DEFENSE HEALTH BOARD
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FALLS CHURCH, VA 22041-3206

DEC 19 2008

DHB

MEMORANDUM FOR: SURGEON GENERAL OF THE ARMY, LTG ERIC B. SCHOOMAKER, MD, PHD

SUBJECT: Defense Health Board Review of the U.S. Army Center for Health Promotion and Preventive Medicine Assessment of Sodium Dichromate Exposure at Qarmat Ali Water Treatment Plant

EXECUTIVE SUMMARY

At the request of LTG Eric B. Schoomaker, the Surgeon General of the Army, the Defense Health Board (DHB) conducted an external review of a U.S. Army Center for Health Promotion and Preventive Medicine (USACHPPM) occupational and environmental health assessment conducted in 2003 at the Qarmat Ali Water Treatment Plant (WTP) in Basra, Iraq to address a potential sodium dichromate exposure to United States military service members. The DHB was asked to opine on whether the medical evaluations conducted by USACHPPM were comprehensive and appropriate to address the potential exposure of U.S. military and Department of Army civilian personnel to sodium dichromate, to identify lessons learned, and to provide recommendations for improving the Department's policies and procedures.

The DHB Military Occupational and Environmental Health and Medical Surveillance Subcommittee reviewed the classified final report, "Deployment Occupational and Environmental Health Survey and Operational Health Risk Assessment, Qarmat Ali Industrial Water Treatment Plant, Basra, Iraq" which included exposure, medical, epidemiologic, and health risk assessments, as well as information pertaining to health communication efforts undertaken by the USACHPPM Occupational and Environmental Health and Safety (OEHS) Team.

The Subcommittee found the risk assessment timely, comprehensive and appropriate for the potential risk posed to the service members. The comprehensive environmental health assessment including soil and air sampling conducted within weeks of first notification revealed minimal levels of Chromium (Cr) (VI).

Members of the Indiana National Guard, the cohort considered at highest risk, received medical assessments within approximately 30 days of last potential exposure and included biological monitoring for chromium exposure in whole blood, physical examination, medical history, and a several routine periodic tests. Whole blood chromium levels were consistent with published results for the general U.S. population, and were lower than those for groups with known occupational exposures.

Preventive measures were well-planned and satisfactorily executed. Risk communication efforts focused on service members and other stakeholders and employed multiple venues and

formats, including town hall meetings and a series of seven health risk communication fact sheets.

While the Subcommittee found USACHPPM met or exceeded the standard of practice for occupational medicine in regard to the exposure assessment and medical evaluation, they also identified areas for improvement that were both specific to the Qarmat Ali assessment and general.

Specific:

1. **Service members who participated in the field investigation or who had potential for exposure should receive assessment results as soon as they are available. Risk communication efforts should reinforce the following findings: while environmental contamination may be present, all available evidence indicates low levels of personal exposure; a lack of evidence of hazardous levels of absorption and of medical effects (aside from respiratory irritation which is common in the desert environment); as well as no expectation of any future adverse health outcomes. Soldiers who were similarly exposed but were not studied should be reassured that these results apply to them as well. While unlikely, it cannot be negated that there is a possibility that some determinant (for example an unusual job duty, personal habit, or exposure before site remediation) might entail a higher exposure that was not detected in the evaluations conducted. For that reason, information about this episode should be conveyed to appropriate medical care providers and added to the permanent record.**

2. **CHPPM should conduct an assessment as to whether individuals with potential for exposure received and understood the results and implications of information provided to them regarding this assessment.**

3. **The final report should be redacted and declassified and disseminated to all those with a need to know its content.**

4. **The Qarmat Ali assessment provides an excellent case study for future training purposes.**

5. **A debriefing should be arranged to include representatives of all "silos" involved. This includes several state National Guard units, the contractor, and those responsible for local public health to insure that information about this episode is fully shared.**

6. **For each individual potentially involved, an entry should be made in the service and medical record to indicate the individual's personal participation, personal health information generated in the course of the investigation, and synopsis of the investigation.**

7. **A simple registry should be established that includes the names and personal identifiers of each individual involved in this episode including information on potential exposure and personal health information generated in the course of the investigation. This small registry may be useful in the future for confirming service at Qarmat Ali as well as providing the basis for follow-up studies should there be a need.**

General:

1. **The method for anticipating industrial hazards in-theater, including hazard recognition training for soldiers and commanders; in-theater capacity for initial investigation; expertise in health communication; and reserve capabilities to do more comprehensive and thorough investigations, must be maintained.**

2. **An assessment should be conducted in order to determine if there are adequate numbers of available experts in areas such as industrial toxicology and epidemiology. Impediments should be identified and remedies implemented.**

3. **Facilitated and timely access to and availability of civilians with substantial professional experience and expertise should be ensured.**

4. **An external advisory committee should be established to facilitate access to consultation on risk assessment if needed. Activities would include providing advice as requested while certain assessments are being conducted as well as post hoc reviews of completed assessments as requested.**

5. **Exposure avoidance training for soldiers at all ranks should be reviewed and evaluated to ensure effectiveness and maintenance of an appropriate balance between these hazards and the relatively more traditional military hazards.**

6. **Efforts must be made to address the impact of organizational silos on the identification and mitigation of environmental risks in operational settings. Given that joint and combined nature of modern warfare operations, organizational silos consisting of various entities such as nation's armed forces, those from multiple nations, civilian contractors, and residential civilians are a given. However, some or all of these entities may all be involved in the same exposure event and could benefit from an all-inclusive approach to risk assessment. Approaches employing appropriate bridging techniques across silos risk cohorts should be assessed.**

7. **The system for classification of documents related to health related matters should be modified in order to better balance the need for security with the need to facilitate more timely dissemination of results to those that have a need to know.**

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SUBJECT: Defense Health Board Review of the U.S. Army Center for Health Promotion and Preventive Medicine Assessment of Sodium Dichromate Exposure at Qarmat Ali Water Treatment Plant

REFERENCES

a. Memorandum, Department of the Army, Office of the Surgeon General, October 6, 2008, Request for Defense Health Board Review of the Center for Health Promotion and Preventive Medicine (USACHPPM) Occupational and Environmental Health Assessment.

b. 2003 U.S. Army Center for Health Promotion and Preventive Medicine Deployment Occupational and Environmental Health Survey and Operational Health Risk Assessment, Qarmat Ali Industrial Water Treatment Plant, Basra, Iraq.

c. Presentation: Information Briefing Occupational and Environmental Health (OEH) Assessment: Sodium Dichromate Exposures at the Qarmat Ali Water Treatment Plant (WTP) in 2003, to the Defense Health Board Military Occupational and Environmental Health and Medical Surveillance Subcommittee, November 12, 2008, by Mr. James Sheehy and Dr. Coleen Weese, U.S. Army Center for Health Promotion and Preventive Medicine.

d. Versieck J, Hoste J, Barbier F, et al (1978) Determination of Chromium and Cobalt in Human Serum by Neutron Activation Analysis *Clinical Chemistry* 24(2): 303-308.

e. Weese C (2008) Health Implications of Occupational Environmental Sampling. *The Army Medical Department Journal* April-June: 1-7.

f. Nomiyama H, Yotoriyama M et al (1980) Normal Chromium Levels in Urine and Blood of Japanese Subjects Determined by Direct Flameless Atomic Absorption Spectrophotometry, and Valency of Chromium in Urine After Exposure to Hexavalent Chromium *American Industrial Hygiene Association Journal* 41(2):98-102.

g. Vankatesh I and Joost Woittiez (1988) Trace Elements in Human Clinical Specimens: Evaluation of Literature Data to Identify Reference Values. *Clinical Chemistry* 34(3):474-481.

h. Fact Sheet: Potential Exposure of Troops in 2003 to Sodium Dichromate at the Qarmat Ali Water Treatment In Iraq, August 2008, Veterans Health Administration.

i. Fact Sheet: Health Risk Facts Related to Sodium Dichromate at Qarmat Ali Water Treatment Plant, Basrah, Iraq, 29 October 2003, Commander, U.S. Army Center for Health Promotion and Preventive Medicine-Europe.

j. Fact Sheet: Update on Sodium Dichromate Exposure at Qarmat Ali Water Treatment Plant in 2003 (For Soldiers), Date Unavailable, Health Risk Communication Program, U.S. Army Center for Health Promotion and Preventive Medicine.

BACKGROUND

Assessment Process

In a memorandum dated October 6, 2008, the Surgeon General of the Army LTG Eric B. Schoomaker requested the Defense Health Board (DHB) review an Occupational and Environmental Health (OEH) Assessment conducted by the United States Army Center for Health Promotion and Preventive Medicine (USACHPPM) in response to chromium contamination at the Qarmat Ali Water Treatment Plant Iraq in 2003, during Operation Iraqi Freedom. Specifically, the DHB was charged to assess the adequacy of the occupational medicine standard of practice provided and comment on the validity of the assessment conclusions.

Dr. Gregory A. Poland, DHB President, assigned the review to the DHB Military Occupational and Environmental Health and Medical Surveillance Subcommittee, chaired by William E. Halperin MD, MPH, DrPH, and requested a response within 60 days. The Subcommittee held meetings and a teleconference in October and November 2008, including a review of the classified risk assessment, "Deployment Occupational and Environmental Health Survey and Operational Health Risk Assessment, Qarmat Ali Industrial Water Treatment Plant, Basra, Iraq September 30 to November 2, 2003." The report with all appendices was made available to Subcommittee members and questions were answered in an open and forthcoming manner.

Site

Qarmat Ali Industrial Water Treatment Plant located in Basra, Iraq produces industrial water for use in oil production, and does not produce potable water. The site is in an urban area, enclosed by a perimeter fence, and consists of several structures lacking sleeping or living quarters; it was ransacked and not functional when secured by U.S. military forces.
The site was visibly contaminated by sodium dichromate, a corrosion suppression agent used in the water treatment process. Sodium dichromate, the exposure agent in this assessment, is an inorganic compound containing hexavalent chromium known to be toxic and carcinogenic to humans and animals. Subsequently, the exposure agent will be referred to as hexavalent chromium in this report.

Four groups worked at Qarmat Ali during the time of concern: Kellogg, Brown, and Root (KBR), a U.S. based company contracted to restore the plant to operative status; the U.S. National Guard units from Oregon, South Carolina, and Indiana, who provided personal security

to KBR; the British military previously present at the site to secure the area; and Iraqi civilians hired by KBR to assist in the restoration effort. In addition, there is some suggestion that civilians may routinely pass by outside the perimeter fence.

Chronology

In 2003, Army personnel were assigned to provide security for the KBR workers restoring the industrial-grade water treatment facility at Qarmat Ali, Basra, Iraq. In the summer of that year, contract work crews and safety personnel identified sodium dichromate as a potential occupational hazard in the work environment. Several Army soldiers reported to the supporting military medical facility and inquired about the potential health risks posed to them as security detail. Concurrently, KBR initiated containment of the contaminated site and conducted environmental sampling. In-theater military occupational and environmental health specialists addressed the health concerns of the military units at a local "town hall" meeting. Additionally, medical evaluations were conducted for all personnel present at that time to include the Indiana Army Reserve National Guard and Department of the Army civilians, and included a medical history, physical examination, pulmonary function test, chest x-ray, urinalysis, hematology, and a whole-blood total chromium count. All available findings were provided to soldiers for inclusion in their medical record.

Of the 161 potentially-exposed soldiers and Department of Defense (DoD) civilians, 137 were evaluated. No findings indicative of acute hexavalent chromium exposure were identified. Fact Sheets for health risk communication were developed and provided to the soldiers at the site and to appropriate command authorities.

Results of the total chromium blood tests were received later and were marginally above, at, or below the detection limit of the test method. Final after-action reports were prepared and submitted to command authorities. Approximately five months elapsed from the initial awareness of a potential occupational health risk to dissemination of the final written report.

Principles of Risk Assessment/Environment Assessment

Risk Assessment is based upon exposure assessment including the identification and quantification of exposure, and assessment of potential risk based upon prior knowledge of dose response relationships. The principles of Environmental/Occupational risk assessments are based upon an extensive body of knowledge which has identified and provided replicable findings supporting relationships between exposure(s) and outcome(s). Exposure assessment includes, but is not limited to: collection of materials and specimens, for example urine or blood, from potentially exposed individuals in adequate quantities to address current and feasible questions concerning exposure/response relationships; and the collection of information from these individuals on the timing, extent, and plausible responses to the exposure(s) which are independently verifiable whenever practicable.

Risk assessment depends upon analyses of the exposure assessment data utilizing recognized laboratory and epidemiologic methods. These analyses must, by design, incorporate what is known or at least plausible, about sources of variability for both exposure and response

data. With respect to human exposure, age and gender of the potentially-exposed are likely to be important. Analysis of the materials/specimens collected is affected by time between collection and analyses (degradation), quantity of materials/ specimens gathered, and most importantly, the limits of detection.

The end product of the interpretation of findings of the above analyses is a scientifically-defensible measure (estimate) of risk(s) for the exposed individuals given the limitations of both measures of exposure(s) and response(s).

SPECIFIC FINDINGS

Exposure Assessment

KBR health, safety, and environmental (HSE) personnel identified elevated hexavalvent chromium concentrations in various locations of the water treatment plant; subsequently, KBR staff encapsulated various soil areas with a layer of liquid asphalt and loose gravel aggregate, and collected general area air samples and more limited breathing zone air samples before and after containment measures. Results indicated minimal exposure to airborne hexavalent chromium. Limited air monitoring by a British Force (BRITFOR) Environmental Monitoring Team after containment measures also found minimal exposure to hexavalent chromium. Comprehensive soil and air sampling on and around the Qarmat Ali Water Treatment Plant by the USACHPPM Special Medical Augmentation Response Team-Preventive Medicine (SMART-PM), focusing on occupational and environmental health and safety (OEHS) found elevated hexavalent chromium levels in soil particularly at offsite locations. General areas and breathing zone air samples detected no hexavalent chromium.

Medical Assessment

The medical assessment consisted of two parts: biological monitoring for total chromium (representing both hexavalent chromium and trivalent chromium counts, the latter being considerably less toxic) and involved the testing of whole blood as well as a physical examination including medical histories to assess the possible adverse consequences that could result from acute hexavalent chromium exposure. In addition to these exposure-specific medical tests, several routine periodic tests not specific to hexavalent chromium exposure were also conducted, such as pulmonary function tests and chest x-rays.

The choice of test for the biologic monitoring for total chromium was a pivotal decision. Briefly after absorption through inhalation, ingestion, or dermal pathways, the resulting hexavalent chromium compounds can be found in serum, urine, or blood cells. Where hexavalent chromium will be found, if at all, depends on the timing of the sample collection *vis-à-vis* the time of exposure. In this investigation, hexavalent chromium was appropriately sought in whole blood to include red blood cells, rather than in serum or urine where its absence would be expected, since testing was done approximately one month after the end of potential exposure.

The whole blood test results for total chromium revealed generally low levels consistent with published results for the general U.S. population. The results were lower than published

results for groups with known occupational exposure. None of the results were substantially elevated; however, some results were in excess of background levels for the general population. This finding did not correlate with self-reported time on the site. Peer-reviewed findings indicate that in similarly-exposed populations, if total chromium values for some members of the population are slightly higher than those of others, the results are most often due to differences in trivalent chromium, which is influenced by factors such as diet and exercise, and not due to a difference in hexavalent chromium levels.

Had even a subset of the results demonstrated substantial elevation, it would have been essential to assess other information, such as specific job duties, to determine if a subset of the population had evidence of greater exposure due to a common characteristic. In retrospect, given the absence of excessive total chromium levels in the samples acquired, it seems appropriate to have a limited epidemiologic analysis conducted for basic characteristics such as estimated time spent at the field site.

Physical examinations and medical histories did not reveal findings that would point specifically to excessive acute hexavalent chromium exposure. Such outcomes would have included nasal ulceration and /or perforation and characteristic skin ulcers. The extensive testing of the soldiers did reveal a substantial prevalence of reports of respiratory tract irritation. However, the prevalence of irritation is reported to be consistent with the experience of other soldiers in the desert environment. The lack of results indicating excessive absorption of hexavalent chromium (for example, through biological monitoring) further supports the prevalence of respiratory irritation not being related to potential exposure. In retrospect, even though biological monitoring levels were not excessive, it may have been revealing or reassuring to have known whether a difference in chromium levels was present, albeit low, in regard to service members who reported respiratory irritation.

Medical testing was limited to members of the Indiana National Guard and Department of Army civilians on site and was not conducted among members of the Oregon or South Carolina National Guard who were no longer at the site. Had the testing of the Indiana National Guard pointed to excessive exposure and/or worrisome physical signs or symptoms, it would have been reasonable to assess the other guard units. However, the essentially negative results for the Indiana National Guard led to a pragmatic and reasonable decision not to extend testing and medical examination to the other Guard contingents from Oregon and South Carolina. We infer that the decision not to test other units which had previously been at the site was also related to the declining ability of biologic monitoring tests to detect hexavalent chromium as weeks and months pass.

Biological monitoring and medical testing of civilian contractors, the military of other nations, or of civilians who traversed contaminated areas outside of the perimeter fence, were not conducted as part of this field evaluation given the scope and authority of the SMART-PM team. Given that remediation efforts were greater inside the perimeter fence than outside the fence, and that the length of exposure was time-limited for military units but may be extended for civilians in the area, it is possible that more extensive evidence of exposure may be found in the civilian population.

Epidemiologic Assessment

Results of the medical evaluations were summarized and displayed as sample population means or proportions. Some line listings for specific variables (total chromium) were provided. Minimal descriptive epidemiologic assessment was displayed. No analytic epidemiologic analyses were displayed.

Health Risk Assessment

The health risk assessment for Qarmat Ali Water Treatment Plant was designed to estimate the levels of risk for military personnel located at the site both pre- and post-encapsulation. Measures of exposure variables (for example, duration, frequency, and description of duties performed by these personnel) were ascertained. Effects of these variables on exposure assessment were provided. Estimates of risk were included in light of the exposure variables for both current and previously exposed personnel. Statements of confidence in these estimates are stated as "medium" for current exposures and "low" for past exposures.

Health Risk Communication

An initial town hall meeting was held on September 21, 2003 at the Qarmat Ali Water Treatment Plant. Stakeholders included soldiers from C/1-152 Indiana Battalion (IN BN) and the U.S. Army Forces Central Command (USARCENT) – Kuwait Surgeon in collaboration with the Coalition Forces Land Component Command (CFLCC) Surgeon Office. An initial fact sheet regarding health effects from sodium dichromate and hexavalent chromium was distributed and general health risks were discussed. Also, future steps were outlined regarding the exposure assessment and the plan to offer a medical examination. An additional fact sheet was subsequently provided which addressed specific questions from the initial town hall meeting. Additional town hall meetings with units in the local CFLCC area of responsibility were held between October 30 and November 2, 2003 with previously potentially exposed guard force units who provided security at the Water Treatment Plant prior to June 20, 2003. Individuals were asked to complete an exposure and symptom questionnaire, the results which were available to be placed in individual medical records for future reference, along with a fact sheet for medical providers. For those potentially exposed security force units in distant areas of responsibility, a provider information packet was given to the CFLCC Surgeon Office to be forwarded to the medical point of contact in each area of responsibility, as part of the administration of the exposure and symptom questionnaire.

For soldiers from C/1-152 IN BN medical evaluations were conducted at the Kuwait Army Health Clinic. During the individual medical evaluations, one-on-one clinical health communication was provided by the health care provider to the soldier. All available results were included in the soldier's permanent medical file.

Overall, seven health risk communication fact sheets were issued regularly in 2003 explaining the exposure assessment and medical evaluation program. Additional fact sheets from the Veterans Health Administration and the USACHPPM were issued in August and September, 2008, respectively.

Activism

In light of the conditions under which the Qarmat Ali Water Treatment Plant OEHS Team performed their duties, they are to be highly commended. The team was tasked to complete an OEH survey and risk assessment of the locations that included environmental and occupational health sampling of the contaminated site and clinical medical exams of the members of both the military security forces and Department of Army Civilians (DACs) assigned to the site. Within a matter of approximately four weeks (September 29 – October 30, 2003) the team under the leadership of LTC Mark Lovell, Occupational Medicine physician, Team Leader, and Maj Thomas Delk, industrial hygienist, Assistant Team Leader, both with USACHPPM – Europe provided outbriefs to MG Speakes, Deputy Commander CFLCC on preliminary OEHS and medical evaluation findings, conclusions and health risk management recommendations. On September 19, 2003 access to the site was restricted, and on October 17, 2003 all coalition personnel entering the restricted areas had to be wearing personal protective equipment (PPE). The timeliness of the team's response and the preventive measures taken are laudatory.

Information/Communication Silos

Numerous agencies, organizations, and contractors were involved in different activities in Basra, Iraq. Qarmat Ali is physically in the British Area of Responsibility (AOR). The Army Corps of Engineers with contractor support were responsible for restoring the plant online. U.S. Army units under U.S. Central Command (CENTCOM) provided security support. Special Medical Augmentation Response Teams (from outside the AOR) were deployed to support CENTCOM occupational health and safety in-theater personnel. Specialized clinical laboratory support services were provided by DoD units in the U.S. The operational environment required classification of information, restricting flow of information. Separate control and command of these entities also perpetuated having silos of responsibility for health and safety at the same worksite and likely impeded cross-silo collaborative efforts in information gathering, evaluation, and intervention.

Dissemination of Results

The results of this investigation are relevant to others who served at this particular site and to others who worked at similar sites elsewhere. Health Communications were directed to other units at this site. The Subcommittee did not assess the effectiveness of communication to coalition forces or the civilian population responsible for similar industrial facilities elsewhere or to authorities responsible for civilian health.

U.S. soldiers, contractors, and civilians may encounter plants similar to Qarmat Ali or other industrial facilities that involve potential exposures to other hazardous agents. The Subcommittee did not assess the effectiveness of the dissemination of the investigation's findings to other military units regarding the more general issue of avoiding industrial hazards in an active war theater.

Issues of Support and Training for Field Investigations and Real-Time Consulting

It is inevitable that military units will encounter potentially hazardous industrial sites during combat operations. The hazards encountered may pose risks of infectious disease, poisonings from industrial toxins, or injuries. Minimizing illness and injury from these sources or from the concomitant battle hazards requires not only the usual industrial hygiene approach (for example, anticipation, recognition, evaluation, intervention), but also a judicious approach that balances the costs and benefits of incurring exposure at an industrial site and avoiding hazards of the battle environment. Restated, an informed local judgment is necessary to minimize the combined exposure of both an industrial and military hazard.

It is the impression of the Subcommittee that this concept is well-recognized in the military and that resources are in place to enable the implementation of optimal decisions. These resources include proactive elements such as the identification and characterization of industrial sites prior to combat and the availability of back up expert hazard evaluation teams upon request, for example the Special Medical Augmentation Response Team-Preventive Medicine (SMART-PM).

It would be imprudent to attempt to characterize the adequacy of resources based on the subcommittee's evaluation of the field investigation of Qarmat Ali. However the Subcommittee would like to pose the following questions:

1. In the area of toxics, are there sufficient numbers of well qualified epidemiologists, industrial hygienists, and toxicologists to assist preventive medicine officers available?

   1a. Is there a career ladder including training opportunities?

2. While the conduct of this investigation was impressive, is it idiosyncratic to the specific investigators or does it reflect the general level of performance including training and education of the field investigators?

   2a. Is there a need for training and exercising for field investigators?

The Subcommittee also offers the opinion that there is usually value in external consultation in circumstances that may be new to the field investigator such as the hazards particular to specialized industrial processes, but in which civilians may have decades of experience. This suggests the potential value in establishing at minimum a list of civilian experts, and preferably a ready reserve of consultants who could be made available at a short notice to provide supplementary expertise to the military.

Finally, the Subcommittee opines that the military might consider building upon the tradition of the Armed Forces Epidemiological Board (AFEB) in having a Board available to review and advise in selected situations during the course of a field investigation.

Given that complexities of exposure assessments in the context of plausible health outcomes are exacerbated during war; and, that CHPPM has been asked to perform Occupational

and Environmental Health (OEH) assessments while our Nation is at war; the Subcommittee strongly recommends an External Advisory Board be established to provide real-time consultations on: recognized and plausible health outcomes associated with potential exposure(s); ascertainment and identification of potentially exposed personnel; development and utilization of established standards for the collection, storage, and analysis of environmental samples relevant to routes of exposure and response pathways; development and employment of established standards for obtaining information (including responses to questionnaires) from potentially exposed personnel, emphasizing the need for independent verification whenever practicable; establishment of timelines for data collection, analyses; and, communication of findings in a manner which facilitates an understanding of the findings and adherence to the recommendations.

The recommended External Advisory Board must be multi-disciplinary in order to address these complex questions. It must include an adequate depth of interested and committed professionals who can respond under extremely abbreviated time constraints.

National Guard

All soldiers and DoD civilians involved were provided equivalent opportunities for medical evaluation and documentation. It is unclear how health risk communication literature was provided to units previously assigned security duty at Qarmat Ali but no longer in-theater at the point in time when U.S. military forces were alerted to the potential occupational health exposure. It is advisable that aside from personal health information, a synopsis of this episode be included in the permanent files of all members of the military who had potential for involvement, and that a registry be maintained so that in the future a complete list of individuals, a history of their potential exposure, and related health information is available.

Classified Information

In order for the DHB Subcommittee to complete their mandate from the Surgeon General of the Army, Subcommittee members had to possess active secret-level clearance in order to attend the briefing session and review the final risk assessment report. The designation of the final report as secret classified information precluded the opportunities for interested stakeholders to obtain appropriate detailed information to assess the methodology used for exposure assessment and medical exposure evaluation. The timely declassification of reports such as this would facilitate transparency in this area. Prospectively, having a higher threshold for secret classification of material would encourage communication and reduce potential for distrust.

CONCLUSIONS

Standard of Practice for Occupational Medicine

It is the opinion of this Subcommittee that USACHPPM met or exceeded the standard of practice for occupational medicine in regard to the exposure assessment and medical exposure evaluation conducted in 2003 for soldiers potentially exposed to hexavalent chromium at the

Qarmat Ali Water Treatment Plant, Iraq. This opinion is based on the following facts: the first report addressed to the ARCENT-Kuwait Surgeon by the 152nd Indiana Battalion that expressed potential health concerns resulted in restricting site access only four days later; a comprehensive OEH survey including soil and air sampling for hexavalent chromium was conducted within three weeks of first notification; a comprehensive medical evaluation to document potential acute health effects was performed within approximately 30 days of the last potential exposure; an objective measure such as the biological monitoring of whole blood was used to evaluate potential previous exposure and to detect significant hexavalent chromium dosage levels; comprehensive health communication was conducted for soldiers with potential exposure through health providers on an one-to-one basis, town hall meetings, and numerous health communication fact sheets; the results of the medical evaluation process, fact sheets for medical providers, and contact sources for obtaining additional information were included within individual medical records; and, an appropriate risk assessment was conducted based on exposure information and the results of the initial exposure evaluation and biological monitoring.

One charge to the DHB was to assess the conclusions reached by CHPPM. Herein the Subcommittee provides holistic comments not only on the "conclusions" and "recommendations" sections of the classified CHPPM report, but also on the field investigation as conducted in its totality.

The findings of the DHB Military Occupational and Environmental Health and Medical surveillance Subcommittee reflect that this field investigation was completed in an exemplary fashion and that its conclusions, recommendations, and interventions were sound and appropriate. In explaining the Subcommittee's evaluation, four actions routinely utilized in occupational and environmental medicine are addressed below:

1. **Anticipation:** Capacity for successfully completing the field investigation is not happenstance but rather the result of a concerted effort. Sentinels of the success of this undertaking include the prompt and effective action by an in-theater medical commander placed close to a potentially hazardous site, as well as the rapid response of CHPPM to organize and deploy a field investigator team. However, the Subcommittee would like to emphasize the lack of evidence indicating the forces anticipated a potential hazard at Qarmat Ali. Rather, it appears that the DoD response, while prompt and effective, was triggered by KBR's staff appearing on-site wearing substantial PPE.

2. **Recognition:** Once alerted to the presence of hexavalent chromium compounds in Qarmat Ali, the DoD response was prompt and appropriate: access was restricted, the use of PPE was required, and a request for a field investigation was initiated.

3. **Evaluation:** A field team with complimentary training and skills was rapidly placed in the field. An integrated evaluation was initiated, including: a substantial and appropriate assessment of environmental exposure; the identification of soldiers with potential exposure; and, the performance of medical examinations including medical histories, physical examinations, and background monitoring. The data were appropriately analyzed and actions recommended.

4. **Interventions:** Numerous interventions were initiated that led to reduction in potential exposure. These included: the recognition that KBR initiated exposure reduction by paving contaminated areas as well as that DoD minimized exposure by limiting access to high-risk locations, requiring the use of PPE, and providing risk communication.

In the spirit of continuous improvement, the Subcommittee would like to comment on certain areas of concern. With regard to the coordination of efforts, while there may have been good communication among the DoD, British Forces, and private contractors, it is an area of potential improvement. In addition, the Subcommittee would like to suggest the DoD consider avenues by which a broad spectrum of expertise could be available to DoD for consultation, since there are numerous potential industrial hazards that could be encountered in combat.

RECOMMENDATIONS

Specific:

1. **Service members who participated in the field investigation or who had potential for exposure should receive assessment results as soon as they are available. Risk communication efforts should reinforce the following findings: while environmental contamination may be present, all available evidence indicates low levels of personal exposure; a lack of evidence of hazardous levels of absorption and of medical effects (aside from respiratory irritation which is common in the desert environment); as well as no expectation of any future adverse health outcomes. Soldiers who were similarly exposed but were not studied should be reassured that these results apply to them as well. While unlikely, it cannot be negated that there is a possibility that some determinant (for example an unusual job duty, personal habit, or exposure before site remediation) might entail a higher exposure that was not detected in the evaluations conducted. For that reason, information about this episode should be conveyed to appropriate medical care providers and added to the permanent record.**

2. **CHPPM should conduct an assessment as to whether individuals with potential for exposure received and understood the results and implications of information provided to them regarding this assessment.**

3. **The final report should be redacted and declassified and disseminated to all those with a need to know its content.**

4. **The Qarmat Ali assessment provides an excellent case study for future training purposes.**

5. **A debriefing should be arranged to include representatives of all "silos" involved. This includes several state National Guard units, the contractor, and those responsible for local public health to insure that information about this episode is fully shared.**

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7. **A simple registry should be established that includes the names and personal identifiers of each individual involved in this episode including information on potential exposure and personal health information generated in the course of the investigation. This small registry may be useful in the future for confirming service at Qarmat Ali as well as providing the basis for follow-up studies should there be a need.**

General:

1. **The method for anticipating industrial hazards in-theater, including hazard recognition training for soldiers and commanders; in-theater capacity for initial investigation; expertise in health communication; and reserve capabilities to do more comprehensive and thorough investigations, must be maintained.**

2. **An assessment should be conducted in order to determine if there are adequate numbers of available experts in areas such as industrial toxicology and epidemiology. Impediments should be identified and remedies implemented.**

3. **Facilitated and timely access to and availability of civilians with substantial professional experience and expertise should be ensured.**

4. **An external advisory committee should be established to facilitate access to consultation on risk assessment if needed. Activities would include providing advice as requested while certain assessments are being conducted as well as post hoc reviews of completed assessments as requested.**

5. **Exposure avoidance training for soldiers at all ranks should be reviewed and evaluated to ensure effectiveness and maintenance of an appropriate balance between these hazards and the relatively more traditional military hazards.**

6. **Efforts must be made to address the impact of organizational silos on the identification and mitigation of environmental risks in operational settings. Given that joint and combined nature of modern warfare operations, organizational silos consisting of various entities such as nation's armed forces, those from multiple nations, civilian contractors, and residential civilians are a given. However, some or all of these entities may all be involved in the same exposure event and could benefit from an all-inclusive approach to risk assessment. Approaches employing appropriate bridging techniques across silos risk cohorts should be assessed.**

7. **The system for classification of documents related to health related matters should be modified in order to better balance the need for security with the need to facilitate more timely dissemination of results to those that have a need to know.**

The Board gratefully acknowledges the efforts of the Force Health Protection and Readiness and USACHPPM staff, particularly Mr. James Sheehy, and Dr. Coleen Weese in facilitating the review, providing background information, and offering insights into the complex issues involved in conducting environmental risk assessments in combat environments.

The above findings, conclusions, and recommendations were unanimously approved.

FOR THE DEFENSE HEALTH BOARD:

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cc:

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Surgeon General of the Army
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Surgeon General of the Air Force
Joint Staff Surgeon
Library of Congress