0.	0.		0.	0.		1.	4.		2.	6.		2.	8.		15.	31.		0.00	0.01		0.2	0.3	

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Environmenta rvey Program
Jubail Industrial Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - APR 91

day	SO2 AVG PPB	SO2 MAX PPB	SO2 MX HR	H2S AVG PPB	H2S MAX PPB	H2S MX HR	NO AVG PPB	NO MAX PPB	NO MX HR	NO2 AVG PPB	NO2 MAX PPB	NO2 MX HR	NOX AVG PPB	NOX MAX PPB	NOX MX HR	O3 AVG PPB	O3 MAX PPB	O3 MX HR	NMOC AVG PPMC	NMOC MAX PPMC	NMOC MX HR	CO AVG PPM	CO MAX PPM	CO MX HR
1	0.	3.	16	0.	2.	22	5.	20.	24	19.	51.	23	24.	63.	24	28.	57.	17	------	------	--	0.3	0.7	24
2	3.	18.	13	3.	6.	7	16.	131.	7	27.	58.	8	43.	169.	7	---	---	--	------	------	--	0.5	1.0	1
3	1.	8.	18	0.	2.	6	13.	76.	7	23.	48.	7	36.	123.	7	38.	58.	18	0.12	0.81	15	0.5	0.9	7
4	1.	5.	13	0.	1.	22	4.	16.	11	12.	35.	19	16.	39.	19	36.	59.	14	------	------	--	0.4	0.6	19
5	0.	1.	2	1.	2.	5	3.	10.	16	9.	22.	1	13.	30.	16	28.	40.	8	0.01	0.04	12	0.2	0.5	1
6	0.	0.	0	1.	3.	21	7.	19.	14	12.	26.	14	19.	45.	14	22.	34.	24	0.06	0.23	11	0.2	0.3	7
7	0.	1.	22	1.	3.	24	4.	10.	12	5.	19.	21	9.	25.	7	---	---	--	0.04	0.47	15	0.2	0.3	6
8	1.	2.	7	3.	5.	1	5.	15.	15	11.	25.	18	15.	34.	18	18.	31.	20	0.07	0.20	17	0.3	0.4	7
9	0.	0.	7	1.	3.	6	5.	16.	11	13.	32.	22	18.	41.	11	21.	30.	16	0.06	0.15	22	0.3	0.7	19
10	0.	1.	7	1.	3.	3	5.	22.	7	6.	23.	7	10.	47.	7	32.	44.	22	0.00	0.04	15	0.2	0.5	7
11	0.	1.	24	0.	0.	21	3.	10.	9	7.	19.	24	10.	20.	24	34.	45.	16	0.04	0.34	24	0.3	0.4	20
12	0.	1.	15	1.	6.	22	2.	6.	20	6.	29.	21	8.	31.	21	36.	51.	17	0.05	0.16	1	0.2	0.5	21
13	0.	1.	2	1.	3.	7	3.	13.	10	7.	26.	20	10.	28.	10	35.	50.	17	------	------	--	0.3	0.3	6
14	2.	11.	9	0.	2.	22	2.	4.	15	6.	19.	20	8.	21.	20	42.	53.	13	------	------	--	0.3	0.3	6
15	1.	4.	10	1.	2.	9	2.	20.	11	4.	12.	7	7.	24.	11	38.	57.	14	0.00	0.00	0	0.2	0.3	6
16	2.	8.	15	1.	3.	22	4.	15.	8	13.	39.	21	18.	48.	21	27.	41.	14	0.08	0.21	16	0.3	0.4	8
17	2.	8.	18	0.	2.	9	2.	5.	18	11.	27.	18	13.	32.	18	36.	60.	4	0.05	0.13	1	0.4	0.8	18
18	3.	7.	13	0.	1.	23	3.	12.	19	13.	34.	19	16.	47.	19	31.	58.	14	0.04	0.10	18	0.4	0.5	1
19	1.	5.	13	1.	6.	23	3.	9.	10	9.	22.	22	12.	29.	12	32.	44.	2	0.01	0.08	22	0.3	0.4	11
20	0.	1.	11	1.	4.	21	2.	8.	15	8.	20.	15	11.	29.	15	31.	45.	13	0.04	0.12	4	0.3	0.4	18
21	7.	26.	10	1.	4.	23	3.	12.	15	11.	31.	20	14.	41.	20	29.	37.	18	------	------	--	0.3	0.5	7
22	6.	31.	12	1.	7.	21	6.	44.	20	12.	49.	20	18.	93.	20	21.	34.	11	------	------	--	0.3	1.1	20
23	5.	33.	9	0.	0.	3	2.	8.	18	7.	31.	18	8.	39.	18	28.	42.	13	0.07	0.15	18	0.2	0.5	18
24	5.	16.	10	0.	2.	24	7.	39.	20	14.	47.	20	21.	86.	20	23.	37.	13	------	------	--	0.4	1.0	20
25	1.	5.	14	0.	2.	22	3.	8.	18	16.	29.	17	19.	35.	17	20.	43.	16	------	------	--	0.3	0.5	24
26	1.	4.	12	1.	3.	22	2.	18.	21	13.	43.	21	15.	62.	21	33.	59.	12	------	------	--	0.4	0.9	21
27	0.	1.	23	0.	2.	1	2.	6.	8	2.	10.	17	3.	15.	17	35.	40.	21	------	------	--	0.2	0.3	2
28	6.	31.	5	0.	2.	4	3.	10.	7	6.	23.	20	8.	28.	20	29.	39.	15	0.08	0.19	23	0.3	0.5	7
29	6.	31.	12	0.	1.	1	2.	5.	19	11.	29.	22	13.	33.	22	26.	42.	15	------	------	--	0.4	0.5	18
30	4.	14.	16	1.	10.	23	2.	7.	15	10.	27.	21	12.	31.	21	28.	48.	16	------	------	--	0.3	0.5	21
#	30	30		30	30		30	30		30	30		30	30		28	28		17	17		30	30	
Avg	2.	9.		1.	3.		4.	20.		11.	30.		15.	46.		30.	46.		0.05	0.20		0.3	0.6	
Max	7.	33.		3.	10.		16.	131.		27.	58.		43.	169.		42.	60.		0.12	0.81		0.5	1.1	
Min	0.	0.		0.	0.		2.	4.		2.	10.		3.	15.		18.	30.		0.00	0.00		0.2	0.3	

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Environmenta' ey Program
Jubail Indus i Complex
Kingdom of Saudi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1

Date - MAY 91

day	SO2 AVG PPB	SO2 MAX PPB	SO2 MX HR	H2S AVG PPB	H2S MAX PPB	H2S MX HR	NO AVG PPB	NO MAX PPB	NO MX HR	NO2 AVG PPB	NO2 MAX PPB	NO2 MX HR	NOX AVG PPB	NOX MAX PPB	NOX MX HR	O3 AVG PPB	O3 MAX PPB	O3 MX HR	NMOC AVG PPMC	NMOC MAX PPMC	NMOC MX HR	CO AVG PPM	CO MAX PPM	CO MX HR
1	11.	42.	12	4.	12.	23	11.	57.	21	12.	27.	14	22.	75.	21	17.	32.	4	------	------	--	0.5	1.8	21
2	3.	12.	13	3.	5.	1	1.	6.	7	2.	7.	2	3.	10.	1	27.	46.	14	------	------	--	0.3	0.7	14
3	8.	33.	8	3.	7.	3	0.	0.	9	0.	1.	2	0.	1.	2	45.	54.	13	------	------	--	0.3	0.5	2
4	7.	42.	10	1.	3.	10	1.	3.	20	5.	24.	20	6.	27.	20	41.	56.	15	0.06	0.13	14	0.3	0.6	20
5	4.	12.	6	0.	2.	10	2.	4.	19	5.	19.	23	7.	20.	20	28.	39.	11	0.05	0.21	21	0.3	0.4	19
6	2.	16.	9	1.	2.	4	1.	5.	18	5.	21.	18	6.	26.	18	29.	43.	13	0.04	0.07	24	0.3	0.5	20
7	2.	10.	10	1.	4.	10	2.	5.	18	11.	33.	20	14.	38.	20	26.	45.	11	0.08	0.41	20	0.3	0.5	20
8	5.	23.	19	1.	10.	22	26.	163.	21	16.	49.	19	41.	212.	21	21.	38.	14	0.15	0.55	21	0.5	2.1	21
9	5.	32.	15	0.	3.	22	6.	25.	19	12.	34.	19	18.	59.	19	16.	29.	12	0.12	0.37	22	0.3	0.6	19
10	4.	19.	10	1.	4.	6	2.	9.	20	5.	25.	20	6.	33.	20	---	---	--	0.08	0.11	21	0.2	0.5	20
11	6.	34.	10	2.	10.	22	2.	10.	19	9.	33.	20	11.	42.	20	21.	35.	14	0.02	0.08	6	0.3	0.6	19
12	2.	10.	11	10.	63.	19	1.	4.	17	7.	20.	17	9.	24.	17	25.	41.	13	0.00	0.05	20	0.3	0.5	7
13	0.	0.	1	1.	3.	23	2.	7.	16	9.	25.	23	11.	28.	17	22.	36.	14	0.11	0.25	18	0.3	0.6	22
14	0.	0.	0	0.	2.	21	4.	12.	21	10.	29.	21	13.	41.	21	16.	29.	13	0.02	0.07	22	0.3	0.6	17
15	1.	5.	16	1.	8.	17	9.	51.	22	15.	37.	21	24.	88.	22	13.	31.	15	0.06	0.20	17	0.4	0.9	22
16	4.	9.	21	1.	4.	4	3.	24.	7	17.	34.	19	22.	44.	7	22.	34.	16	0.04	0.10	11	0.3	0.9	7
17	1.	2.	2	1.	3.	7	2.	5.	10	3.	15.	10	4.	19.	10	42.	39.	12	------	------	--	0.3	0.4	7
18	0.	0.	23	0.	3.	1	1.	2.	8	1.	4.	21	2.	5.	20	48.	51.	18	0.09	0.58	16	0.3	0.4	20
19	3.	21.	11	2.	4.	8	1.	3.	7	2.	9.	7	3.	12.	7	---	---	--	0.01	0.18	10	0.3	0.5	7
20	6.	23.	9	1.	9.	21	2.	7.	18	6.	26.	19	8.	31.	18	---	---	--	------	------	--	0.3	0.7	19
21	1.	5.	13	1.	4.	9	2.	9.	7	8.	20.	19	10.	25.	7	---	---	--	0.12	0.36	23	0.3	0.4	7
22	0.	2.	9	0.	2.	5	3.	7.	8	4.	20.	9	7.	26.	9	28.	47.	24	------	------	--	0.3	0.4	7
23	0.	0.	0	0.	0.	0	1.	3.	16	1.	9.	19	3.	11.	19	42.	56.	3	0.10	0.47	11	0.3	0.4	18
24	1.	8.	10	1.	3.	24	1.	2.	10	1.	9.	20	1.	10.	20	32.	41.	16	0.02	0.09	1	0.2	0.3	9
25	11.	41.	11	2.	7.	9	1.	4.	20	7.	24.	20	8.	28.	20	26.	41.	16	0.04	0.15	24	0.2	0.4	20
26	5.	22.	9	0.	2.	9	2.	4.	20	8.	23.	24	10.	24.	24	26.	40.	11	0.06	0.14	7	0.2	0.4	21
27	1.	4.	12	0.	4.	22	3.	18.	22	12.	33.	22	15.	51.	22	20.	35.	12	0.04	0.19	22	0.3	0.9	22
28	2.	8.	10	1.	4.	4	1.	4.	19	3.	22.	1	4.	24.	1	33.	43.	14	0.01	0.13	7	0.2	0.4	1
29	1.	2.	7	2.	4.	1	1.	3.	8	1.	8.	20	2.	10.	20	35.	43.	9	0.00	0.09	7	0.2	0.3	4
30	1.	6.	7	1.	3.	22	1.	5.	7	2.	8.	7	3.	13.	7	35.	43.	9	0.01	0.11	7	0.3	0.4	7
31	0.	0.	0	1.	2.	22	1.	2.	7	0.	0.	0	0.	2.	7	39.	43.	15	0.00	0.00	0	0.2	0.3	17
#	31	31		31	31		31	31		31	31		31	31		27	27		25	25		31	31	
Avg	3.	14.		1.	6.		3.	15.		6.	21.		9.	34.		29.	42.		0.05	0.20		0.3	0.6	
Max	11.	42.		10.	63.		26.	163.		17.	49.		41.	212.		48.	59.		0.15	0.58		0.5	2.1	
Min	0.	0.		0.	0.		0.	0.		0.	0.		0.	1.		13.	29.		0.00	0.00		0.2	0.3	

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Environmentz ~vey Program
Jubail Ind… al Complex
Kingdom of …udi Arabia
Monthly AQ Summary

Final Data

FOR: Site - J1 Date - JUN 91

day	SO2 AVG PPB	SO2 MAX PPB	SO2 MX HR	H2S AVG PPB	H2S MAX PPB	H2S MX HR	NO AVG PPB	NO MAX PPB	NO MX HR	NO2 AVG PPB	NO2 MAX PPB	NO2 MX HR	NOX AVG PPB	NOX MAX PPB	NOX MX HR	O3 AVG PPB	O3 MAX PPB	O3 MX HR	NMHC AVG PPMC	NMHC MAX PPMC	NMHC MX HR	CO AVG PPM	CO MAX PPM	CO MX HR
1	0.	1.	24	1.	3.	3	1.	4.	7	2.	10.	7	3.	14.	7	31.	40.	11	0.00	0.05	23	0.3	0.6	7
2	6.	24.	24	0.	1.	6	1.	4.	18	3.	9.	18	4.	13.	18	25.	36.	11	0.02	0.08	24	0.2	0.3	17
3	4.	18.	2	2.	6.	4	1.	5.	7	1.	7.	7	2.	12.	7	38.	51.	13	0.02	0.10	4	0.2	0.4	5
4	6.	24.	9	2.	5.	5	1.	5.	7	1.	9.	7	2.	14.	7	35.	45.	13	0.02	0.12	3	0.2	0.3	7
5	11.	41.	10	1.	2.	5	1.	3.	18	2.	11.	19	3.	14.	19	33.	44.	14	------	------	--	0.2	0.3	12
6	11.	34.	8	1.	2.	8	1.	3.	18	2.	12.	19	3.	15.	19	30.	36.	15	0.02	0.08	7	0.2	0.4	19
7	5.	20.	8	1.	4.	7	1.	2.	7	0.	4.	7	1.	6.	7	25.	31.	11	------	------	--	0.3	0.3	1
8	0.	1.	8	2.	5.	22	2.	3.	9	3.	17.	19	4.	20.	19	24.	33.	15	0.10	0.19	17	0.3	0.5	19
9	8.	51.	12	2.	6.	3	1.	2.	9	3.	10.	19	4.	12.	18	33.	42.	10	0.02	0.11	8	0.2	0.4	19
10	6.	14.	5	1.	12.	21	2.	13.	18	10.	42.	18	13.	55.	18	23.	37.	12	0.05	0.22	19	0.3	0.7	18
11	3.	8.	9	0.	2.	20	2.	7.	19	5.	24.	19	7.	30.	19	26.	40.	13	0.05	0.12	7	0.3	0.5	19
12	1.	6.	8	0.	2.	23	1.	3.	18	3.	12.	23	4.	13.	23	28.	36.	13	0.01	0.07	23	0.2	0.3	7
13	2.	10.	18	0.	3.	24	1.	2.	17	2.	9.	18	3.	10.	18	31.	39.	16	0.01	0.05	1	0.2	0.3	1
14	1.	3.	7	1.	6.	22	1.	3.	7	2.	11.	21	2.	13.	21	30.	40.	12	0.01	0.04	24	0.2	0.4	21
15	2.	7.	10	1.	2.	3	2.	5.	20	9.	26.	21	10.	29.	20	20.	33.	14	0.02	0.12	22	0.2	0.8	16
16	4.	15.	15	1.	11.	23	3.	8.	9	13.	26.	19	15.	32.	19	18.	36.	11	0.03	0.18	2	0.4	0.7	19
17	1.	4.	7	1.	7.	21	2.	13.	4	5.	15.	8	7.	22.	4	28.	39.	13	0.02	0.06	22	0.3	0.6	8
18	4.	25.	4	1.	6.	21	1.	2.	15	5.	20.	17	6.	22.	17	32.	43.	11	0.04	0.13	21	0.3	0.5	17
19	1.	9.	2	1.	20.	21	3.	20.	21	10.	41.	21	13.	61.	21	28.	46.	11	0.04	0.35	21	0.4	0.8	21
20	0.	0.	21	2.	5.	8	2.	4.	9	8.	15.	15	10.	19.	11	26.	37.	13	0.00	0.00	0	0.4	0.5	7
21	0.	1.	6	1.	4.	7	2.	8.	17	10.	27.	17	12.	35.	17	25.	36.	4	0.00	0.00	0	0.4	1.0	23
22	0.	1.	9	0.	1.	3	0.	1.	10	6.	16.	19	7.	17.	19	19.	35.	16	0.00	0.01	8	0.3	0.4	17
23	1.	1.	5	0.	1.	23	1.	2.	9	4.	12.	14	5.	12.	14	19.	48.	14	0.00	0.00	0	0.3	0.5	23
24	0.	1.	24	1.	4.	6	2.	12.	15	5.	20.	15	7.	32.	15	18.	40.	18	0.00	0.02	21	0.3	0.4	21
25	1.	2.	22	2.	5.	3	1.	5.	7	13.	34.	15	14.	37.	15	22.	54.	14	0.02	0.10	19	0.4	0.8	19
26	1.	2.	7	1.	4.	7	2.	21.	7	14.	30.	17	16.	49.	7	25.	97.	15	0.02	0.09	7	0.4	0.9	7
27	0.	1.	24	1.	2.	4	0.	2.	6	8.	20.	18	9.	21.	18	24.	48.	15	0.01	0.07	21	0.2	0.5	18
28	0.	1.	2	4.	16.	4	0.	1.	13	0.	4.	13	1.	5.	13	30.	44.	12	0.00	0.04	13	0.2	0.3	13
29	0.	0.	0	2.	9.	20	1.	2.	18	5.	20.	19	5.	20.	19	25.	43.	15	0.10	0.31	19	0.3	0.6	19
30	0.	3.	12	2.	17.	21	1.	5.	18	9.	30.	19	9.	32.	18	28.	48.	15	0.11	0.23	19	0.3	0.7	19
#	30	30		30	30		30	30		30	30		30	30		30	30		28	28		30	30	
Avg	3.	11.		1.	6.		1.	6.		5.	18.		7.	23.		27.	43.		0.03	0.10		0.3	0.5	
Max	11.	51.		4.	20.		3.	21.		14.	42.		16.	61.		38.	97.		0.11	0.35		0.4	1.0	
Min	0.	0.		0.	1.		0.	1.		0.	4.		1.	5.		18.	31.		0.00	0.00		0.2	0.3	

Pa

Environmenta[illegible]vey Program
Jubail Indu[illegible]l Complex
Kingdom of [illegible]udi Arabia
Monthly AQ Summary

Final Data

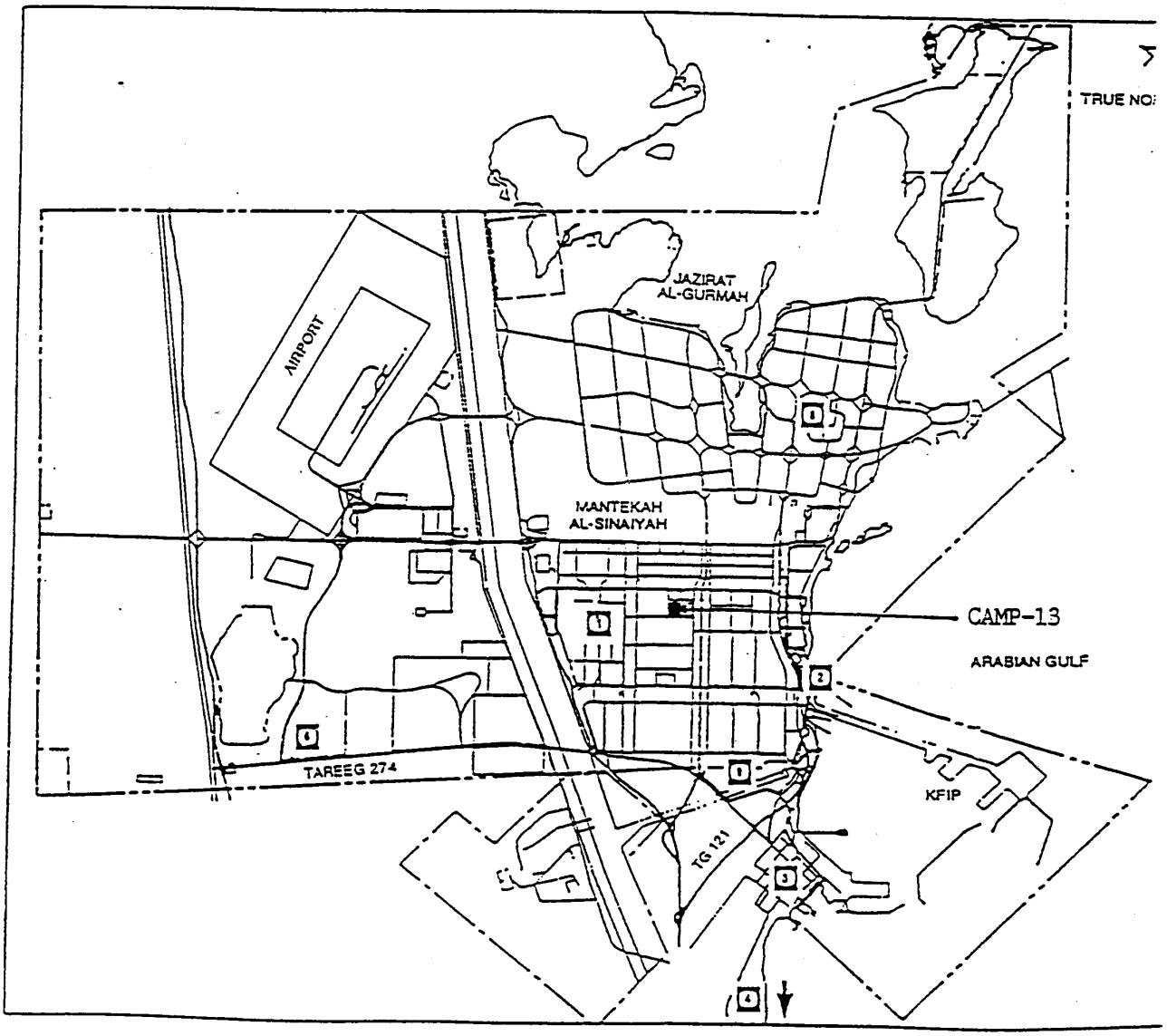
FOR: Site - J1 Date - JUN 91

day	SO2 AVG PPB	SO2 MAX PPB	SO2 MX HR	H2S AVG PPB	H2S MAX PPB	H2S MX HR	NO AVG PPB	NO MAX PPB	NO MX HR	NO2 AVG PPB	NO2 MAX PPB	NO2 MX HR	NOX AVG PPB	NOX MAX PPB	NOX MX HR	O3 AVG PPB	O3 MAX PPB	O3 MX HR	NMOC AVG PPMC	NMOC MAX PPMC	NMOC MX HR	CO AVG PPM	CO MAX PPM	CO MX HR
1	0.	1.	24	1.	3.	3	1.	4.	7	2.	10.	7	3.	14.	7	31.	40.	11	0.00	0.05	23	0.3	0.6	7
2	6.	24.	24	0.	1.	6	1.	4.	18	3.	9.	18	4.	13.	18	25.	36.	11	0.02	0.08	24	0.2	0.3	17
3	4.	18.	2	2.	6.	4	1.	5.	7	1.	7.	7	2.	12.	7	38.	51.	13	0.02	0.10	4	0.2	0.4	5
4	6.	24.	9	2.	5.	5	1.	5.	7	1.	9.	7	2.	14.	7	35.	45.	13	0.02	0.12	3	0.2	0.3	7
5	11.	41.	10	1.	2.	5	1.	3.	18	2.	11.	19	3.	14.	19	33.	44.	14	------	------	--	0.2	0.3	12
6	11.	34.	8	1.	2.	8	1.	3.	18	2.	12.	19	3.	15.	19	30.	36.	15	0.02	0.08	7	0.2	0.4	19
7	5.	20.	8	1.	4.	7	1.	2.	7	0.	4.	7	1.	6.	7	25.	31.	11	------	------	--	0.3	0.3	1
8	0.	1.	8	2.	5.	22	2.	3.	9	3.	17.	19	4.	20.	19	24.	33.	15	0.10	0.19	17	0.3	0.5	19
9	8.	51.	12	2.	6.	3	1.	2.	9	3.	10.	19	4.	12.	18	33.	42.	10	0.02	0.11	8	0.2	0.4	19
10	6.	14.	5	1.	12.	21	2.	13.	18	10.	42.	18	13.	55.	18	23.	37.	12	0.05	0.22	19	0.3	0.7	18
11	3.	8.	9	0.	2.	20	2.	7.	19	5.	24.	19	7.	30.	19	26.	40.	13	0.05	0.12	7	0.3	0.5	19
12	1.	6.	8	0.	2.	23	1.	3.	18	3.	12.	23	4.	13.	23	28.	36.	13	0.01	0.07	23	0.2	0.3	7
13	2.	10.	18	0.	3.	24	1.	2.	17	2.	9.	18	3.	10.	18	31.	39.	16	0.01	0.05	1	0.2	0.3	1
14	1.	3.	7	1.	6.	22	1.	3.	7	2.	11.	21	2.	13.	21	30.	40.	12	0.01	0.04	24	0.2	0.4	21
15	2.	7.	10	1.	2.	3	2.	5.	20	9.	26.	21	10.	29.	20	20.	33.	14	0.02	0.12	22	0.2	0.8	16
16	4.	15.	15	1.	11.	23	3.	8.	9	13.	26.	19	15.	32.	19	18.	36.	11	0.03	0.18	2	0.4	0.7	19
17	1.	4.	7	1.	7.	21	2.	13.	4	5.	15.	8	7.	22.	4	28.	39.	13	0.02	0.06	22	0.3	0.6	8
18	4.	25.	4	1.	6.	21	1.	2.	15	5.	20.	17	6.	22.	17	32.	43.	11	0.04	0.13	21	0.3	0.5	17
19	1.	9.	2	1.	20.	21	3.	20.	21	10.	41.	21	13.	61.	21	28.	46.	11	0.04	0.35	21	0.4	0.8	21
20	0.	0.	21	2.	5.	8	2.	4.	9	8.	15.	15	10.	19.	11	26.	37.	13	0.00	0.00	0	0.4	0.5	7
21	0.	1.	6	1.	4.	7	2.	8.	17	10.	27.	17	12.	35.	17	25.	36.	4	0.00	0.00	0	0.4	1.0	23
22	0.	1.	9	0.	1.	3	0.	1.	10	6.	16.	19	7.	17.	19	19.	35.	16	0.00	0.01	8	0.3	0.4	17
23	1.	1.	5	0.	1.	23	1.	2.	9	4.	12.	14	5.	12.	14	19.	48.	14	0.00	0.00	0	0.3	0.5	23
24	0.	1.	24	1.	4.	6	2.	12.	15	5.	20.	15	7.	32.	15	18.	40.	18	0.00	0.02	21	0.3	0.4	21
25	1.	2.	22	2.	5.	3	1.	5.	7	13.	34.	15	14.	37.	15	22.	54.	14	0.02	0.10	19	0.4	0.8	19
26	1.	2.	7	1.	4.	7	2.	21.	7	14.	30.	17	16.	49.	7	25.	97.	15	0.02	0.09	7	0.4	0.9	7
27	0.	1.	24	1.	2.	4	0.	2.	6	8.	20.	18	9.	21.	18	24.	48.	15	0.01	0.07	21	0.2	0.5	18
28	0.	1.	2	4.	16.	4	0.	1.	13	0.	4.	13	1.	5.	13	30.	44.	12	0.00	0.04	13	0.2	0.3	13
29	0.	0.	0	2.	9.	20	1.	2.	18	5.	20.	19	5.	20.	19	25.	43.	15	0.10	0.31	19	0.3	0.6	19
30	0.	3.	12	2.	17.	21	1.	5.	18	9.	30.	19	9.	32.	18	28.	48.	15	0.11	0.23	19	0.3	0.7	19
#	30	30		30	30		30	30		30	30		30	30		30	30		28	28		30	30	
Avg	3.	11.		1.	6.		1.	6.		5.	18.		7.	23.		27.	43.		0.03	0.10		0.3	0.5	
Max	11.	51.		4.	20.		3.	21.		14.	42.		16.	61.		38.	97.		0.11	0.35		0.4	1.0	
Min	0.	0.		0.	1.		0.	1.		0.	4.		1.	5.		18.	31.		0.00	0.00		0.2	0.3	

FIGURE 1

MADINAT AL-JUBAIL AL-SINAIYAH

JUBAIL ATMOSPHERIC MONITORING NETWORK (JAMN)



LEGEND:

AIR MONITORING SITES

ROYAL COMMISSION BOUNDARY

SAUDI ARABIA TRIP
ITINERARY AND PERSONS INTERVIEWED
3 - 15 AUGUST 1994

3 WED Depart Norfolk, 1510

4 THU Arrive Riyadh, 1625
Met by Marc L. Desjardins, American Embassy

5 FRI Rest day (Saudi weekend)

6 SAT American Embassy

LTC Roger S. Bass, USA, Assistant Army Attache
Marc L. Desjardins, Political-Military Desk
Richard A. Smith, Political-Military Counselor

Discussed general purpose of visit; attitudes and concerns of Saudi government toward Persian Gulf illness and toward our trip in face of prior trips by others; arrangements for meetings.

U.S. Military Training Mission (at the Ministry of Defense and Aviation (MODA))

LTC Dennis P. Goodes, MSC, USA; Senior Med Advisor
COL Joseph D. Molinari, USA; Chief, Joint Section

Discussed general purpose of visit; who we hoped to meet with; attitudes of Saudi military toward this issue.

7 SUN Travel to Dhahran and Jubail

Met by Ibrahim Nur, American Embassy, Dhahran airport

American Counsel General, Dhahran

David M. Winn, Consul General
Ibrahim M. Nur, Assistant Consul/Government Liaison Officer
H. Bridget Burkart, Consul

Courtesy call on Consul General Winn.

Embassy car to Royal Commission, Jubail, with I. Nur.

Enclosure 2

Royal Commission for Jubail and Yanbu

Dr. Jassem M. Al-Ansari, Director General
Jasim A. Al-Hejji, Deputy Director General for Community Affairs
Terry C. Valenzano, Vice President and Program Manager, Bechtel, Jubail Project
Abdullah Al-Ajmi, Director, Public Affairs
Hassan Al-Sadah, Public Relations Department
Mohammed Al-Harbi, Public Relations Department

Explained purpose of visit: Evaluate possible exposure of Naval Mobile Construction Battalion (NMCB) 24 to industrial chemicals in Jubail, particularly from a fertilizer plant (ammonia fumes) and a steel mill near Camp 13 (base camp of NMCB 13). Also interested in general health experience of Jubail residents and workers during and after Desert Storm, and would like to visit the Camp 13 site (Haii 13), King Abdul-Azziz Naval Base (NMCB 24 detachment site), and Fleet Hospitals 5 and 15 sites. Discussed origin and development of Jubail and its deliberate adherence to highest environmental protection standards, activities in Jubail during the war and subsequently including health of Jubail residents, and concerns and attitudes of those present toward this issue.

Visit Royal Commission Visitors' Center.

Tour industrial and residential areas of Jubail with Mohammed Harbi. (Mr. Harbi served as guide and escort in Jubail. Dr. Ahmed Alhazami also accompanied us during visits to all SABIC (Saudi Arabia Basic Industries Corporation) companies.)

8 MON National Methanol Company (Ibn SINA)

Saeed H. Al-Ghamdi, QC Laboratory Supervisor

Al-Jubail Fertilizer Company (SAMAD)

Ahmad Abdullah Al-Ahmad, President
Ali Al-Hasan, General Manager

Saudi Iron and Steel Company (HADEED)

Abdullah A. Al-Gahtani, Vice President Finance & Administration
Tawfeek Shammasi, Environmental Superintendent

9 TUE King Abdul-Azziz Naval Base

COMO Ibrahim A. Aqqad, Base Commander
CAPT Awad Al-Abbas Nazzal, Operations & Maintenance
CDR Stephen S. King, USN, NAVSECMTM DET Jubail

Royal Commission, Health Services Department

Jasim A. Al-Hejji, Deputy Director General for Community Affairs
Raouf R. Arafat, MD, MPH, Epidemiologist
Niaz A. Khan, Environmental Specialist
Hussain Al-Bishri, Medical Group Manager

Discussed environmental monitoring of air, ground water, sea water, and hazardous waste and sanitary landfills in and around Jubail, including results of oil well fire smoke. Discussed overall health of Jubail residents during Desert Storm and subsequently. Visit a remote, automated air monitoring station.

10 WED Arabian Petrochemical Company (PETROKEMYA)
National Plastic Company (Ibn HAYYAN)

Ibrahim S. Al-Sheweir, Ibn Hayyan President & Petrokemya Executive Vice President
Daniel D. Robinson, General Manager, Hydrocarbons

Royal Commission, Health Services Department

Visit waste water treatment plant.

Visit Fleet Hospital 5 site.

11 THU Visit Dhahran (Saudi weekend)

12 FRI (Saudi weekend)

13 SAT Royal Commission, Outbrief

Dr. Jassem M. Al-Ansari
Terry C. Valenzano
Mohammed Al-Harbi

Enclosure 2

Drive to Dhahran.

Visit to ARAMCO, (canceled at last minute).

American Consulate, Dhahran

Outbrief, Consul General Winn

Travel to Riyadh

14 SUN American Embassy, Outbrief

Marc L. Desjardins
LTC Roger S. Bass

Ministry of Agriculture and Water

Dr. Ateiyiah S. Al-Rowaithy, Economic Advisor & Director of Foreign Relations, et al.
Hussein B. Mousa, Marketing Analyst, American Embassy

Discussed overall health of agricultural animals in Saudi Arabia, especially whether there were increased numbers of deaths during and after Desert Storm.

American Embassy, Outbrief

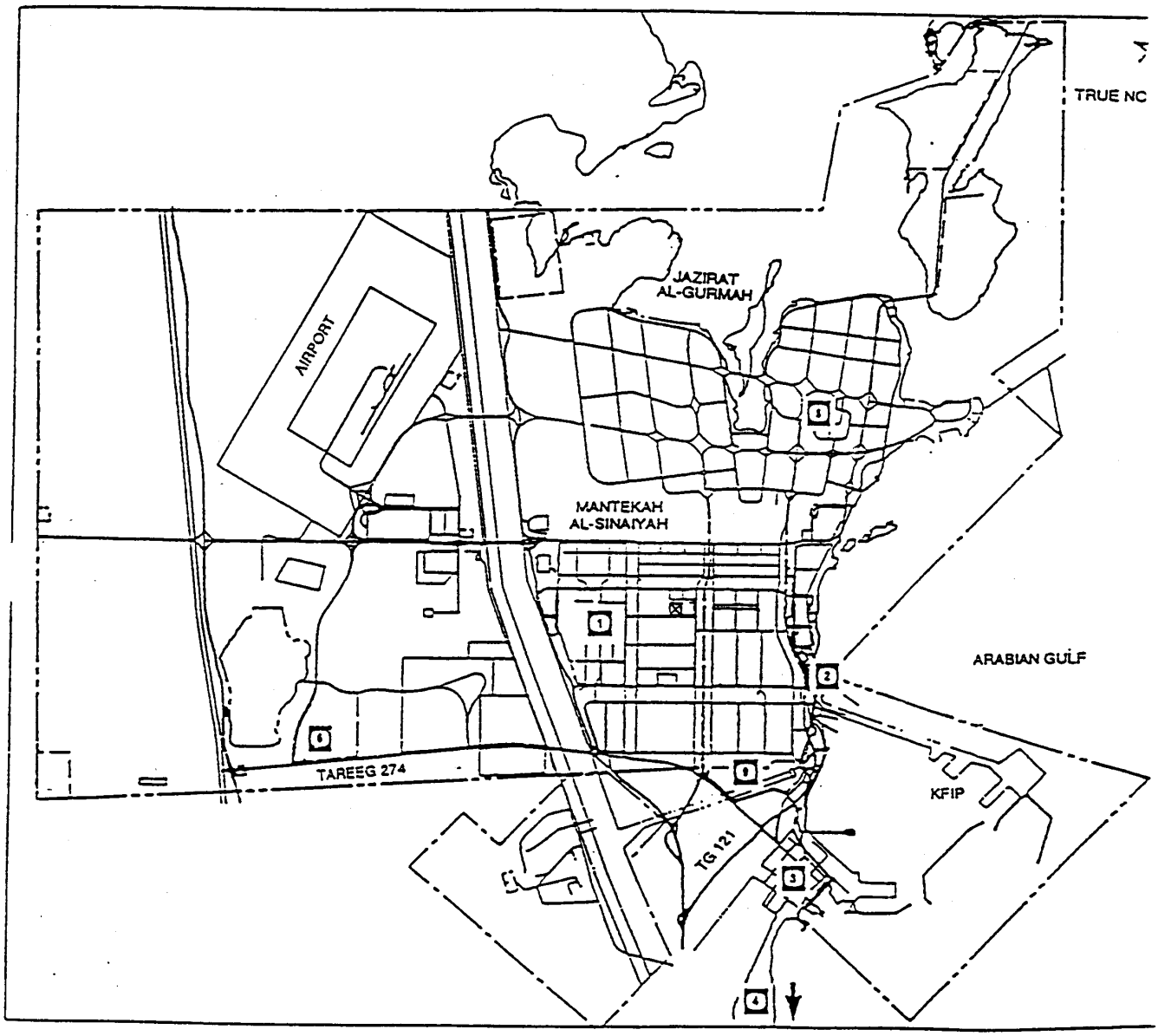
Marc L. Desjardins

15 MON Return to Norfolk

Enclosure 2

MADINAT AL-JUBAIL AL-SINAIYAH

JUBAIL ATMOSPHERIC MONITORING NETWORK (JAMN)



LEGEND:

AIR MONITORING SITES

ROYAL COMMISSION BOUNDARY

X = Camp (Haii) 13

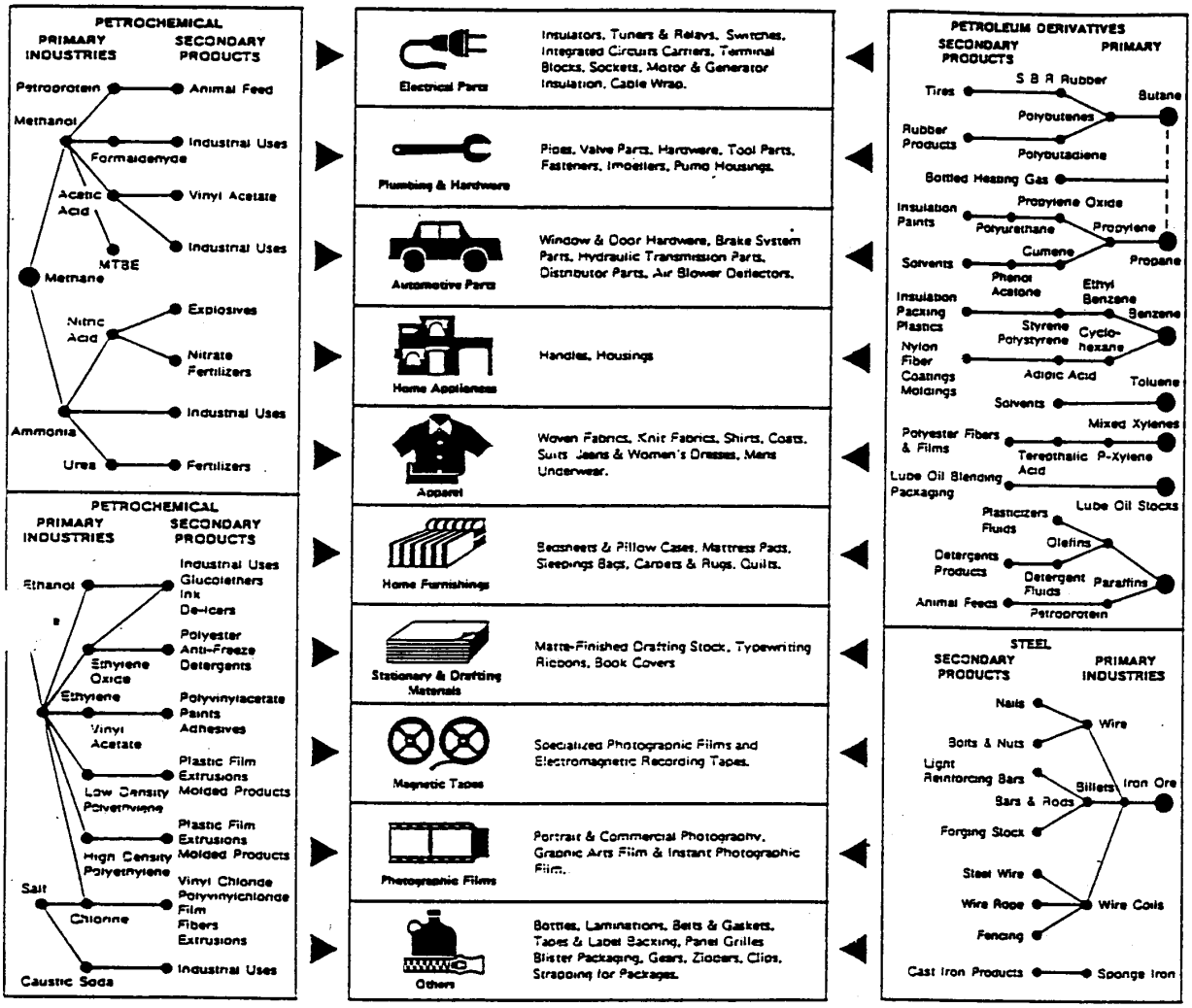
Enclosure (3)

PRIMARY INDUSTRIES AT JUBAIL

	COMPANY	NOMINAL CAPACITY	MAJOR PRODUCTS	START-UP
SABIC	SAUDI IRON AND STEEL CO. (HADEED)	1,100,000 TPY	Steel billets, sponge iron, reinforcing rods, and wire coils (future: cold rolled sheet)	1982
	SAUDI METHANOL CO. (AR-RAZI)	640,000 TPY	Methanol (chemical grade)	1983
	AL-JUBAIL FERTILIZER COMPANY (SAMAD)	600,000 TPY	Urea	1983
	SAUDI PETROCHEMICAL CO. (SADAF)	2,430,000 TPY	Caustic soda, industrial grade ethanol, ethylene dichloride, styrene, and ethylene	1984
	AL-JUBAIL PETROCHEMICAL CO. (KEMYA)	300,000 TPY	Linear low and high-density polyethylene	1984
	NATIONAL METHANOL CO. (IBN-SINA)	770,000 TPY	Methanol (future: vinyl acetate, acetic acid, and ethylene glycols)	1984
	NATIONAL INDUSTRIAL GASES CO. (GAS)	438,000 TPY O2 146,000 TPY N2	Oxygen and nitrogen	1984
	ARABIAN PETROCHEMICAL CO. (PETROKEMYA)	800,000 TPY	Ethylene, polystyrene, and butene-1	1985
	EASTERN PETROCHEMICAL CO. (SHARQ)	470,000 TPY	Ethylene glycols, linear low-density polyethylene	1985
	NATIONAL PLASTICS CO. (IBN-HAYYAN)	500,000 TPY	Vinyl chloride monomer and polyvinyl chloride	1986
	NATIONAL CHEMICAL FERTILIZER CO. (IBN AL-BAYTAR)	500,000 TPY	Anhydrous ammonia	1987
	SAUDI EUROPEAN PETROCHEMICAL CO. (IBN-ZAHR)	500,000 TPY	Methyl tertiary butyl ether (MTBE), butene-1, and butadiene	1988
PETROMIN	SULFUR PRILLING AND EXPORT Aramco built and operated for Petromin	1,500,000 TPY	Prilled sulfur	1984
	PETROMIN/SHELL REFINERY CO. (PSRC)	250,000 BPSD	Fuel oil, naphtha, kerosene, gas oil, diesel, LPG, benzene	1985
	JUBAIL LUBE OIL BLENDING PLANT	1,000 BPSD	Range of lube oils, transformer oils, and greases	1986
	PETMARK BULK TERMINALS	1,050,000 TPY	Sale of bunkering fuel and diesels, gasoline, and jet fuel	Future
	JUBAIL LUBE OIL REFINERY	76,000 BPSD	Lube oil stock, wax, bunker fuel, and asphalt	Future

Enclosure 4

PRIMARY AND DOWNSTREAM INDUSTRIES RELATIONSHIP



Enclosure 5

ALLEGED INCREASE IN ANIMAL DEATHS DURING ODS/S

1. Background. A series of written questions was submitted to the Ministry of Agriculture and Water (MOAW) regarding animal morbidity and mortality during ODS/S because of reports that large numbers of dead animals had been seen then. The most creditable report came from a Navy infectious disease specialist, who observed this during September-October 1990 in the Jubail area. His discussions with local health officials revealed this was a well-recognized phenomenon, a periodic animal die-off due to an infectious agent. This individual saw no subsequent die-offs, and specifically emphasized he saw no die-offs during the combat phase of ODS/S when Iraqi missile attacks were under way. Nevertheless, some individuals have interpreted these reports of animal die-offs as indicating the possible use of biological or chemical warfare agents.

2. MOAW Interview. MOAW officials were interviewed, using the submitted questions as a starting point. The officials feel they have a highly effective program to promote animal husbandry in Saudi Arabia. Barley is provided to herdsmen at subsidized prices, and vaccines and medications are free. There are strict import controls to prevent sick animals from being brought into the country.

3. MOAW officials denied any increase in animal deaths during ODS/S above the normal mortality rate of 5-7 per 100 animals per year. These figures are based on self-reports from Bedouins and considered by MOAW to be only an estimate. (The report alluded to in paragraph 1 may have been a localized disease outbreak, which did not noticeably affect the total number of dead animals in the entire country.) There is currently no program to compensate Bedouins or others for lost animals, even if there is an epidemic die-off. A proposal has been developed to compensate animal owners if herds have to be destroyed, e.g. because of the presence of rinderpest.

4. Periodic die-offs do occur, usually due to hemorrhagic septicemia. If epidemics occur, samples are collected and processed at a reference laboratory for viral and bacterial isolates. Outbreaks in commercial farms are subject to quarantine. Outbreaks among the Bedouins are subject only to general restrictions, because stricter controls are not practicable.

5. Bedouins were advised to move out of possible combat areas during ODS/S. No large numbers or clusters of dead animals were seen during this time. After the ground war, a small number of dead camels were seen, who were felt possibly to have eaten something poisonous. The number was sufficiently small that no evaluation was felt to be indicated. The death rate after ODS/S was estimated to be about 8%, comparable to the normal rate. The number of aborted animals and stillbirths did not increase during or after ODS/S.

MEDICAL ILLNESSES IN SAUDI MILITARY PERSONNEL AND DEPENDENTS

1. Informal discussions were held with a small number of senior physicians who together had 28 years of experience in Saudi military hospitals, (which also provide services to an extensive range of dependents). A particular focus was pulmonary disease in desert dwellers which might be related to exposure to desert sand.

2. In general, pulmonary illness has not been a problem among Saudi military personnel, including during and after ODS/S. Physicians in Saudi Arabia have closely followed reports of post-ODS/S illness in U.S. military personnel. They commented forcefully upon the lack of any post-ODS/S morbidity or mortality among Saudi troops, a striking difference in their opinion. In their view, this seems to be exclusively an American phenomenon.

3. (Saudis and foreign workers interviewed by the team, especially in Jubail, often volunteered that they and their families had lived there during and after ODS/S, with no evidence of adverse health among themselves or their friends or neighbors. The Royal Commission's Health Services Department monitors morbidity and mortality among residents of Jubail. It has detected no evidence of increased morbidity or mortality, and no cases of unusual illnesses or any illness resembling that reported in U.S. ODS/S veterans.)

4. The winter of 1993-94 saw large numbers of cases of influenza-like illness, and pneumococcal and Hemophilus pneumonia, primarily among civilians. Asthma cases were also markedly increased this past winter, however asthma cases have been steadily increasing, mostly in city dwellers, beginning several years before ODS/S. The cause is unknown, but it is attributed possibly to the "Arizona effect." (Asthma cases began to increase markedly in Arizona as large numbers of people moved to the state. This is attributed to an accompanying increase in landscaping, made possible by increased availability of irrigation, and resultant increased pollen.) This possibility is being investigated by the systematic sampling of pollen at five locations in Riyadh.

5. One physician suggested asthma may be more common in desert dwellers, for unknown reasons. Speculated reasons included dust and sand exposure, pollen when desert plants bloom, and organic matter from animal feces or skins.

6. In addition to asthma, the most common pulmonary complaints have long been fibrosing alveolitis, bronchiectasis (attributed to inadequate treatment of childhood pneumonias 20-30 years ago), and tuberculosis. Bedouins currently constitute less than 15% of the population, but even among old long term Bedouins silicosis is not seen, and pulmonary diseases, (other than those cited above), are not a noteworthy feature. One physician remarked he

had seen more silicosis in training in a large American city than he had in Saudi Arabia. Another mentioned a poorly described entity he labeled "Saudi Desert Lung" characterized by increased pulmonary markings, but which is not silicosis.

7. The physicians were familiar with the Military Medicine article on "Al Askhan Pneumonia," speculatively attributed in the article to exposure to desert sand and pigeon droppings. To them, the illness sounded like an outbreak of garden variety influenza. They pointed out pigeons are commonly found throughout Saudi Arabia, including large numbers at the compounds where they live, but pigeons do not appear to be related to outbreaks of respiratory disease. Histoplasmosis, coccidioidomycosis, and blastomycosis are not seen in Saudi Arabia, and candidiasis and aspergillosis are seen only in immunocompromised individuals. One physician had seen only six cases of allergic bronchopulmonary aspergillosis in over seven years.

8. Formal statistical data on pulmonary diseases are not kept, however there is a strong impression that cases of active tuberculosis have been steadily decreasing over the past 12 years. This is attributed to good housing and food, and vigorous use of BCG vaccine. (Children who do not receive mandated vaccines, including BCG, do not receive a birth certificate.)

9. Occasional cutaneous leishmaniasis is seen in individuals living around Riyadh. Kala azar is common among children in southern Saudi Arabia, especially in the southwest. No cases of viscerotropic leishmaniasis have been seen, and the physicians were surprised at its report in a medical journal.