Military Deployment
Periodic Occupational and Environmental Monitoring Summary (POEMS):
Eskan Village, Kingdom of Saudi Arabia
Calendar Years: 1999-2015

AUTHORITY: This periodic occupational and environmental monitoring summary (POEMS) has been developed in accordance with Department of Defense (DoD) Instructions 6490.03, 6055.05, and JCSM (MCM) 0028-07, See REFERENCES.

PURPOSE: This POEMS documents the DoD assessment of base camp level Occupational and Environmental Health Surveillance (OEHS) exposure data for Eskan Village. It presents the identified health risks and assessments along with the possible associated medical implications. The findings were based on information collected from October 1999 through December 2015 to include deployment OEHS sampling and monitoring data (e.g. air, water, and soil), field investigation and health assessment reports, as well as country and area-specific information on endemic diseases. While this assessment may reflect similar exposures and health risks pertaining to historic or future conditions at this site, the underlying data were limited to the time period(s) and area(s) sampled and thus may not reflect fluctuations or unique occurrences. It also may not have been fully representative of all the fluctuations during the timeframe. To the extent that the data allowed, this summary describes the general ambient conditions at the site and characterizes the health risks at the population–level. While useful to inform providers and others of potential health effects and associated medical implications, it does not represent an individual exposure profile. Actual individual exposures and specific resulting health effects depend on many variables and, should be addressed in individual medical records by providers as appropriate at the time of an evaluation of a unique exposure.

SITE DESCRIPTION: Eskan Village (population 840) was located southeast of the city Riyadh (population 6 million) in the Kingdom of Saudi Arabia. It was situated in a broad desert plain near the center of the Arab Peninsula 600 meters above sea level. Primary U.S. mission operations were the 64th Air Expeditionary Group, U.S. Military Training Mission and Office of the Program Manager Saudi Arabian National Guard (OPM-SANG). Eskan Village does not have a runway or any aircraft operations. Eskan Village was located 2 kilometers northwest of a nearby industrial area that contains Saudi Carbonate Factory, United Wood Products Factory, Nestle Water Factory, Adwan Chemicals, and other industrial corporations that cover a 24 square kilometer area. Also, the Aramco Riyadh Oil Refinery lies 5 kilometers to the south and covers a 9 square kilometer area. Eskan Village was initially developed for the Bedouins and was therefore similar to a large suburban community. The majority of the base consists of housing units (villas). The villas serve as both residential and work areas.

SUMMARY: Summarized below were the key health risk estimates along with recommended follow-on medical actions, if any, that providers should be aware of. The following pages provide a list of all the identified health risks at Eskan Village (Table 1). As indicated in the detailed sections that follow the table, controls that had been effectively established to reduce health risk levels had been factored into this overall assessment.

Table 1. Population-Based Health Risk Estimates - Eskan Village, Saudi Arabia[1,2,5]

Source of Identified Health Risk[3]			
AIR	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
PM_{10}	Short-term: **Low-High**, Daily levels varied, acute health effects (e.g., upper respiratory tract irritation) were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).	Limiting strenuous physical activities when air quality was especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: **Low-High**, Daily levels varied, acute health effects (e.g., upper respiratory tract irritation) were possible in susceptible persons (e.g., those with asthma/existing respiratory diseases).
	Long-term: **No health guidelines**		Long-term: **No health guidelines**
$PM_{2.5}$	Short-term: **Low-High**, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may had produced mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may had been exacerbated.	Limiting strenuous physical activities when air quality was especially poor; and actions such as closing tent flaps, windows, and doors.	Short-term: **Low-High**, A majority of the time mild acute (short term) health effects were anticipated; certain peak levels may had produced mild eye, nose, or throat irritation in some personnel and pre-existing health conditions (e.g., asthma, or cardiopulmonary diseases) may had been exacerbated.
	Long-term: **Moderate**, Small percentage of persons may had been at increased risk for developing chronic conditions (particularly those more susceptible to acute (short term) effects (e.g., those with asthma/existing respiratory diseases).		Long-term: **Moderate**, Small percentage of persons may had been at increased risk for developing chronic conditions (particularly those more susceptible to acute (short term) effects (e.g., those with asthma/existing respiratory diseases).
Metals	Short-term: None Identified		Short-term: None Identified
	Long-term: None Identified		Long-term: None Identified
VOCs	Short-term: None Identified		Short-term: None Identified
	Long-term: None Identified		Long-term: Acrolein was identified in many of the samples above the 1-year MEG. However, the risk is **low.**
Soil	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
Various Analytes	Short-term: No health guidelines		Short-term: No health guidelines
	Long-term: None Identified		Long-term: None Identified
Water	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
Consumed Water	Short-term: None Identified	Potable water used from approved sources	Short-term: None Identified
	Long-term: None Identified		Long-term: None Identified
Water used for other purposes	Short-Term: None Identified		Short-term: None Identified
	Long-Term: None Identified		Long-term: None Identified

ENDEMIC DISEASE	Unmitigated Health Risk Estimate[4]	Control Measures Implemented	Residual Health Risk Estimate[4]
Food borne/ Waterborne	Short-term: Variable: **High** (Bacterial Diarrhea) to Moderate (Hepatitis A, Typhoid/Paratyphoid Fever, Diarrhea-Protozoal, Brucellosis). If ingesting local food/water, the health effects could be temporarily incapacitating to personnel (Diarrhea) or result in prolonged illness (Hepatitis A).	Preventive measures included Hepatitis A vaccination, consumption of food and water used only from approved sources and routinely monitored. (MOD 12)	Short-term: **Low**
	Long-term: **None Identified**		Long-term: **None Identified**
Arthropod Vector Borne	Short-term: **Moderate** (Dengue, Crimean Congo Hemorrhagic Fever, Leishmaniasis, Alkhumra virus) to Low (Sandfly Fever, Plague, Flea-borne Typhus, West Nile Fever, Tick-borne Rickettsioses, Sindbis, Malaria, Rift Valley Fever)	Preventive measures included proper wear of a properly treated uniform, application of repellent to exposed skin, appropriate chemoprophylaxis if required (malaria meds), use of bed nets if sleeping outdoors, and avoidance of peak biting hours.	Short-term: **Low**
	Long-term: **None Identified**		Long-term: **None Identified**
Water-Contact (e.g. wading, swimming)	Short-term: **Moderate** (Leptospirosis, Schistosomiasis)		Short-term: **Moderate**
	Long-term: **None Identified**		Long-term: **None Identified**
Respiratory	Short-term: **Low** (Tuberculosis (TB), Meningococcal Meningitis).	Providing adequate living and work space; medical screening; vaccination	Short-term: **Low**
	Long-term: None Identified		Long-term: None Identified
Animal Contact	Short-term: **Moderate** (Q-Fever) to Low (Rabies, Anthrax, H5N1 avian influenza)	Prohibiting contact with, adoption, or feeding of feral animals IAW CENTCOM GO 1B. Risks were further reduced in the event of assessed contact by prompt post- exposure rabies prophylaxis IAW the CDC's ACIP guidelines.	Short-term: **Moderate** (Q-Fever), Low (Rabies, Anthrax, H5N1 avian influenza)
	Long-term: **Low** (Rabies)		Long-term: **Low** (Rabies)
VENOMOUS ANIMAL/INSECTS	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
Snakes, Scorpions, Spiders, Snails	Short-term: **Low to High**	Risks reduced by education, avoiding contact, and proper and timely reporting and treatment.	Short-term: **Low to High** (If encountered, effects of venom varied with species from mild localized swelling to potentially lethal)
	Long-term: None Identified		Long-term: None Identified
HEAT/COLD STRESS	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
Heat	Short-term: **Low to High**	Work-rest cycles, proper hydration and nutrition, and WBGT Monitoring.	Short-term: **Low to High**
	Long-term: **Low**		Long-term: **Low**

Cold	Short-term: **Low** Long-term: **Low**	Risks from cold stress reduced with protective measures such as use of the buddy system, proper wear of protective clothing, and proper hydration and nutrition.	Short-term: **Low** Long-term: **Low**
NOISE	**Unmitigated Health Risk Estimate[4]**	**Control Measures Implemented**	**Residual Health Risk Estimate[4]**
Continuous (Power generation equipment) Impulse (Weapon firing)	Short-term: **Low** Long-term: **Low**	Hearing protection used by personnel in higher risk areas	Short-term: **Low** Long-term: **Low**

[1] This Summary Table provides a qualitative estimate of population-based short- and long-term health risks associated with the general ambient and occupational environment conditions at Eskan Village. It does not represent a unique individual exposure profile. Actual individual exposures and health effects depend on many variables. For example, while a chemical may had been present in the environment, if a person did not inhale, ingest, or contact a specific dose of the chemical for adequate duration and frequency, then there may had been no health risk. Alternatively, a person at a specific location may had experienced a unique exposure which could had resulted in a significant individual exposure. Any such person seeking medical care should had their specific exposure documented in an SF600.

[2] This assessment was based on specific data and reports obtained from the October 1999 through October 2012 timeframe. It was considered a current representation of general site conditions but may not reflect certain fluctuations or unique exposure incidents. Acute health risk estimates were generally consistent with field-observed health effects.

[3] This Summary Table was organized by major categories of identified sources of health risk. It only lists those sub-categories specifically identified and addressed at the site(s) evaluated. The health risks were presented as Low, Moderate, High or Extremely High for both acute and chronic health effects. The health risk level was based on an assessment of both the potential severity of the health effects that could be caused and probability of the exposure that would produce such health effects. Details could be obtained from the APHC/AIPH. Where applicable, "None Identified" was used when an exposure was identified and no health risk of either a specific acute or chronic health effects were determined. More detailed descriptions of OEH exposures that were evaluated but determined to pose no health risk were discussed in the following sections of this report.

[4] Health risks in this Summary Table were based on quantitative surveillance thresholds (e.g. endemic disease rates; host/vector/pathogen surveillance) or screening levels, e.g. Military Exposure Guidelines (MEGs) for chemicals. Some previous assessment reports may provide slightly inconsistent health risk estimates because quantitative criteria such as MEGs may had changed since the samples were originally evaluated and/or because this assessment makes use of all historic site data while previous reports may had only been based on a select few samples.

1 Discussion of Health Risks at Eskan Village, Saudi Arabia by Source

The following sections describe the major source categories of potential health risk that were evaluated at Eskan Village. For each category, the evaluation process includes identifying what, if any, specific sub-categories/health concerns were present.

2 Air

2.1 Area Specific Sources Identified

Eskan Village was situated in a dusty semi-arid desert environment. Inhalational exposure to high levels of dust and particulate matter, such as during high winds or dust storms may had resulted in mild to more serious short-term health effects (e.g., eye, nose or throat and lung irritation) in some personnel. Additionally, certain subgroups of the deployed forces (e.g., those with pre-existing asthma/cardio pulmonary conditions) were at greatest risk of developing notable health effects.

Environmental surveillance occurred between 1999 and 2015. The summary of results follows.

2.2 Particulate matter

Particulate matter (PM) was a complex mixture of extremely small particles suspended in the air. PM includes solid particles and liquid droplets emitted directly into the air by sources such as: power plants, motor vehicles, aircraft, tactical generators, construction activities, fires, and natural windblown dust. PM could include sand, soil, metals, volatile organic compounds, allergens, and other compounds such as nitrates or sulfates that were formed by condensation or transformation of combustion exhaust. PM composition and particle size vary considerably depending on the source. Generally particulate matter of health concern was divided into two fractions: PM_{10}, which includes coarse particles with a diameter of 10 micrometers or less (0.0004 inches or one-seventh the width of a human hair), and fine particles less than 2.5 micron ($PM_{2.5}$), which could reach the deepest regions of the lungs when inhaled. Exposure to excessive PM was linked to a variety of potential health effects.

2.3 Particulate matter, less than10 micrometers (PM_{10})

2.3.1 Exposure Guidelines:

Short-term (24-hour) PM_{10} (mg/m^3):
Negligible MEG=0.250
Marginal MEG=0.420
Critical MEG=0.600

Long-term PM_{10} MEG (mg/m^3):
Not defined.

The range of 24-hour PM_{10} concentrations in 351 samples collected from 1999-2015 was 0.001 to 2.92 mg/m^3 with an average concentration of 0.166 mg/m^3.

2.3.2 Short-term health risks:

Low-High: Short term risk was based on comparison of daily concentrations to 24-hr MEGs. The variability in the risk was due to significant fluctuation in the daily concentrations.

Overall 174/203 (85.7%) of the sampling days had concentrations below the 24-hour negligible MEG (LOW Risk); 16/203 (7.9%) of the sampling days were between the 24-hour negligible MEG and the 24-

hour marginal MEG (LOW Risk); 6/203 (3%) of the sampling days were between the 24-hour marginal and the 24-hour critical MEG (MODERATE Risk); 7/203 (<3.4%) of the sampling days were greater than the critical MEG (HIGH risk). Confidence was medium based on the quantity of sampling data and the days represented in the calendar year.

Respiratory effects could increasingly impact real-time health and mission capabilities as they exceed higher levels of MEGs. Acute effects to relatively healthy troops were mostly eye, nose, and throat irritation, and respirator effects (sneezing, adaptive responses such as coughing, sinus congestion and drainage) that could be exacerbated by increased activity.

2.3.3 Long-term health risk:

Not Evaluated-no available health guidelines. The Environmental Protection Agency has retracted its long-term standard (NAAQS) for PM_{10} due to an inability to clearly link chronic health effects with chronic PM_{10} exposure levels.

2.4 Particulate Matter, less than 2.5 micrometers ($PM_{2.5}$)

2.4.1 Sample data/Notes:

Exposure Guidelines:

Short-term (24-hour) $PM_{2.5}$ MEGs (mg/m3):
Negligible MEG=0.065
Marginal MEG=0.250
Critical MEG=0.500

Long-term (1year) $PM_{2.5}$ MEGs (mg/m3):
Negligible MEG=0.015
Marginal MEG=0.065.

The range of 24-hour PM2.5 concentrations in 39 samples collected from 1999-2015 was 0.01 to 0.91 mg/m3, with an average concentration of 0.09 mg/m3.

2.4.2 Short-term risk:

Overall 25/36 (69.4%) of the sampling days had concentrations below the 24-hour negligible MEG (LOW Risk); 10/36 (27.8%) of the sampling days were between the 24-hour negligible MEG and the 24-hour marginal MEG (LOW Risk); 0/36 (0%) of the sampling days were between the 24-hour marginal and the 24-hour critical MEG (MODERATE Risk); 1/36 (2.8%) of the sampling days were greater than the critical MEG (HIGH risk). Confidence was low based on limitations in sampling data.

Low-High: Short term risk was based on comparison of daily concentrations to 24-hr MEGs. The variability in the risk was due to significant fluctuation in the daily concentrations. The risk assessment was based on sampling data from 1999-2015.

2.4.3 Long-term (chronic) health risks:

For chronic health risk, it was assumed that the longest deployment lasted twelve months. To assess chronic risk associated with $PM_{2.5}$, the overall yearly average concentration of $PM_{2.5}$ was used to arrive at a long term health risk. All of the yearly averages of data for each year were above the $PM_{2.5}$ 1-year MEG of 0.015 mg/m^3. The average for 2009 was 0.033 mg/ m^3, the average for 2011 was 0.11 mg/ m^3, the average for 2012 was 0.18 mg/ m^3, and the average for 2014 was 0.033 mg/ m^3.

Moderate: The long-term $PM_{2.5}$ health risk assessment for Eskan Village was moderate based on $PM_{2.5}$ concentrations and the likelihood of exposure at these hazard severity levels. A moderate health risk

assessment suggests that long-term exposure to peak $PM_{2.5}$ concentrations at Eskan Village were expected to had degraded mission capabilities in terms of the required mission standard and would result in reduced mission capability if hazards occurred during the mission. Confidence in the short-term $PM_{2.5}$ health risk assessment was low (TG 230, Table 3-6).

2.4 Airborne Metals

2.4.1 Sample data/Notes:

From 1999-2015, metals analysis was performed on 389 ambient air particulate matter samples (including PM_{10} and $PM_{2.5}$) collected at Eskan Village.

For screening purposes, both peak and average concentrations of all airborne metals detected were compared to their corresponding 1-year negligible MEG. Risk estimates based on the USAPHC TG 230 methodology were calculated for any compound detected at a concentration greater than its 1-year MEG in 5% or more of the samples collected.

2.4.2 Short and long-term health risks:

None identified based on the available sampling data: All contaminants were measured at concentrations below MEGs. Three contaminants had detection limits greater than the MEG (Beryllium, Cadmium, and Vanadium). Since these contaminants weren't detected in any of the samples and/or there was no expected source of these contaminants, no further assessment was needed (based on guidance in TG 230 paragraph 3.4.4.4). Confidence in this risk assessment was low based on limitations in sampling data and analytical limits of detection.

2.5 Volatile Organic Compounds (VOC)

2.5.1 Typically, most VOC sampling was either associated with a specific source or incident driven. Data of this type, especially when there was sparse sampling data exist, was generally not representative of exposure to an entire camp population.

For screening purposes, peak and average concentrations of all airborne VOCs detected were compared to their corresponding 1-year negligible MEG. Short-term risk estimates based on the USAPHC TG 230 methodology were determined for any compound detected at a concentration greater than its 1-year MEG and long-term risk estimates were determined where VOC were detected above their respective 1-year MEG in 5% or more of the samples collected.

The health risk assessment was based on average and peak concentrations of 257 valid volatile organic chemical (VOC) air samples collected at Eskan Village from 1999-2015.

All VOCs were detected at levels below pertinent MEGs except for acrolein. 2/21 samples were above the 0.137 µg/m³ 1-year Negligible MEG. However, this level was below all short-term MEGs.

2.5.2 Short and long-term health risks:

The hazard severity for acrolein was considered negligible because the sample concentrations were not greater than any of the short-term (1-hour) MEGs. The lowest of these was the minimal 1-hour MEG of 70 µg/m³, which was the level above which there was the potential for chronic respiratory disease. Because the detected concentrations were far below this level, as well as below the levels at which severe acute effects would occur, little or no adverse impact to the mission was anticipated. Acrolein will be retained as a hazard for future sampling and risk assessments.

No long or short-term health risks were identified from all other VOCs based on the available sampling data and no parameters exceeding 1-year Negligible MEGs.

3 Soil

3.1 Site-Specific Sources Identified

The region was extremely arid with little vegetation and mostly sandy soils. The subsurface conditions were divided into three distinctive layers. The first layer consists of silty sands with some clay approximately 7.5 feet in depth. The second layer was highly weathered limestone 11.5 feet thick and the third layer was a highly weathered limestone with cracks and voids (over 10% water loss) approximately 13 feet thick.

3.2 Sample data/Notes:

A total of 25 soil samples were collected from Eskan Village from 1999-2015 to assess OEH health risk to deployed personnel. The primary soil contamination exposure pathways were dermal contact and dust inhalation. Typical parameters analyzed for included SVOCs, radionuclides, heavy metals, PCBs, pesticides, herbicides. If the contaminant was known or suspected, other parameters may have been analyzed for (i.e. total petroleum hydrocarbons (TPH) and polycyclic aromatic hydrocarbons (PAH) near fuel spills).

3.3 Short-term health risk:

Not an identified source of health risk. No short term (acute) health risks identified**.**

3.4 Long-term health risk:

None identified based on available sample data. All contaminants were measured at concentrations below MEGs.

4 Water

In order to assess the health risk to U.S. personnel from exposure to water in theater, the USAPHC identified the most probable exposure pathways. These were based on the administrative information provided on the field data sheets submitted with the samples taken over the time period being evaluated.

Bottled water was the primary source of drinking water for all deployed personnel in Saudi Arabia.

Eskan Village draws its hard-piped water (used for personal hygiene and cooking) from Riyadh Water Authority (RWA). RWA water comes from a variety of sources; ground water, ground water under the influence of surface water and desalinated water.

4.1Drinking Water: Bottled

4.1.1Site-Specific Sources Identified

All bottled water was from U.S. Army Public Health Command-approved sources (Nova, Nestle, and Al Manhal). Each shipment of bottled water was tested upon receipt. The monitoring includes total coliform presence/absence and E. coli. In addition, broad spectrum analysis has been performed on bottled water.

4.1.2 Sample data/Notes:

Three broad spectrum analysis samples were collected in 2004. All analytes were detected at levels below the short or long term exposure levels. Additionally, all routine monitoring results were within acceptable limits.

4.1.3 Short-term and long-term health risks:

None identified based on available sample data.

4.2 Non-Drinking Water: Treated/Disinfected

4.2.1 Site-Specific Sources Identified

Monitoring included total coliform presence/absence and *E. coli*, pH, chlorine residual, and monthly M272. Additionally, annual comprehensive screening analysis was taken and submitted to USAPHC IAW *TB Med 577*. All Results were loaded in DOEHRS DoD Surveillance program office. While the water provided in the distribution systems met *TB Med 577* for water potability, the systems were classified as non-potable due to lack of backflow prevention devices and the risk of infiltration to the aging system. The system was used for brushing teeth, washing clothes, washing dishes, and taking showers.

Although the primary route of exposure for most microorganisms was ingestion of the contaminated water, dermal exposure to some microorganisms, chemicals, and biological contaminants may had also caused adverse health effects. Complete exposure pathways would had included drinking, brushing teeth, personal hygiene, cooking, providing medical and dental care using a contaminated water supply or during dermal contact at vehicle or aircraft wash racks.

4.2.2 Sample data/Notes:

From 1999-2015, 21 broad spectrum analysis samples were collected and evaluated for this health risk assessment.

Broad spectrum analytes were not detected at levels above the short or long term MEGs.

Records indicate that the routinely monitored parameters (pH, chlorine, bacteriological) were typically within acceptable limits. Deviations from acceptable limits were investigated and corrected as they occur.

4.2.3 Short and long-term health risks:

None identified based on available sample data

5 Military Unique

5.1 Chemical Biological, Radiological Nuclear (CBRN) Weapons

There were no specific hazard sources or exposure incidents documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS) or the Military Exposure Surveillance Library (MESL) during the period from 1999-2015.

5.2 Depleted Uranium (DU)

There were no specific hazard sources or exposure incidents documented in the Defense Occupational and Environmental Health Readiness System (DOEHRS) or the Military Exposure Surveillance Library (MESL) during the period from 1999-2015.

5.3 Ionizing Radiation

5.3.1 Security Forces personnel used an x-ray backscatter device (Rapiscan), located in the ESFS Visitor Control Center, for vehicles entering the gate. Radiation protection survey performed verified that shielding and precautions taken were adequate for operations and showed compliance with occupational and general public radiation safety standards.

5.3.2 Short-term and long-term health risks:

Low: Procedures were in place to maintain exposures as low as reasonable achievable. Confidence in this risk was high.

5.4 Non-Ionizing Radiation

5.4.1 Radar and communication antennas, which emit radio frequency radiation, were scattered throughout the base. Exposure potential was low due to elevated antennas, restricted areas, warning signs, and safe standard operating procedures.

5.4.2 Short and long-term health risks:

Low: Procedures were in place to maintain exposures below the permissible exposure limits. Confidence in this risk assessment was medium.

6 Endemic Disease[1]

All information was taken directly from the National Center for Medical Intelligence (NCMI) (https://www.intelink.gov/ncmi), Infectious Disease Risk Assessment for Saudi Arabia 29 March 2011. This document lists the endemic disease reported in the region, its specific risks and severity and general health information about the disease. The general information on meningococcal meningitis regarding how it was transmitted from person to person came from the World Health Organization's Fact Sheet No. 141 on Meningococcal Meningitis. USCENTCOM MOD 12 (Reference 11 of this document) lists deployment requirements, to include immunization and chemoprophylaxis, in effect during the time frame covered by this POEMS.

6.1 Foodborne and Waterborne Diseases

Food borne and waterborne diseases in the area were potentially transmitted through the consumption of local food and water. Sanitation was poor throughout the country, including major urban areas. Local food and water sources were heavily contaminated with pathogenic bacteria, parasites, and viruses to which most U.S. Service members had little or no natural immunity. Effective host nation disease surveillance did not exist within the country. Only a small fraction of diseases were identified or reported in host nation personnel. Diarrheal diseases could be expected to temporarily incapacitate a very high percentage of U.S. personnel within days if local food or water was consumed. Hepatitis A and typhoid fever could cause prolonged illness in a smaller percentage of unvaccinated personnel. Vaccination was required for DOD personnel and contractors. In addition, although not specifically assessed in this document, viral gastroenteritis (e.g., norovirus) and food poisoning (e.g., Bacillus cereus, Clostridium perfringens, and Staphylococcus) may cause significant outbreaks. Key disease risks (Moderate risk and above) were summarized below:

1 NOTE: "Risk" level refers to both severity of disease (without controls, for example vaccinations) and probability of disease based on local rates/endemic status. Diseases described were those presenting greater risk when compared with U.S. conditions. Most identified disease risks could and were being mitigated with military preventive medicine measures/policies.

6.1.1 Diarrheal Diseases (Bacteriological)

Unmitigated High - Mitigated Low: Mitigation was in place, U.S. Forces were provided food and water from approved sources. Diarrheal diseases could be expected to temporarily incapacitate a very high percentage of personnel (potentially over 50 percent per month) within days if local food, water, or ice was consumed from unapproved sources. Field conditions (including lack of hand washing and primitive sanitation) may facilitate person-to-person spread and epidemics. Typically mild disease treated in outpatient setting; recovery and return to duty in less than 72 hours with appropriate therapy. A small proportion of infections may require greater than 72 hours limited duty, or hospitalization.

6.1.2 Hepatitis A

Unmitigated Moderate - Mitigated Low: Unmitigated health risk to U.S. personnel was moderate year round. Hepatitis A is usually spread by eating food or drinking water contaminated with infected feces. Mitigation was in place, U.S. Personnel did not drink untreated water and vaccination with Hepatitis A vaccine was required for deployment into the CENTCOM AOR. Water consumed by U.S./DOD personnel was treated on military camps. Typical case involves 1 to 3 weeks of debilitating symptoms, sometimes initially requiring inpatient care; recovery and return to duty may require a month or more.

6.1.3 Typhoid / Paratyphoid Fever

Unmitigated Moderate – Mitigated Low: Unmitigated health risk to U.S. personnel was moderate year round. Mitigation measures include mandatory Typhoid vaccination for U.S. deployers to the CENTCOM AOR. Risk was typically highest following spring floods. Typhoid and paratyphoid were potentially acquired through the consumption of fecally contaminated food or water. Asymptomatic carriers were common with typhoid and contribute to sustained transmission. A small number of cases (less than 1% per month attack rate) could had occurred among unvaccinated personnel who consumed local food, water, or ice. Common source outbreaks may had occurred. Mitigation was in place, U.S. personnel did not drink untreated water. With appropriate treatment, typhoid and paratyphoid fever were debilitating febrile illnesses typically requiring 1 to 7 days of supportive care, followed by return to duty.

6.1.4 Diarrhea – Protozoal

Unmitigated Moderate – Mitigated Low: Mitigation was in place, U.S. personnel did not drink untreated water. Risk was typically highest following spring floods. In general, Cryptosporidium spp., Entamoeba histolytica, and Giardia lamblia were the most common protozoal causes of diarrhea wherever sanitary conditions were significantly below U.S. standards. A small number of cases (less than 1% per month attack rate) could had occurred among personnel consuming local food, water, or ice. Outbreaks affecting a higher percentage of personnel were possible with Cryptosporidium.
Symptomatic cases varied in severity; typically mild disease demonstrating recovery and return to duty in less than 72 hours with appropriate therapy; severe cases may require 1 to 7 days of supportive care, followed by return to duty.

6.1.5 Brucellosis

Unmitigated Moderate – Mitigated Low: Mitigation was in place, U.S. Forces were provided food and water from approved sources. Rare cases (less than 0.1% per month attack rate) could occur among personnel consuming local dairy products or having direct occupational-type contact with livestock. (U) With appropriate treatment, brucellosis is a febrile illness of variable severity, potentially requiring inpatient care; convalescence is usually over 7 days even with appropriate treatment. The risk from direct animal contact is likely to be highest in rural areas where livestock are present. However, the risk from contaminated dairy products can occur countrywide, including urban areas. Brucellosis is hyperendemic in the rural central region around Riyadh.

6.1.6 Short-term Health Risks:

Unmitigated Moderate to High – Mitigated Low: The overall short-term unmitigated risk associated with food borne and waterborne diseases was considered High (for bacterial diarrhea) to Moderate (for hepatitis A and diarrhea-protozoal) if local food or water was consumed from unapproved sources. Preventive medicine measures such as vaccinations reduce the risk estimate to none (for Hepatitis A). Additionally, U.S. Forces were provided food and water from approved sources. Confidence in the health risk estimate was Medium

6.1.7 Long-term Health Risks:

None identified based on available data.

6.2 Arthropod Vector-Borne Diseases

During warmer months (approximately April to November), ecological conditions in rural and periurban areas support arthropod vectors, including ticks with variable rates of disease transmission. Because Saudi Arabia lacks adequate diagnostic capability, vector-borne diseases frequently were underreported, and there was a reliance on clinical (symptom-based, vs. laboratory confirmation-based) diagnosis.
Vector-borne diseases were transmitted at low or unknown levels and may have constituted a significant health risk in the absence of mitigation measures. See Section 10.4 for more information about pesticides and pest control measures.

6.2.1 Crimean-Congo hemorrhagic fever

Unmitigated Moderate – Mitigated Low: Potential unmitigated health risk to U.S. personnel was Moderate year round with peak transmission from March through November, but reduced to low with mitigation measures. For U.S. personnel, risk mitigation included proper wear of treated uniforms and application of repellent to exposed skin. Risk from tick-borne transmission was limited primarily to warmer months. Risk of transmission from animal contact was present year-round. Most primary Crimean-Congo hemorrhagic fever (CCHF) infections occur as sporadic cases or clusters of cases, and were associated with tick bites or occupational contact with blood or secretions from infected animals.
Outbreaks of CCHF occur infrequently, but may be associated with changes in agricultural land use that increase tick contact or incursions of susceptible populations into areas where the disease was endemic. Rare cases (less than 0.1% per month attack rate) could have occurred among personnel exposed to tick bites. Direct contact with blood and body fluids of an infected animal or person may also have transmitted infection. It was a very severe illness typically requiring intensive care with fatality rates from five to fifty percent.

6.2.2 Leishmaniasis – Cutaneous/Visceral

Unmitigated Moderate – Mitigated Low: Potential health risk to U.S. personnel was moderate year round. For U.S. personnel, risk mitigation included proper wear of treated uniforms, application of repellent to exposed skin, and minimizing outdoor activities (when possible) between dusk and dawn. Leishmaniasis was transmitted by sandflies. Transmission generally was limited to the warmer months. A small number of cases (less than 1% per month attack rate) could occur among personnel exposed to sandfly bites in areas with infected people, rodents, dogs, or other reservoir animals. Asymptomatic chronic infections may had occurred, which may become symptomatic years later. Cutaneous infection was unlikely to be debilitating, though lesions could be disfiguring. Definitive treatment previously required non-urgent evacuation to the continental United States; currently, not all cases require evacuation.

6.2.3 Dengue Fever

Unmitigated Moderate – Mitigated Low: Sporadic cases could occur most of the time. However, conditions may support unpredictable increases in transmission, during which limited outbreaks affecting up to 1% per month could occur among personnel exposed to mosquito bites, primarily during the day. More than 90 percent of reported cases occur in Jiddah and Mekka, with a small number reported in Jizan and Medina. The remainder of the country is risk-free. Dengue fever is a debilitating febrile illness typically requiring 1 to 7 days of inpatient care, followed by return to duty. Some cases may require a longer recovery period. Because most U.S. personnel have not had extensive previous exposure to dengue, the force-wide risk for dengue hemorrhagic fever and dengue shock syndrome (DHF/DSS) from sequential infections with multiple serotypes has been low. DHF and DSS are more severe, requiring longer hospitalization and convalescence, with potential fatalities. Surveillance and control measures are expected to contain transmission under most circumstances.

6.2.4 Alkhumra virus (also called Alkhurma)

Unmitigated Moderate – Mitigated Low: Rare cases (less than 0.1% per month attack rate) could occur in personnel exposed to tick bites, blood or body fluids of a potentially infected animal (sheep, potentially camels), or unpasteurized milk of an infected animal. Mosquito exposure may also be a risk. (U) Debilitating febrile illness sometimes requiring intensive care; approximately 25 percent of cases demonstrate hemorrhagic symptoms and 23 percent have central nervous system manifestations including encephalitis. The most recent data indicate a fatality rate of 1 percent to 2 percent. Evidence of Alkhurma hemorrhagic fever virus infection was found in Ornithodoros savignyi (soft ticks) and Hyalomma dromedarii (hard ticks) collected in Najran Province, southern Saudi Arabia, in 2009.

6.2.5 Sandfly Fever

Low: Potential health risk to U.S. personnel was Low and transmission generally was limited to the warmer months. The disease was transmitted by sandflies, which typically bite at night and breed in dark places rich in organic matter, particularly in rodent or other animal burrows. Other suitable habitats include leaf litter, rubble, loose earth, caves, and rock holes. Sandflies may be common in peridomestic settings. Abandoned dwellings, sometimes used by troops as temporary quarters, also could harbor significant numbers of sandflies. Stables and poultry pens in peridomestic areas also may harbor sandflies. Although data were insufficient to assess potential disease rates, 1 to 10 percent of personnel could had been affected per month under worst case conditions. In small groups, exposed to heavily infected sandfly populations in focal areas, attack rates could had been very high (over 50 percent). Incidents could result in debilitating febrile illness typically requiring 1 to 7 days of supportive care followed by return to duty.

6.2.6 Plague

Low: Potential health risk to U.S. personnel was Low year round. Bubonic plague typically occurs as sporadic cases among people who come in contact with wild rodents and their fleas during work, hunting, or camping activities. Outbreaks of human plague were rare and typically occur in crowded urban settings associated with large increases in infected commensal rats (Rattus rattus) and their flea populations. Some untreated cases of bubonic plague may develop into secondary pneumonic plague. Respiratory transmission of pneumonic plague was rare but has the potential to cause significant outbreaks. Close contact was usually required for transmission. In situations where respiratory transmission of plague was suspected, weaponized agent must be considered. Extremely rare cases (less than 0.01% per month attack rate) could occur. Incidence could result in potentially severe illness which may require more than 7 days of hospitalization and convalescence.

6.2.7 Flea-borne Typhus

Low: Potential health risk to U.S. personnel was Low. The disease was transmitted by fleas, usually on rats. While rat fleas were the most common vectors, cat fleas and mouse fleas were less common modes of transmission. These fleas were not affected by the infection. Human infection occurs because of flea-fecal contamination of the bites on human skin.

6.2.8 West Nile Fever

Low: Potential health risk to U.S. personnel was Low with transmission generally limited to the warmer months. West Nile fever was present and was maintained by bird populations and multiple species of Culex mosquitoes that help to transfer the diseases from birds to humans. The majority of infections in young, healthy adults were asymptomatic although it could result in fever, headache, tiredness, and body aches, occasionally with a skin rash (on the trunk of the body) and swollen lymph glands.

6.2.9 Tick-borne rickettsioses (Spotted fever group)

Low: Potential health risk to U.S. personnel was Low with rare cases present. The disease was transmitted to humans through bites of certain species of ticks.

6.2.10 Malaria

Low: Rare cases (less than 0.1% per month attack rate) could occur among personnel exposed to mosquito bites, primarily at night. Predominantly P. falciparum; remainder is P. vivax. Year-round (peak transmission period Mar through Sep). Risk is typically elevated during and immediately following the rainier months. Outbreaks can follow any prolonged rainy period. Risk varies by location. Most of the country is malaria free including the cities of Jeddah, Medina, Mecca, and Taif. Local transmission occurs in the western emirates of Al Bahah, Asir, and Jazan bordering Yemen. Debilitating febrile illness typically requiring 1 to 7 days of inpatient care, followed by return to duty. Severe P. falciparum cases may require intensive care or prolonged convalescence, and fatalities can occur.

6.2.11 Rift Valley Fever

Low: Sporadic cases could occur most of the time. However, conditions may support unpredictable increases in transmission, during which limited outbreaks affecting up to 1% per month could occur among personnel exposed to mosquito bites or blood of potentially infected livestock. Risk varies by location, however RVF primarily occurs in the southwestern corner of Saudi Arabia bordering Yemen. Year-round (peak transmission period Mar through Sep). Risk is typically elevated during and just after the rainy season. Debilitating febrile illness typically requiring 1-7 days of supportive care, followed by return to duty. Retinopathy sometimes leading to blindness may occur in up to 10 percent of patients. Severe complications including hepatitis with hemorrhage, and encephalitis may occur, leading to fatalities. Saudi Arabia has excellent surveillance and control measures for RVF, including widespread vaccination as needed. The potential for a significant outbreak affecting humans is low.

6.2.12 Sindbis (and Sindbis-like virus)

Low: Potential health risk to U.S. personnel was Low with rare cases present. The virus was transmitted by mosquitoes and was maintained in nature by transmission between vertebrate (bird) hosts and invertebrate (mosquito) vectors. Humans were infected with Sindbis virus when bitten by an infected mosquito.

6.2.13 Short and long-term health risks:

Moderate: The unmitigated health risk estimate was moderate. Health risk was reduced to low by proper wear of the uniform, application of repellent to exposed skin, and appropriate chemoprophylaxis. Confidence in health risk estimate was medium.

6.2.14 Long-term health risks:

None identified based on available data.

6.3 Water Contact Diseases

Operations or activities that involved extensive water contact may result in personnel being temporarily debilitated with leptospirosis in some locations. Leptospirosis health risk typically increases during flooding. In addition, although not specifically assessed in this document, bodies of surface water were likely to be contaminated with human and animal waste. Activities such as wading or swimming may had resulted in exposures to enteric diseases such as diarrhea and hepatitis via incidental ingestion of water. Prolonged water contact may also lead to the development of a variety of potentially debilitating skin conditions such as bacterial or fungal dermatitis.

6.3.1 Leptospirosis

Unmitigated – Moderate / Mitigated - Low: Leptospirosis unmitigated risk was moderate year-round with peak season April through October. The disease was present in Saudi Arabia, but at unknown levels. Data were insufficient to assess potential disease rates, up to 1-10 percent of personnel wading or swimming in bodies of water such as lakes, streams, or irrigated fields could be affected per month. Human infection occurs through exposure to water or soil contaminated by infected animals and has been associated with wading, and swimming in contaminated, untreated open water. Leptospirosis could enter the body through cut or abraded skin, mucous membranes, and conjunctivae. Ingestion of contaminated water could also lead to infection. The acute generalized illness associated with infection could mimic other tropical diseases (for example, dengue fever, malaria, and typhus), and common symptoms include fever, chills, myalgia, nausea, diarrhea, cough, and conjunctival suffusion.
Manifestations of severe disease could include jaundice, renal failure, hemorrhage, pneumonitis, and hemodynamic collapse. Recreational activities involving extensive water contact may result in personnel being temporarily debilitated with leptospirosis. Mitigation strategies included avoiding water contact and recreational water activities, proper wear of uniform (especially footwear), and protective coverings for cuts/abraded skin.

6.3.2 Schistosomiasis

Unmitigated – Moderate / Mitigated - Low: Schistosomiasis unmitigated risk was moderate with peak season April through November. Humans release schistosome eggs through urine and feces, which may be contaminating surface water. When water temperatures in lakes, streams, and rivers were at or above 68^{o}F, the eggs hatch and release the larvae into the water. If the right type of freshwater snail was present, the larvae penetrate the snail, develop, and emerge as free-swimming cercariae that could infect humans by penetrating the skin of people while wading or swimming. Mitigation strategies were the same as listed above.

6.3.3 Short-term health risks:

Unmitigated – Moderate / Mitigated - Moderate: Health risk of leptospirosis and schistosomiasis was moderate without mitigation strategies in place. Confidence in the health risk estimate was medium

6.3.4 Long-term health risks:

None identified based on available data.

6.4 Respiratory Diseases

Although not specifically assessed in this document, deployed U.S. forces may be exposed to a wide variety of common respiratory infections in the local population. These included influenza, pertussis, viral upper respiratory infections, viral and bacterial pneumonia, and others. U.S. military populations living in close-quarter conditions were at risk for substantial person-to-person spread of respiratory pathogens. Influenza was of particular concern because of its ability to debilitate large numbers of unvaccinated personnel for several days.

6.4.1 Tuberculosis (TB)

Low: Potential unmitigated health risk to U.S. personnel was Low year round. Transmission typically requires close and prolonged contact with an active case of pulmonary or laryngeal tuberculosis (TB), although it also could occur with more incidental contact. The likelihood of exposure to an active case varies with the overall incidence and the degree of contact with the local population, particularly those living in conditions of crowding and poverty. Tuberculin skin test (TST) conversion rates may had been elevated over baseline for personnel with prolonged close exposure to local populations. A TST screening to detect latent infection may be warranted in personnel with a history of prolonged close exposure to local populations. Tuberculosis exposure and infection was evaluated as part of the Post Deployment Health Assessment (PDHA) process.

6.4.2 Meningococcal Meningitis

Low: Potential unmitigated health risk to U.S. personnel was Low year round. However, the health risk may be elevated during cooler months. Asymptomatic colonization and carriage of meningococcal bacteria was common worldwide, including within U.S. military populations; rare symptomatic cases may had occurred periodically in military populations, regardless of geographic location. Meningococcal meningitis was potentially a very severe disease typically requiring intensive care; fatalities may occur in 5-15% of cases.

6.4.3 Short-term health risks:

Low: Confidence in the health risk estimate was Medium.

6.4.4 Long-term health risks:

None identified based on available data.

6.5 Animal-Contact Diseases

6.5.1 Q-Fever

Unmitigated – Moderate / Mitigated - Low: Potential unmitigated health risk to U.S. personnel was Moderate year round. Rare cases were possible among personnel exposed to aerosols from infected animals, with clusters of cases possible in some situations. Significant outbreaks (affecting 1-50%) could occur in personnel with heavy exposure to barnyards or other areas where animals were kept. Unpasteurized milk may also transmit infection. The primary route of exposure was respiratory, with an infectious dose as low as a single organism. Incidence could result in debilitating febrile illness, sometimes presenting as pneumonia, typically requiring 1 to 7 days of inpatient care followed by return to duty. Mitigation strategies included consuming approved food sources, proper food preparation and cooking temperatures, avoidance of animals and farms, dust abatement when working in these areas, and proper PPE for personnel working with animals.

6.5.2 Rabies

Low: Potential unmitigated health risk to U.S. personnel was Low year round. Rabies was transmitted by exposure to virus-laden saliva of an infected animal, typically through bites. Prevalence in feral and wildlife populations was well above U.S. levels due to the lack of organized control programs. Personnel bitten by potentially infected reservoir species may had developed rabies in the absence of appropriate prophylaxis. The circumstances of the bite should had been considered in evaluating individual health risk; in addition to dogs and cats, bats or wild carnivores should also had been regarded as rabid unless proven otherwise. General Order 1B mitigated rabies risk by prohibiting contact with or adoption or feeding of feral animals. Very severe illness with near 100% fatality rate could had occurred in the absence of post-exposure prophylaxis. Typically the time period from exposure to the onset of symptoms was 2 – 12 weeks, but could rarely take several years.

6.5.3 Anthrax

Low: Potential unmitigated health risk to U.S. personnel was Low year round. Anthrax was a naturally occurring infection of livestock and wild herbivores with a worldwide distribution. Rare cases (less than 0.1% per month attack rate) could had occurred among personnel with occupational-type exposure to livestock or wild herbivores, hides, wool products from these species, as well as handling or consumption of undercooked meat. In the absence of such exposures, the health risk was essentially zero. Inhalation cases raise the possibility of weaponized agent. Cutaneous and gastrointestinal anthrax were the most common forms of naturally occurring anthrax. The health risk of naturally acquired inhalation (pulmonary) anthrax was remote. Cutaneous anthrax typically requires 1 to 7 days of supportive care with subsequent return to duty; gastrointestinal anthrax typically requires hospitalization, and has a high fatality rate if untreated. Inhalation anthrax was very severe, often requiring intensive care; fatalities may occur even in treated cases.

6.5.4 H5N1 avian influenza

Low: Potential unmitigated health risk to U.S. personnel was Low. Although H5N1 avian influenza (AI) was easily transmitted among birds, bird-to-human transmission was extremely inefficient. Human infections had occurred on a very rare basis and had been associated with activities involving close, direct contact with infected poultry, such as plucking, slaughter, or other handling. There was no health risk from consumption of properly cooked poultry products. Human-to-human transmission appears to be exceedingly rare, even among relatively close contacts. Extremely rare cases (less than 0.01% per month attack rate) could had occurred. Incidence could have resulted in very severe illness with fatality rate higher than 50 percent in symptomatic cases.

6.5.5 Short-term health risks:

Unmitigated – Varies / Mitigated - Low: Low for rabies, H5N1 avian influenza and anthrax, Moderate for Q-fever. Confidence in the health risk estimate was Medium.

6.5.6 Long-term health risks:

Low: The long term risk for rabies was Low.

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7 Venomous Animal/Insect

All information was taken directly from the Clinical Toxinology Resources web site (http://www.toxinology.com) from the University of Adelaide, Australia and from the Armed Forces Pest

Management Board Living Hazards Database (http://www.afpmb.org/content/living-hazards-database). The species listed below had home ranges that overlap the location of Saudi Arabia and may present a health risk if they were encountered by personnel. Personnel at Eskan Village experience minimal sightings or contact.

7.1 Spiders

- Latrodetus hasselti (Red-Backed Spider), Latrodectus mactans (Black Widow Spider): Severe envenoming possible, potentially lethal. Mainly neurotoxic.

7.2 Scorpions

- Androctonus crassicauda (Black Scorpion), Leiurus quinquestriatus (Death Stalker): Severe envenoming possible, potentially lethal. Cardiotoxicity may be direct or indirect, but was a feature of severe envenoming, with cardiac arrhythmias, cardiac failure.
- Scorpio maurus (Large-clawed Scorpion), Scorpio maurus palmatus (Golden Desert Scorpion): Envenomation causes moderate to severe local pain, usually resolves in 24 hours with only symptomatic treatment.

7.3 Snakes

- Cerastes cerastes (Desert horned viper), Cerastes gasperettii (Gasperetti's Horned Sand Viper), Pseudocerastes persicus (Persian horned viper): Significant local effects and systemic effects, including coagulopathy could occur.
- Malpolon monspessulanus (Montpellier snake): Moderately neurotoxic. Symptoms observed for up to 48 hours in severe cases
- Atractaspis microlepidota (Small-scaled Burrowing Asp), Bitis arietans (Puff Adder), Echis coloratus (Burton's carpet viper), Echis pyramidum (Geoffroy's Carpet Viper), Naja haje (Arabian Cobra), Macrovipera lebetina (Levantine Viper), Pseudocerastes fieldi (Field's Horned Viper), Walterinnesia aegyptia (Desert cobra): Severe envenoming possible, potentially lethal.

7.4 Snails

- Conus textile (Snails): Serious & painful envenomations (sometimes fatal) usually occur when swimmers (waders) pick up shells with live snails still inside

7.5 Short-term health risk:

Unmitigated – High / Mitigated - Low: If encountered, effects of venom varied with species from mild localized swelling (to potentially lethal effects. See effects of venom above. Mitigation strategies included avoiding contact, proper wear of uniform (especially footwear), and timely medical treatment. Stings or bites by local spiders, scorpions, snakes, or snails should be treated as a medical emergency and personnel should seek immediate medical treatment and antivenin, if necessary and available. Confidence in the health risk estimate was low (TG 230 Table 3-6).

7.6 Long-term health risk: None identified.

8 Heat/Cold Stress

Predominant winds were from the North from June through September, and were mixed (both blowing

from the North or South) the rest of the year.

8.1 Heat

The health risk of heat stress/injury based on temperatures alone was Low (< 78 °F) in December - February, High (82-87.9°F) in March, November and extremely high (≥ 88°F) from April – October. However, work intensity and clothing/equipment worn pose greater health risk of heat stress/injury than environmental factors alone (Goldman, 2001).

Personnel were educated on dangers of heat stress, water intake and work/rest cycles.

8.1.1 Short-term health risk:

Unmitigated – Low to High / Mitigated - Low to High: Risk of heat injury in unacclimatized personnel, susceptible populations (older, previous history of heat injury, poor physical condition, underlying medical/health conditions), and those under operational constraints (equipment, PPE, vehicles) from April to October was High, and Low for all other months. The risk of heat injury was reduced through preventive measures. Because the occurrence of heat stress/injury was strongly dependent on operational factors (work intensity and clothing), confidence in the health risk estimate was low (TG 230, Table 3-6).

8.1.2 Long-term health risk:

Low: Long-term health implications from heat injuries were rare but could occur, especially from more serious injuries such as heat stroke. However, the health risk may be greater to certain susceptible persons–those older (i.e., greater than 45 years), in lesser physical shape, or with underlying medical/health conditions. The long-term health risk was Low; confidence in the health risk estimates was medium (TG 230, Table 3-6).

8.2 Cold

Even on warm days there could be a significant drop in temperature after sunset by as much as 40 °F. There was a risk of cold stress/injury when temperatures fall below 60 °F, which could occur from November to March. The health risk assessment for non-freezing cold injuries (chilblain, trench foot, and hypothermia) was Low based on historical temperature and precipitation data. Frostbite was unlikely to occur because temperatures rarely drop below freezing. However, personnel may encounter significantly lower temperatures during field operations at higher altitudes. As with heat stress/injuries, cold stress/injuries were largely dependent on operational and individual factors instead of environmental factors alone. With protective measures in place the health risk assessment was low for cold stress/injury; confidence in the health risk estimate was medium.

8.2.1 Short-term health risks:

Low: The health risk of cold injury was Low. Confidence in the health risk estimate was medium.

8.2.2 Long-term health risk:

Low: The health risk of cold injury was Low. Confidence in the health risk estimate was high

9 Noise

9.1 Continuous

Power generation taking place at Eskan Village create outdoor noise levels that occasionally fluctuated above the threshold level requiring single-level hearing protection (85 A-weighted decibels (dBA)). For the majority of personnel on this site, noise levels above the hearing protection threshold were for short durations and average daily exposures were below levels requiring participation in a hearing conservation program.

9.1.1 Short-term health risks:

Low: Short-term risk of noise injury with appropriate hearing protection use was Low. Confidence in the health risk assessment was medium (TG 230, Table 3-6).

9.1.2 Long-term health risks:

Low: Long-term risk of noise injury with appropriate hearing protection use was Low. Confidence in the health risk assessment was medium (TG 230, Table 3-6).

9.2 Impulse

Personnel at this site did not participate in convoy operations. Weapon firing was limited to mostly training. Exposure was intermittent.
9.2.1 Short-term health risks

Low: Short-term risk of noise injury with appropriate hearing protection use was Low. Confidence in the health risk assessment was medium (TG 230, Table 3-6).

9.2.2 Long-term health risks:

Low: Long-term risk of noise injury with appropriate hearing protection use was Low. Confidence in the health risk assessment was medium (TG 230, Table 3-6).

10 Unique Incidents/Concerns

10.1 Potential environmental contamination sources

DoD personnel were exposed to various chemical, physical, ergonomic, and biological hazards in the course of performing their mission. These types of hazards depend on the mission of the unit and the operations and tasks which the personnel were required to perform to complete their mission. The health risk associated with these hazards depends on a number of elements including what materials were used, how long the exposure last, what was done to the material, the environment where the task or operation was performed, and what controls were used. These process and hazards were identified and evaluated in DOEHRS for the corresponding work centers. Exposures to these occupational hazards could occur through inhalation (air), skin contact, or ingestion; however exposures through air were generally associated with the highest health risk.

10.2 Waste Sites/Waste Disposal

10.2.1 Site specific sources identified:

Solid waste was removed by a local contractor and disposed of in an off-base host nation landfill. Medical waste was transported to local hospital for incineration. Due to the limited industrial operations on base, minimal hazardous wastes were generated (mostly used POL products). Personnel handling these wastes had proper personal protective equipment available in their workplace. Finally, there was a burn barrel used to dispose of classified paper documents.

10.2.2 Short and Long-Term Health Risks:

Low: U.S. personnel had little exposure to waste materials. Confidence in this evaluation was medium.

10.3 Fuel/petroleum products/industrial chemical spills:

No Fuel/petroleum products/industrial chemical spills documented in DOEHRS or the MESL.

10.4 Pesticides/Pest Control:

10.4.1 Site specific sources identified

There were various types of pest control measures utilized at Eskan Village. Glue traps were used to control rates when reported in area. CE & Environmental Health trap cats and the Veterinarian vaccinates them and clips a portion of the ear for identification purposes then releases the cat back to where they found it as it was good in controlling rats/mice. Ants were controlled via Integrated Pest Management (eradicate the source, then use traps, then spray as a last resort). Pesticide spraying for mosquitoes was discontinued in 2010 because there were few vectors present.

10.4.2 Short-term and Long-term health risks

Low: Long term health risk was Low. Confidence in the health risk assessment was medium (TG 230 Table 3-6).

10.5 Asbestos

10.5.1 Site specific sources identified

A single sample collected on 11 Dec 96 by Bioenvironmental Engineering personnel detected 15-30% Chrysotile asbestos from roof tile at building 906 (a warehouse in the old BX area). No systematic base-wide survey has occurred. It was not uncommon for countries outside the U.S. to use materials that contain asbestos. Asbestos-containing materials that were intact and managed in place, present minimal hazards to U.S. personnel.

10.5.2 Short and long-term health risks:

Low. Confidence was this risk assessment was low due to limited data availability.

10.6 Lead Based Paint

There was no specific information available to assess this hazard.

11 References[2]

1. Armed Forces Pest Management Board Living Hazards Database: http://www.afpmb.org/content/living-hazards-database

2. Casarett and Doull's Toxicology: the Basic Science of Exposures, Chapter 2- Principles of Toxicology; Fifth Edition, McGraw Hill, New York.

3. Clinical Toxinology Resources: http://www.toxinology.com/. University of Adelaide, Australia.

4. Defense Occupational and Environmental Health Readiness System (referred to as the DOEHRS-EH database) at https://doehrs-ih.csd.disa.mil/Doehrs/.

5. Department of Defense (DoD) Instruction 6490.03, Deployment Health, 2006.

6. DoDI 6055.05, Occupational and Environmental Health, 2008.

7. DoD MESL Data Portal: https://mesl.apgea.army.mil/mesl/. Some of the data and reports used may be classified or otherwise had some restricted distribution.

8. Goldman RF. 2001. Introduction to heat-related problems in military operations. In: Textbook of military medicine: medical aspects of harsh environments Vol. 1, Pandolf KB, and Burr RE (Eds.), Office of the Surgeon General, Department of the Army, Washington DC.

9. Joint Staff Memorandum (MCM) 0028-07, Procedures for Deployment Health Surveillance, 2007.

10. National Center for Medical Intelligence (NCMI): https://www.intelink.gov/ncmi/index.php.

11. Modification 12 to United States Central Command Individual Protection and Individual, Unit Deployment Policy, 2 December 2013.

12. USA PHC TG230, June 2010 Revision.

13. USACHPPM 2008 Particulate Matter Factsheet; 64-009-0708, 2008.

[2] NOTE. The data were currently assessed using the 2010 TG230. The general method involves an initial review of the data which eliminates all chemical substances not detected above 1-yr negligible MEGs. Those substances screened out were not considered acute or chronic health hazards so were not assessed further. For remaining substances, acute and chronic health effects were evaluated separately for air water (soil was only evaluated for long term risk). This was performed by deriving separate short-term and long term population exposure level and estimates (referred to as population exposure point concentrations (PEPC)) that were compared to MEGs derived for similar exposure durations. If less than or equal to negligible MEG the risk was Low. If levels were higher than negligible then there was a chemical-specific toxicity and exposure evaluation by appropriate SMEs, which includes comparison to any available marginal, critical or catastrophic MEGs. For drinking water 15 L/day MEGs were used for the screening while site specific 5-15 L/day were used for more detailed assessment. For nondrinking water (such as that used for personal hygiene or cooking) the 'consumption rate' was limited to 2 L/day (similar to the EPA) which was derived by multiplying the 5 L/day MEG by a factor of 2.5. This value was used to conservatively assess non drinking uses of water.

12 Where Did I Get More Information?

If a provider feels that the Service member's or Veteran's current medical condition may be attributed to specific OEH exposures at this deployment location, he/she could contact the Service-specific organization below. Organizations external to DoD should contact DoD Force Health Protection and Readiness (FHP & R).
Army Institute of Public Health Phone: (800) 222-9698. http://phc.amedd.army.mil/
Navy and Marine Corps Public Health Center (NMCPHC) (formerly NEHC) Phone: (757) 953-0700. http://www-nehc.med.navy.mil
U.S. Air Force School of Aerospace Medicine (USAFSAM) (formerly AFIOH) Phone: (888) 232-3764. http://www.wpafb.af.mil/afrl/711hpw/usafsam.asp
DoD Health Readiness Policy and Oversight (HRP&O) Phone: (800) 497-6261. http://fhpr.dhhq.health.mil/home.aspx