Technical Investigation Report

Release of GB at the Tooele Chemical Agent Disposal Facility (TOCDF) on May 8-9, 2000

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CHEMICAL DEMILITARIZATION BRANCH

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List of Acronyms

ACAMS	Automatic Continuous Air Monitoring System®
AFB	Afterburner
ASC	Allowable Stack Concentration
CAMDS	Chemical Agent Munitions Disposal System
CDC	Centers for Disease Control and Prevention
ChE	Cholinesterase
CRO	Control Room Operator
DAAMS	Depot Area Air Monitoring System
DFS	Deactivation Furnace System
DPE	Demilitarization Protective Ensemble
ECR	Explosive Containment Room
ECV	Explosive Containment Vestibule
EOC	Emergency Operations Center
EPA	Environmental Protection Agency
FPD	Flame Photometric Detector
GB	Sarin; isopropyl methylphosphonofluoridate
GC	Gas Chromatograph or Gas Chromatography
GPL	General Population Limit
LOQ	Limit of Quantification
MDL	Minimum Detection Limit
MGLC	Maximum Ground Level Concentration
MS	Mass Spectrometry or Mass Spectral
PAS	Pollution Abatement System
PDARS	Process Data Acquisition and Recording System
QL	Quality Laboratory
QP	Quality Plant
RT	Retention Time
SCRO	Supervisor Control Room Operator
TOCDF	Tooele Chemical Agent Disposal Facility
TWA	Time-Weighted Average [concentration]
USCHPPM	U.S. Army Center Center for Health Promotion and Preventive Medicine
VX	O-ethyl-S-(2-diisopropylaminoethyl) methyl phosphonothiolate

Release of GB at the Tooele Chemical Agent Disposal Facility, Tooele, Utah

Executive Summary

The Department of Health and Human Services (DHHS) is directed by Congress to provide public health oversight of Department of Defense's chemical weapons disposal facilities. This responsibility has been delegated to the Centers for Disease Control and Prevention (CDC), which is an agency within the DHHS. In response to the release of GB (sarin) at the Tooele Chemical Agent Disposal Facility (TOCDF), CDC dispatched a team to conduct an independent evaluation of this release. This investigation focused on the air monitoring systems and the potential public health impact of the release.

From 11:26 pm on May 8, 2000 to 12:56 am on May 9, 2000, GB was released from the common stack during a bi-phasic incident at TOCDF. The peak concentration was approximately 3.6 times the allowable stack concentration. No munitions or bulk agent were being processed at the time of the release. The source of agent in this incident included a liquid GB agent strainer sock placed on the deactivation furnace system gate. The release occurred during a maintenance procedure conducted under abnormal incinerator conditions. This event does not reflect the efficiency of the deactivation furnace system with its associated pollution abatement system under normal operating conditions.

The Automatic Continuous Air Monitoring System® (ACAMS) for the common stack functioned as designed, alerting personnel of the release. However, control room personnel incorrectly assumed that no agent source existed in the deactivation furnace system. This incorrect assumption resulted in continuation of their attempts to purge and re-light the after-burners even after the second stack ACAMS went into alarm. Because the two involved ACAMS have different types of chromatographic columns, the simultaneous alarms were essentially a confirmation of presence of GB. Control room personnel discounted or misunderstood this information**.** The contingency procedure implemented during the event incorrectly utilized the protocol that assumed presence of agent was not probable.

Review of the biweekly TOCDF ACAMS quality control report indicated that all ACAMS stations at TOCDF were operating well within established quality control limits. However, the deactivation furnace system duct ACAMS provided inconsistent data compared with that observed at the common stack. This inconsistency is believed to have resulted from contamination in the duct sample probe.

The perimeter Depot Area Air Monitoring System (DAAMS) stations were operational at the time of the incident. The GB results of the DAAMS tubes were all below the administratively established reporting limit of 20% of the general population limit. However, perimeter station 905 showed a small, but discernable, chromatographic response at the retention time for GB. Careful evaluation of the meteorological data at the time the incident does not support a relationship between the release at the common stack and the response observed at station 905. However, analytical data from the DAAMS analysis cannot confirm or deny the presence of GB in this sample.

The Emergency Operation Center was informed and reportedly conducted dispersion modeling of the incident. However, the Emergency Operation Center delayed informing Tooele County of the release for approximately 4 hours.

CDC used information gathered from the investigation and the SCREEN3 Environmental Protection Agency's (EPA)-approved dispersion model to evaluate potential human health consequences of this release. Worst-case assumptions were used in the model to predict the maximum possible public health impact of the release. The maximum peak release concentration was assumed constant for the entire 30-minute release, although monitoring data indicated that this peak concentration existed for 6 minutes or less. Even with this most conservative approach, the calculated potential exposures for workers and the general population were less than 1% of the established occupational exposure limit or the general population limit for GB, respectively. Based on this modeling data and current toxicologic data on GB, no short-term or long-term adverse health effects are expected for TOCDF workers or the surrounding population.

This report presents fifteen recommendations to help reduce the probability of similar events, improve the performance and utility of the monitoring system, and improve overall event-related communications (see the Recommendations section of this report).

Introduction

The Department of Health and Human Services (DHHS) is directed by Congress to provide public health oversight of Department of Defense's chemical weapons disposal facilities. This responsibility has been delegated to CDC, which is an agency within the DHHS. In this capacity, CDC was notified on May 9, 2000 about the release of the chemical agent GB on May 8, 2000 at the Tooele Chemical Agent Disposal Facility (TOCDF). CDC dispatched a team to begin an independent investigation of the incident. The CDC investigation focused on the air monitoring systems and the potential public health impact of the release.

Objectives of the CDC Investigation

Operational events. The CDC representatives observed the collection of engineering and other data for the development of a chronology of plant and personnel operational events before, during, and after the release of chemical agent. CDC participated in discussions with engineering staff to develop a basic functional understanding of these chronological events to determine the impact on plant operations, and how these events resulted in the release of chemical agent outside engineering controls.

Air monitoring. The CDC representatives reviewed the operational status of both in-plant and perimeter air monitoring systems before, during, and after the release. The monitoring data, quality control data, and appropriateness of responses and activities of monitoring personnel were evaluated. The overall accuracy and validity of the monitoring data were carefully determined. The documentation, interpretation, and utilization of the monitoring results were examined.

Compatibility of monitoring results and operational activities. CDC representatives compared the air monitoring data and operational events to evaluate the chronological, spatial, and operational compatibility and consistency of these data.

Evaluation of potential impact on public health. CDC representatives utilized the air monitoring data, the operational data, and meteorologic data in conjunction with an Environmental Protection Agency (EPA)-approved dispersion model to define the agent plume to evaluate the potential exposure to workers and the general public. Worst-case scenarios were developed to yield a most conservative result.

Documentation, interpretation, and reporting. Once all data were consolidated, CDC evaluated the data and presented their findings in this independently generated report. This report will include recommendations to help reduce probability of reoccurrence of similar incidents, improve the performance and utility of the monitoring system, and improve overall event-related communications.

Summary of Events

On May 8, 2000, the day shift at the TOCDF was processing M56 rockets in the deactivation furnace system (DFS).[1] At approximately 4:00 pm (1600 hours) the DFS lower tipping gate failed to close properly, and munitions/agent processing was terminated. At 8:10 pm (2010 hours), staff began a demilitarization protective ensemble (DPE) entry to repair the DFS lower tipping gate and to water wash the DFS feed chute. After several problems during the entry, the DPE entrants completed cleaning the tripping gate and the wash-down of the feed chute at approximately 9:30 pm (2130 hours). Before leaving the explosive containment room (ECR), the DPE entrants cleaned the liquid agent strainer and placed the used strainer sock with its GB agent-saturated debris on top of the DFS sliding gate. Approximately one pound of strainer waste was placed on the DFS sliding gate. This waste is currently believed to be the major source of agent involved in the release, although the ECR was highly contaminated with GB from processing earlier during the day, and vapors were drawn from the ECR into the DFS during the incident contributed as a source of agent. During this maintenance operation, temperatures, flow rates, and pressures in the DFS and pollution abatement system (PAS)[2] varied greatly. At 10:02 pm (2202 hours) the Kurz® exhaust gas flow meter in the DFS PAS failed, causing a loss of system purge and an automatic shut-down (lock-out) of burners in both the DFS kiln and the DFS afterburner (AFB). High airflow rates through the PAS resulted in scrubber fluid being drawn through the air flow meter into the demister. This transfer of fluid through the meter is the probable cause of its failure. During initial attempts to re-light these burners, at 11:26 pm (23:26 hours), the Automatic Continuous Air Monitoring System® (ACAMS) station PAS 701C[3] (common stack) went into alarm at 0.67 allowable stack concentration (ASC)[4]. At 11:28 pm (23:28 hours) ACAMS station PAS 701A (common stack) went into alarm at 1.57 ASC, and at 11:41 pm (23:41 hours) ACAMS station PAS 702 (DFS

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[1] The primary components of the DFS are a rotary kiln, a cyclone, and an afterburner connected to a pollution abatement system (PAS). The function of the DFS is to incinerate drained rockets, landmines, and energetics removed from projectiles. These objects are incinerated in the kiln with the products of combustion flowing to the afterburner where the gases are thermally treated. Afterburner exhaust gases then flow to the DFS PAS where they are further processed. The metal parts and other noncombustibles that discharge from the kin are further thermally treated in the heated discharge conveyor .

[2] Each of four furnaces systems at TOCDF has a PAS to cool and chemically treat the exhaust gases before they are released to the atmosphere. Each PAS consists of a quench tower, a venturi scrubber, packed bed scrubber tower, demister, exhaust blower, emergency exhaust blower, various recirculation and transfer pumps, and associated piping and instrumentation. All four PASs discharge exhaust gases to one common stack.

[3] Agent monitoring on the common stack consist of "near-real-time"monitoring by three ACAMS stations (PAS 701A, PAS 701B and PAS 701C) and confirmational monitoring by a DAAMS station associated with each of the three ACAMS stations. Two of the ACAMS stations, with their associated DAAMS stations, are monitoring the common stack at all times. The analytical cycles of the two ACAMS are staggered to ensure continuous sampling of the common stack. When possible these two ACAMS will have dissimilar chromatographic columns to provide dual column confirmation of analyte response. The ducts from the PAS of the four incinerators are each monitored by a ACAMS and DAAMS. Station PAS 702 is on the DFS PAS duct.

[4] The ASC is a ceiling value that serves as a source emission limit, and not as a health standard. It is used for monitoring the furnace ducts and common stack. The ASC provides an early indication of an upset condition. Modeling of worst-case credible event and conditions at each installation must confirm that the general population limit (GPL) monitoring level is not exceeded at the installation boundary as a consequence of releases at the ASC. The ASC value for GB is 0.0003 mg/m^3. The terminology 0.67 ASC means 0.67 times the numerical value of the ASC (0.0003 mg/m^3).

duct) went into alarm at 1.45 ASC. During a second attempt to re-light these burners, at 12:28 am (00:28 hours, May 9, 2000) ACAMS station PAS 702 went into alarm at 0.87 ASC. At 12:29 am (00:29 hours) ACAMS station PAS 701B went into alarm at 0.39 ASC; and at 12:30 am (00:30 hours) ACAMS station PAS 701C went into alarm at 0.56 ASC.

A DFS control room operator (CRO) was on duty at the time of the incident. Although he had completed all required training and was fully certified to be a DFS control room operator, he was relatively inexperienced in operating the DFS under non-normal maintenance conditions. However, this control room operator was being assisted by a second control room operator who had more experience in operating the DFS in non-normal conditions. Believing that the kiln was free of hazardous material, the Supervisor Control Room Operator (SCRO) decided that this was an opportune time for on-the-job-training and allowed the relatively inexperienced control room operator to continue to work to bring the DFS back to normal operating conditions. At 11:26 pm (23:26 hours) when PAS 701C alarmed at 0.67 ASC the control room supervisors responded to the alarm, but because they believed the DFS was free of agent, they allowed the DFS recovery efforts to continue. When PAS 701A alarmed 2 minutes later, the control room staff still did not believe that the DFS could be the source of agent because the DFS duct ACAMS (PAS 702) was not in alarm. Their goal continued to be to purge the DFS system and re-light at least one of the AFB burners to maintain the AFB temperature above 1000 degrees. However, after PAS 702 went into alarm at 11:41 pm (23:41 hours) the SCRO directed the DFS CRO to bottle-up (or isolate) the DFS/DFS PAS at 11:44 pm (23:44 hours).

Although the Depot Area Air Monitoring System (DAAMS) tubes confirmation analyses had not been completed by the laboratory, the SCRO directed the DFS CRO to purge the DFS and re-light the AFB at 12:23 am (00:23 hours, May 9). The control room staff apparently continued to believe that no agent was present in the DFS. However, when at 12:28 am (00:28 hours), the PAS 702 went into alarm, followed be PAS 701B at 12:29 am (00:29 hours) and PAS 701C at 12:30 am (00:30 hours), the SCRO directed the DFS CRO to again bottle-up the DFS PAS at 12:32 am (00:32 hours).

In summary, because of inadequate DFS temperatures, loss of kiln and AFB flame, and decreased residence times through the DFS and PAS due to abnormally high airflow rates, a small amount of GB agent escaped destruction and was released through the common stack. This release occurred during a non-normal maintenance procedure under incinerator conditions, which do not reflect normal operations.

<u>Agent Air Monitoring Systems (TOCDF)</u>

<u>Agent Monitoring Time Line:</u>

The following time-line delineates the ACAMS alarms that occurred during the release of GB.

May 8, 2000	11:26 pm (23:26)	PAS 701C alarms at 0.63 ASC
	11:28 pm (23:28)	PAS 701A alarms at 1.57 ASC
	11:40 pm (23:40)	PAS 701A peaks at 3.39 ASC
	11:41 pm (23:41)	PAS 701C peaks at 3.63 ASC

(Agent Monitoring Time-Line, continued)

	11:41 pm (23:41)	PAS 702 alarms/peaks at 1.45 ASC
	11:51 pm (23:51)	PAS 701A clears alarm
	11:53 pm (23:53)	PAS 701C clears alarm
May 9, 2000	12:08 am (00:08)	PAS 702 clears alarm
	12:28 am (00:28)	PAS 701B alarms at 0.39 ASC
	12:29 am (00:29)	PAS 702 alarms at 0.87 ASC
	12:29 am (00:29)	PAS 701C alarms at 0.56 ASC
	12:31 am (00:31)	PAS 701B peaks at 0.74 ASC
	12:32 am (00:32)	PAS 701C peaks at 0.81 ASC
	12:32 am (00:32)	PAS 702 peaks at 1.07 ASC
	12:38 am (00:38)	PAS 701C clears alarm
	12:40 am (00:40)	PAS 701B clears alarm
	12:56 am (00:56)	PAS 702 clears alarm

<u>Automatic Continuous Air Monitoring System (ACAMS) Overview:</u>

ACAMS stations on the common stack (PAS 701-A, B, and C) functioned as designed in detecting the presence of chemical agent GB in the stack exhaust and alerting the workers (see Figure 1). ACAMS station on the DFS duct (PAS 702) also detected GB, but at a lower level than expected based on the concentrations seen by common stack ACAMS (see discussion in Quality Control). Careful review of data from ACAMS monitoring the ECR, the Explosive Containment Vestibule (ECV), and other areas involved in the incident show results consistent with known plant munitions and maintenance operations. During the incident, monitoring personnel within the plant responded timely and appropriately.

Review of the strip charts containing the ACAMS chromatograms from PAS 701 A, B, and C and PAS 702 showed that the chromatography (i.e., responses observed during the incident) were identical to the responses seen during quality control challenging with known GB agent. The chromatographic peaks were well defined and centered in the retention time window for GB. All Monitoring Branch personnel interviewed during this investigation were fully confident that the PAS 701 and PAS 702 ACAMS detected GB. Careful review of these same strip charts also showed the occurrence of background peaks, possibly caused by various products of incomplete combustion, whose appearance coincided with documented upset conditions in the DFS and/or the DFS PAS.

A review of ACAMS monitoring data for ECR B shows a relationship between AFB and the GB concentration in the ECR B. That is, as the AFB pressure became more negative, drawing additional GB-contaminated air from ECR B into the DFS kiln, a rapidly decreased concentration in the ECR B was observed. These data support the assumption that the contaminated ECR contributed as a source of agent involved in the release. Additionally, a dramatic increase in the ECR GB concentrations from non-detected to approximately 80 times the time-weighted average (TWA)[5] value coincided with the reported time of the DPE entry into this room. All this air monitoring information supports the reported timeline of events.

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[5] The TWA is the airborne concentration to which unprotected workers may be repeatedly exposed for 8 hours per day, 5 days per week, for a working lifetime without adverse health effects. This monitoring level is operationally treated as a ceiling value for the purpose of masking workers at demilitarization facilities. In 1988, CDC recommended a worker control limit for GB at 0.0001 milligrams per cubic meter air (mg/m^3) averaged over 8 hours. In the demilitarization program, this numeric control limit has been called a TWA. In this instance, 80 times

During the investigation, TOCDF staff indicated they had experienced excessive numbers of false positives during the period before the incident. A review of the TOCDF ACAMS common stack alarm report for April and May 2000 showed 37 alarms among the three stack ACAMS (PAS 701 A, B, C). Of these 37 alarms, four were involved in the incident, 22 were alarms associated with waste-feed cut-off tests within the plant, and 10 alarms occurred because of an interference (none were confirmed with DAAMS tubes). The remaining alarm was a non-confirmed unknown source. All 10 alarms associated with the interference involved only a single ACAMS and exhibited an abnormal chromatographic peak. In the case of the incident, both ACAMS monitoring the common stack went into alarm and exhibited a well-formed chromatographic peak in the retention time window for GB. Because the two involved ACAMS have different types of columns, the simultaneous alarms were essentially a confirmation of presence of GB. Therefore, control room personnel should not have discounted this information. During April and May, the only times when two ACAMS simultaneously alarmed (other than actual incident) was during the performance of waste-feed cut-off tests. All other false-positive alarms during this time frame involved only one of the two ACAMS monitoring the stack.

The problem with false-positive alarms related to waste-feed cut-off tests reportedly are related primarily to liquid incinerator #2. Initial indications suggest possible fuel-rich conditions during the test may yield products incomplete combustion.   The source of this problem is under investigation by TOCDF monitoring personnel. Solving this problem would substantially reduce the number of false-positive alarms.

Depot Area Air Monitoring Systems (DAAMS) Confirmation Overview:

DAAMS analyses confirmed the presence of GB in the common stack and the DFS duct. Qualitatively, all available DAAMS flame photometric detector (FPD) and mass spectral (MS) data are consistent with the identification of GB. Quantitatively, DAAMS results are consistent with ACAMS concentrations detected in the common stack. Laboratory personnel followed established laboratory operating procedures, and all laboratory analytical instrumentation were operating well within established quality control limits.

Quality Control (QC):

ACAMS:

A careful review of the biweekly quality control data, which covered the period before, during, and after the event, indicated that ACAMS involved were operating within established quality control parameters. A review of the "ACAMS Weekly/Daily Operational Log" for each of the ACAMS at stations PAS 701 A, B, and C showed that all three instruments demonstrated consistent recoveries of quality control challenges of 90% or greater during the 24-hour period centered around the time of the incident. In accordance with established quality control procedure, these ACAMS are challenged every 4 hours with a known quantity of GB agent. Also, during this timeframe, the PAS 702 ACAMS demonstrated recoveries of 90%-105%. This

the TWA means 80 times the numerical value of the TWA, not the actual average over 8 hours, because the value is treated as a ceiling value. It may be described elsewhere in the document in the format such as "80 TWA."

ACAMS is challenged every 24 hours according to established quality control procedures. The criterion for acceptable quality control challenges is 100% +/- 25%.

A review of the data in the Instrument Log Books for the sample dilution-control units on the three PAS 701 ACAMS and the DFS duct (PAS 702) ACAMS showed that all of these units have been operating well within the +/- 25% criterion since the April 1, 2000.

A review of ACAMS data generated during the event showed an inconsistency between the results obtained from the ACAMS on the common stack (701 A, B, and C) and the ACAMS on the DFS duct (PAS 702). Because the DFS duct feeds directly into the common stack, a predictable correlation between PAS 702 and PAS 701 would be expected. Because of dilution effects in the common stack from other incinerators, the concentrations at PAS 702 would be expected to be greater than those observed at PAS 701. Also, because PAS 702 is upstream from PAS 701, one would expect PAS 702 to go into alarm before, or at least concurrently with, PAS 701. However, in this incident the opposite was observed in both cases.

Recognizing that routine quality control challenges only evaluate agent transfer efficiencies through heated transfer tubes that extend 50 to 70% of the probe length, CDC representatives requested that the PAS 701 and 702 ACAMS probes be removed and challenged from the distal end. Results showed low and inconsistent transfer efficiency for PAS 702. The initial probe challenges from the distal tip were 24% and 57%. After washing the sample tube with deionized water, no (0%) transfer efficiency was noted. Flushing the PAS 702 probe again with deionized water, followed by air-drying, resolved the transfer efficiency problem (efficiency improved to 118%). The "when, where, and what" characteristics of the contaminant(s) causing the apparent low agent transfer efficiency are unknown. However, a plausible cause presented by TOCDF monitoring personnel is the development of water condensation in the probe, which impairs agent transfer. ACAMS chromatographic data observed on PAS 702 during the event could be consistent with possible absorption and desorption of agent in the PAS 702 sample probe. Data from distal-end evaluations of the PAS 701 A, B, and C probes demonstrated acceptable agent transfer efficiencies (75%-105%). Because of the apparent problem with the PAS 702 sample probe, the quantitative data from PAS 701 A, B, and C were used to conduct the risk assessment.

Follow-up evaluations of agent transfer from the end of the probe on May 17, 2000, showed 90% of higher transfer for common stack PAS 701 A, B, and C and metal parts furnace PAS 703. However, the distal end agent transfer check for Liquid Incinerator PAS 704 failed with a 55% transfer. Following rinsing with deionized water, the transfer efficiency increased to 80%.

DAAMS:

The DAAMS tubes are used to conduct more refined chromatography to confirm whether an ACAMS alarm is actually GB agent or an interference. A review of quality control data from the stations DAAMS PAS 701 A, B, and C and DAAMS PAS 702 stations (quality plant [QP])[6], and

[6] A QP is a quality control sample that has been spiked with a known volume and concentration of dilute chemical agent and exposed to the plant atmosphere or sample matrix.

the quality control data from the laboratory instrumentation (quality laboratory – QL)[7], indicated that these systems were functional and operating properly. That is, these quality control parameters indicated that the DAAMS data generated during the release were valid. QL samples were run before and after the actual field samples related to the release to ensure that the gas chromatographs/mass spectrometer (GC/MS) and GC/FPD were operating properly and were in control. The recoveries of the QL samples analyzed in conjunction with the first and second stack alarms were 82% and 74%, respectively, which are within the established criterion of 100%+/-35%. The retention times for GB in the field samples were consistent with the agent GB in standards and quality control samples. The ion ratios observed in the MS analyses of these same field samples were well within the established range.

Personnel Qualification and Performance:

Interviews, observations of work, and available documentation, indicated that the monitoring and analytical staff appeared to be well qualified and proficient at their jobs.

Perimeter Network Air Monitoring System

Eleven perimeter-monitoring stations are located at various points around the perimeter of Deseret Chemical Depot (Figure 2). The perimeter stations use DAAMS tubes to collect air samples over 12-hour sampling periods at a flow rate of approximately 0.5 liters per minute. The sampling is accomplished with two tubes that are aspirated simultaneously at each station. After sampling, the DAAMS tubes are analyzed at the Chemical Agent Munitions Demilitarization System (CAMDS), which is located near TOCDF. Perimeter DAAMS tubes sampled air continuously through the event from 6:00 pm (1800 hours) on May 8, 2000 to 6:00 am (0600 hours) on May 9, 2000. This time frame brackets the times of the two-phase stack release. One DAAMS tube from station #905 showed a discernible chromatographic peak at the expected retention time of GB. Calculated as GB, the observed response equated to a mass of GB of 0.03 nanograms (ng). Over the 12-hour sample period, this quantity of GB would equate to approximately 3% of the general population limit (GPL)[8] for GB (technically, the GPL is calculated over 72 hours). However, the meteorologic data from the time of the incident indicates that station 905 was not within the calculated plume area. A careful review of chromatographic data from downwind perimeter stations 906, 907, and 910 showed no discernable peaks at the retention time for GB.

The second DAAMS tube from perimeter station 905, which could have been utilized for confirmatory analysis, was desorbed (or cleaned) according to existing policy, which essentially states that chromatographic responses equivalent to less than the "reporting limit" (0.2 GPL)[9] will not be evaluated. Because of the frequency of these low-level responses, i.e., those less than

[7] A QL is a quality control sample that has been spiked with a known volume and concentration of dilute chemical agent and may be aspirated long enough to remove residual solvent. QL samples are used to verify calibration status of the DAAMS gas chromatographs.

[8] The GPL is defined as a 72-hour time-weighted average concentration for indefinite unprotected exposure (24-hours/day, 7-day/week for a 70-year lifetime) of the general population without adverse health effects. In 1988 CDC recommended a general population Control Limit for GB at 0.000003 milligrams per cubic meter air (mg/m^3) averaged over 72 hours. In the demilitarization program, this Control Limit has been called a GPL.

[9] The terminology 0.2 GPL means 0.2 times the numerical GPL value (0.000003 mg/m^3).

the reporting limit, CDC staff reviewed perimeter monitoring data for GB agent from April 1, 2000 to May 17, 2000. The detailed analysis and conclusions can be found in Attachment A.

Gas chromatograph calibration checks for each of the three instruments were analyzed at the beginning of each analytical block of perimeter DAAMS samples. These checks verify retention time, sensitivity, and the calibration curve. A careful review of quality control data for May 7-10, 2000 indicated that QL samples and QP were not necessarily run on every instrument for every day. Regarding the samples directly related to the time of the event, the field samples were analyzed on gas chromatographs #1 and #2; however, the QL and QP samples related to this time frame were analyzed on gas chromatograph #3. Quality control samples did not bracket these field samples. See Attachment B for chronological sequence of analyses.

Evaluation of Potential Impact on Public Health

GB is a volatile chemical warfare agent, which makes it primarily an inhalation hazard. It is toxicologically related to organophosphate insecticides, which produce adverse effects on the nervous system by inhibiting cholinesterase (ChE) enzyme activity. The route of exposure of GB can include the eyes, respiratory tract, and skin. One of the earliest sign of exposure to GB is miosis or constriction of the pupil of the eye. Following release into the environment, GB is rapidly dispersed as discussed below. According to Kingery and Allen, nerve agents in the atmosphere are degraded by photolysis and/or radical oxidation.[10] Nerve agents that may be absorbed into water or soil will degrade through hydrolysis. The rate of degradation will depend on the temperature and pH of the media.

The Department of the Army initially reported to CDC that the amount of agent released was approximately 18 milligrams GB. As late as June 15, 2000, the Army has reported that based on refinement of its original calculations, the amount of agent involved during the event ranged between 20 and 35 milligrams. CDC did not use the original 18-milligram value or the revised values for our risk assessment. Instead, CDC's dispersion modeling assumed the highest concentration ACAMS cycle (3.63 ASC) was continually present for a 30-minute period, which is approximately equal to the duration of the two-phase event. Using this assumption, the total agent release for CDC's worst-case model and exposure analysis would be equivalent to 46 mg over the entire release. CDC believes this to be a substantial over-estimation of the actual release amount; and therefore, very conservative for the examination of human health implications.

CDC used information gathered from the investigation and the SCREEN3 EPA-approved dispersion model to evaluate potential human health consequences of this release. The SCREEN3 model is used for many New Source Review (NSR) and other air permitting applications. The SCREEN3 model is based on steady-state Gaussian plume algorithms. SCREEN3 is applicable for estimating ambient impacts from point, area, and volume sources out to a distance of about 50 kilometers. The SCREEN3 model is conservative; if no impact is

[10] Kingery AF, Allen HE. The Environmental Fate of Organophosphorous Nerve Agents: A Review. Toxicol Environ Chem 47:155-184 (1995).

predicted from this screening model, additional enhanced investigations using more refined models are considered unnecessary.[11]

As discussed, worst-case assumptions were used in the model to predict the maximum possible public health impact of the release---that is, the maximum release concentration was assumed constant for the entire 30-minute release, although monitoring data indicate this peak concentration actually existed for approximately 6 minutes or less. (See Attachment C for more detail.) Based upon the results of this modeling and a 30-minute duration of the release, the model predicted the maximum possible exposure to GB at ground level was less than 1/10 of 1% of the exposure one would receive if exposed to the GPL for 72 hours. See Figure 2 for a diagram of the estimated plume direction.

To evaluate the maximum possible impact on the health of workers at TOCDF during the GB release, the model was again run using worst-case parameters. Although local meteorologic data indicated that downwash conditions (wind speed and direction conditions that result in rapid movement of stack gases to ground level near the plant) probably would not have occurred during the release, the downwash option was used to ensure worst case scenario. Even with this most conservative approach, estimated maximum agent concentrations were well below the established 8-hour TWA occupational exposure limits for GB. Considering potential exposure for the entire release period, the maximum possible exposure was less than 1% of the TWA. In actuality, TOCDF workers masked early during the release; consequently exposure would have been far less than the amount used for this analysis.

Medical Clinic

An exposed worker is defined as a person who potentially exhibits clinical signs and symptoms of nerve agent intoxication and/or has a red blood cell ChE depression. This ChE depression may result from nerve agent exposure. CDC is not aware of any clinical signs and symptoms reported by the workers involved with this event. Because no evaluations of TOCDF personnel ChE levels were performed directly in connection with this GB release, CDC requested the medical clinic to provide records from routinely collected ChE samples during this time frame in which the worker's ChE depression exceeded 10% of his/her baseline. Normally, a person with a depression of 25% or greater is removed from the work area and given weekly ChE evaluations. Such a person is not allowed to return to work until his/her ChE value returns to at least 80% of his/her baseline value.

During the medical clinic's normal medical surveillance, blood samples for ChE levels were drawn on May 8, 9, 10, 11, 12, and 13. These specimens were processed during several laboratory runs. Laboratory run 505 (collected May 7, 8, and 9) included 42 specimens with 17 specimens being the first or second baseline specimen, and none exceeded the 10% depression point. In addition, 13 of these samples were tested by U.S. Army Center for Health Promotion and Preventive Medicine (USCHPPM) and met its quality control standards. Laboratory run 506 consists of 26 specimens with 8 specimens being the first or second baseline specimen. None of

[11] Environmental Protection Agency. Requirements for Preparation, Adoption, and Submittal of State Implementation Plans (Guideline on Air Quality Models), 40 CFR, Part 51. Federal Register, 65 (78), April 21, 2000.

these samples exceeded the 10% depression point and 8 samples were tested by the USCHPPM. Laboratory run 507 consisted of 42 samples, and 3 of these samples exceeded the 10% depression value (i.e., 10%, 11%, and 13%). Twenty of these samples were quality control tested by USCHPPM. The highest percent depression was noted in a control room operator who should not have had any exposure because the control room is equipped with positive pressure/carbon filtration ventilation system. Review of the medical records indicated none of these persons exhibited any symptoms and all denied any pesticide exposures away from work. On May 23 and 24, blood samples were drawn from these three individuals for follow-up ChE determinations. ChE results from these follow-up samples indicated that the apparent depressions recovered to 3%, 5%, and 6%, respectively. There is no evidence to indicate that these ChE depressions resulted from nerve agent exposure and were most likely random occurrences.

Emergency Operations Center (EOC) notification

According to the EOC Free Form Log, the EOC was notified by the TOCDF control room in a timely manner at 11:29 pm (23:29 hours) on May 8, 2000, that the PAS 701C was in alarm at 0.63 ASC, and PAS 701A was in alarm at 1.57 ASC. This information correlates with the agent monitoring time line obtained from the Process Data Acquisition and Recording System (PDARS). However, the monitoring team determination that *agent was probable* was not recorded in the Free Form log. At 2:14 am (02:14 hours), the EOC was informed that the PAS 702 DAAMS was non-confirmed. This non-confirmation was later found to be incorrect because of a DAAMS tube mix-up as discussed in the Quality Control section of this report. The EOC reportedly conducted dispersion modeling using D2PC at the time of the incident. The results of this modeling reportedly indicated no significant impact. However, a copy of this modeling was not saved, nor was the time of the modeling documented in the EOC Free Form Log. The earliest D2PC dispersion modeling record had a time listed of 1:44 am (01:44 hours) on May 9, 2000. Records were available for several additional D2PC runs that were conducted later during the morning of 5/9/00.

The Memorandum of Understanding between the Deseret Chemical Depot and Tooele County for Information Exchange states that "notification shall be made at the earliest possible opportunity, even if an event is only suspected…." However, according to the Free Form Log, Tooele County was notified of the release at 3:34 am (03:34 hours), which represented approximately a four-hour delay. The release was classified as a limited area event.

Contingency Procedures

The *Contingency Procedure for Agent Detected in the Stack* (EG 040.A01, Revision 2) was reviewed. These contingency procedures include *Immediate Actions* (Section II), *Follow-up Actions to be Taken if Agent is Probable* (Section III), and *Follow-up Actions to be Taken if Agent is Not Probable* (Section IV). According to the Contingency Procedure, the Monitoring Response Team reports on whether *there is* or *there is not* a probability of agent. During the release, the monitoring team made the determination that agent was probable. However, this information apparently was discounted or misunderstood by the control room, and the procedure outlined in the *Follow-up Actions to be Taken if Agent is Not Probable* apparently was followed.

The course of decisions, such as unmasking the site following the clearing of the ACAMS, may have been different if the probable agent release protocol was followed. However, the guidance in the *probable agent* protocol is unclear regarding the unmasking of the site. Several actions would have been taken if the probable agent procedures were followed.

<u>Conclusions</u>

1. A careful evaluation of the extent and circumstances of the release at TOCDF indicates that the quantity of GB released would be rapidly dispersed into a plume having a low concentration.

2. Based upon modeling data and current toxicologic data on GB, no short-term or long-term adverse health or medical affects on the TOCDF workers or the surrounding population would be expected.

3. The stack ACAMS (PAS 701 A,B,C) were operating in control and provided valid data detecting and quantifying the release of GB. Operational personnel were alerted in a timely manner of the release.

4. The DFS duct PAS 702 ACAMS did not provide valid data during the event because of poor transfer line efficiency. The source of the poor agent transfer has not been identified. This failure of the DFS PAS 702 contributed to the initial erroneous assumption by control room personnel that no agent source was present in the DFS.

5. Initially, the control room personnel incorrectly assumed that no agent source existed in the DFS system. This incorrect assumption resulted in continuation of their attempts to purge and re-light at least one of the AFB burners even after the second stack ACAMS (PAS 701A) went into alarm. Because the two involved ACAMS have different types of columns, the simultaneous alarms were essentially a confirmation of presence of GB. Control room personnel apparently discounted or misunderstood this information**.**

6. The contingency procedure implemented during the event incorrectly utilized the protocol that assumed presence of agent was not probable. The follow-up actions as described in the *probable agent release* protocol were not taken.

7. Thirty-seven alarms occurred during April and May 2000. Four were true alarms related to the incident, and 22 were false alarms related to waste-feed cut-off testing. Eleven additional false positive-alarms of unknown origin occurred during this period. The frequency of false-positive alarms may have contributed to the control room operations' initial erroneous assumption that no agent was present in the DFS during the event.

8. Perimeter-monitoring samples collected during the time of the release at station #905 indicated a chromatographic peak consistent with the agent GB. The quantity of compound observed when calculated as GB was equivalent to 0.03 nanogram of agent. However, the meteorologic data collected during the time of the event does not support a relationship between the release at the common stack and the observed response at station

#905. The B DAAMS tube was discarded, and additional analysis was not possible to confirm or deny the presence of GB.

9. Analyses of quality control samples did not bracket the analyses of field DAAMS perimeter samples. The laboratory analyzed quality control samples for the day of the incident on a different gas chromatograph from that used for the actual field samples.

10. The release occurred during a "non-normal" maintenance procedure under abnormal incinerator conditions after DFS processing had been suspended. This event does not reflect the efficiency of the DFS with its associated PAS under normal operating conditions.

11. Communications between the Control Room and the Emergency Operation Center were timely, and the Emergency Operation Center was updated throughout the incident. However, the Emergency Operation Center delayed informing Tooele County for approximately four hours, which appears inconsistent with the agreement to notify the County "at the earliest possible opportunity, even if an event is only suspected."

<u>Recommendations</u>

1. The process for implementing a "non-normal" procedure should be carefully reviewed to ensure it does not exceed the capabilities of the facility or personnel. An evaluation of the non-normal procedure should ensure that it can be conducted safely and without incident.

2. When stack or duct ACAMS alarms are activated, only the most highly qualified personnel available should be controlling the plant operations. When any agent-related alarm has been activated, any type of on-the-job training is inappropriate.

3. All stack and duct ACAMS alarms should be considered as agent until valid operational data or DAAMS confirmation show otherwise. Assumption of no agent source should be made only after a thorough investigation.

4. The decision making process associated with the *Contingency Procedure for Agent Detected in the Stack* needs to carefully evaluated to ensure that the correct procedures are implemented during an agent release. The Contingency Procedure document should be carefully evaluated to ensure that all information is appropriate and complete.

5. TOCDF should continue and intensify its investigations to identify and eliminate the source of the false stack alarms.

6. The dilution tube in the common stack and duct ACAMS/DAAMS sample probes should be positioned a uniform distance from the distal end of the sample probe. Optimal distance should be determined through careful evaluation of challenge and other quality control data.

7. The ACAMS and DAAMS sample probes for the common stack and all furnace ducts should be challenged from the distal end on a weekly basis. This testing should be continued until adequate data to confirm that moving the end of the dilution tube to a uniform distance near the distal end resolves questions associated with agent transfer.

8. The reasons for the unintentional switching of PAS 702 and 704 DAAMS tubes need to be carefully evaluated. Procedures to prevent reoccurrence of this event should be implemented.

9. Following this event, the perimeter DAAMS tubes were not pulled until the end of the 12-hour aspiration time at approximately 6:00 am (06:00 hours) on May 9, 2000. After a confirmed release from the facility, the perimeter DAAMS tubes should be pulled and analyzed as soon as practical.

10. Low-level perimeter DAAMS data with discernable chromatographic peaks within agent gates, even data below the reporting limit (0.2 GPL), need to be evaluated. The B tubes associated with these low-level responses need to be retained for confirmational analyses.

11. Current quality control procedures related to analysis of perimeter DAAMS samples should be reviewed for possible improvements.

12. TOCDF should conduct an engineering evaluation of the location and operation of the Kurz® flow meter wherever used. Additionally, an evaluation of systems to isolate the DFS kiln from the remainder of the incinerator system should be undertaken. The DFS feed chute and related gates should be evaluated for proper function. Components of the DFS, including the PAS, should be systematically examined to ensure proper functioning before resuming operations.

13. The EOC should review procedures to ensure that Tooele County is informed in a timely manner of potential and confirmed agent releases. The notification process for other organizations with potential involvement following a release should be reviewed through the Chemical Stockpile Emergency Preparedness Program (CSEPP).

14. The EOC should review its basic procedures for documentation to ensure that it can accurately and comprehensively recreate the sequence of events and its justification for actions.

15. For informational purposes, the procedures for calculating the quantity of agent released should be standardized and readily available.

Figure 1

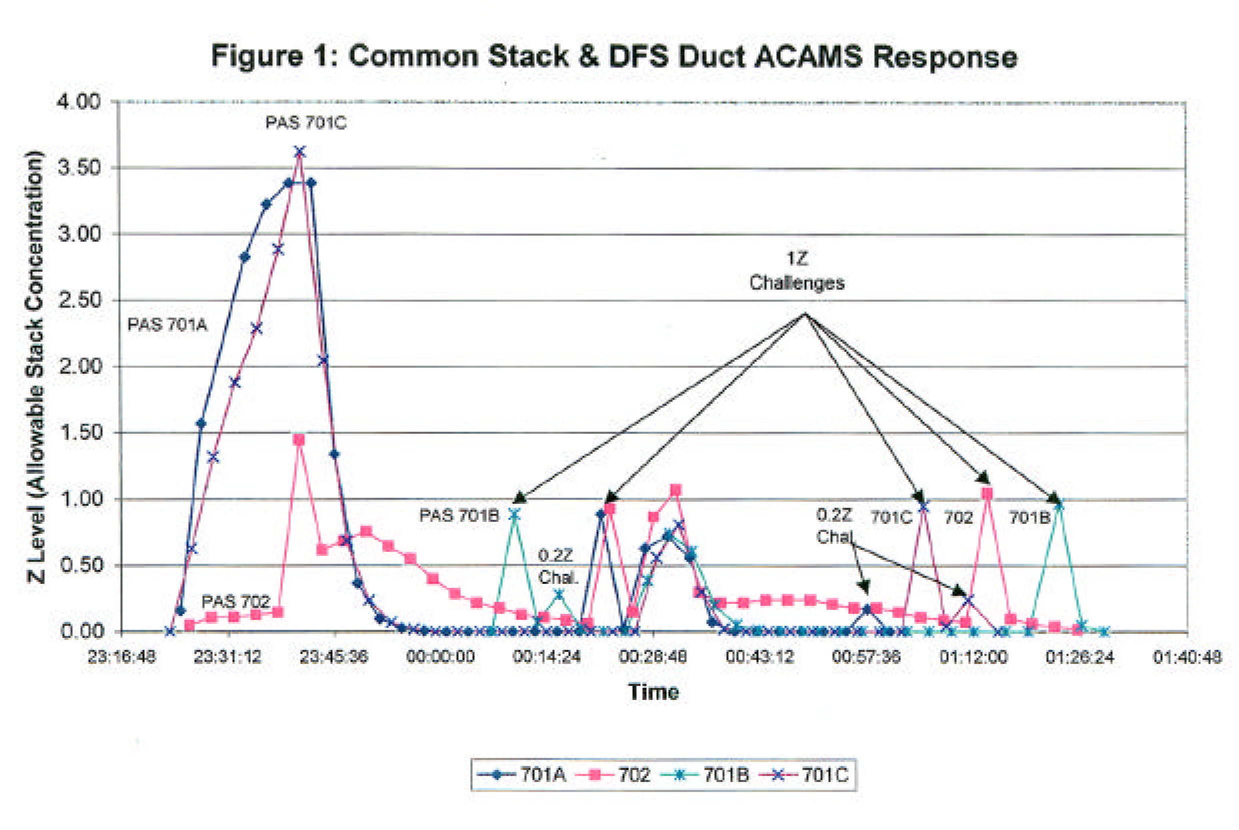
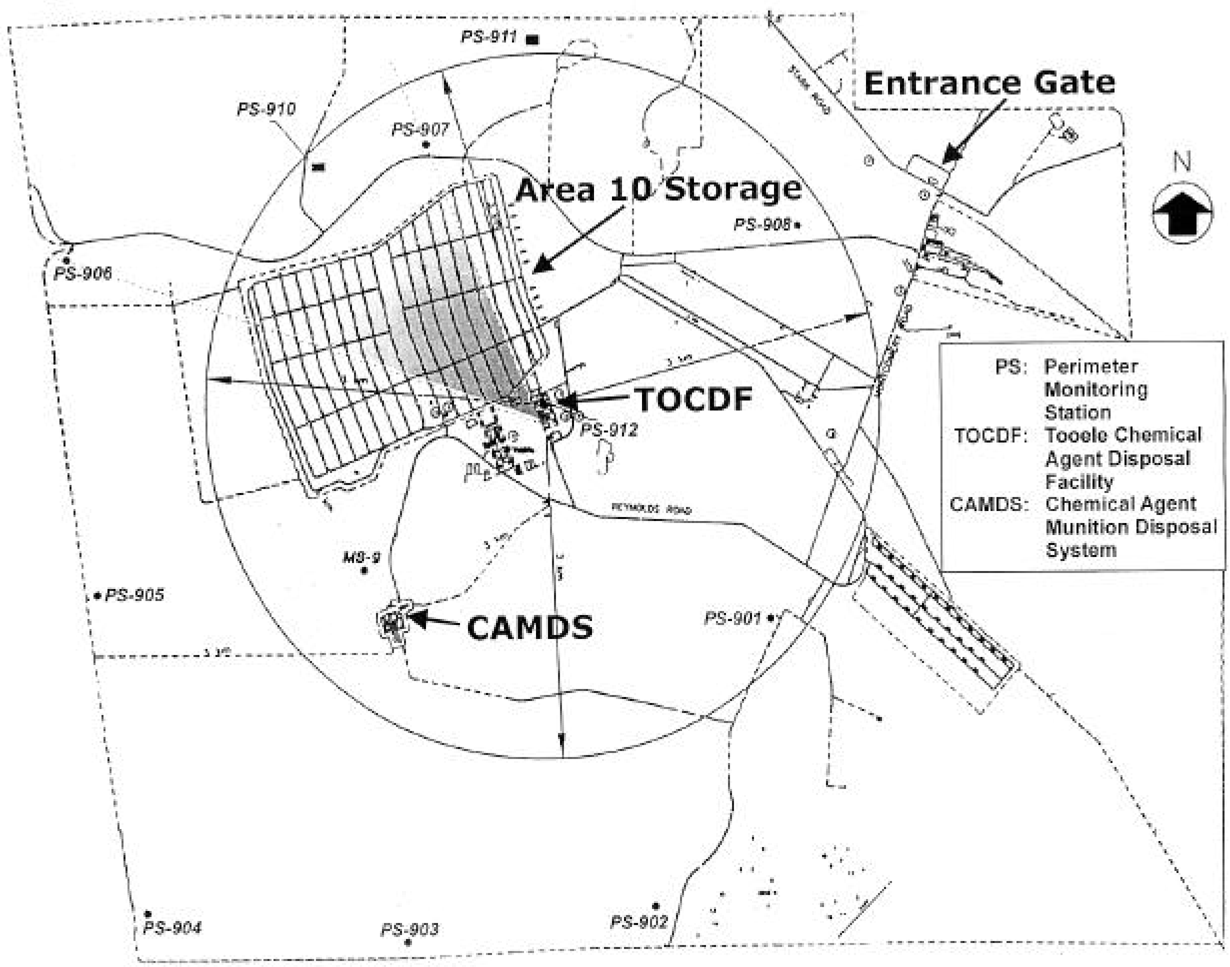


Figure 1: Common Stack & DFS Duct ACAMS Response
Z Level (Allowable Stack Concentration)
4.00
3.50
3.00
2.50
2.00
1.50
1.00
0.50
0.00
23:16:48
23:31:12
23:45:36
00:00:00
00:14:24
00:28:48
00:43:12
00:57:36
01:12:00
01:26:24
01:40:48
Time
PAS 701C
PAS 701A
PAS 702
PAS 701B
0.2Z Chal.
1Z Challenges
0.2Z Chal.
701C
702
701B
701A
702
701B
701C

Figure 2

Figure 2 Estimated Stack Release Plume



Attachment A

Review of Perimeter Monitoring Data for GB Agent
April 1, 2000 to May 17, 2000

Background:

Between 11:26 pm (2326 hours) on May 8, 2000 and 12:56 am (0056 hours) on May 9, 2000, GB was released from the common stack of the TOCDF. This release of GB agent occurred during maintenance on the slide and tipping gates associated with the feed chute to the DFS. The agent was detected by the ACAMS on the common stack and the ACAMS on the DFS duct, and confirmation was conducted by analysis of DAAMS tubes from the common stack. In the evaluation of analytical data collected during the incident, a low-level response at the retention time of GB was observed on the gas chromatogram from the analysis of the "A" DAAMS tube from perimeter Station 905. Because the level of this response equated to a concentration less than the administratively set "reportable limit" of 0.2 GPL, the co-collected "B" DAAMS tube was not analyzed or retained for possible future analyses. Calculated as GB agent, the observed response equated to a found mass of 0.03 nanograms. Assuming an average sampling rate of 0.50 liters per minute and calculated over a 12-hour sampling period, this quantity is equivalent to approximately 0.03 GPL Considering a worst-case scenario by using 30 minutes as the sampling period, which is approximately the length of the release, this quantity would equate to approximately 0.7 GPL over the 30 minutes. (Note: The GPL is normally calculated over a 72-hour sampling period; the above calculations over 12 hours and 30 minutes are presented for perspective only). To investigate possible relations between this "response" at Station 905 and the release of GB from the common stack, an in-depth review of perimeter monitoring and meteorologic data for the Deseret Chemical Depot for April 1, 2000 to May 17, 2000 was conducted.

Outline of Review:

1. "STC/MEC Sequence Summary Reports" with their related GC chromatograms for April 1, 2000 to May 17, 2000 were obtained from CAMDS laboratory.

2. Each GC chromatogram was carefully reviewed to identify "discernible peak" (response) at the expected retention time (RT) of GB. A "discernible peak" is defined as a chromatographic response whose estimated signal to noise ratio (S:N) is 3:1 or greater. Quality control data were reviewed to evaluate the consistency of recovery, RT, and chromatography.

3. Meteorologic data from the 12 meteorologic stations at Deseret Chemical Depot were obtained and carefully studied. Wind data collected at an elevation of 15 meters at Station 9 were used in the evaluation of relationships between TOCDF, CAMDS, or Area 10 and perimeter stations exhibiting "discernible peaks." Station 9 data were used because this

station is centrally located between CAMDS, TOCDF and the Area 10, and its data best represent the average or general meteorologic conditions for the entire Depot.

Summary of Findings and Conclusions:

1. A discernible peak at the expected RT of GB was observed 33 times in the perimeter monitoring data for the study period. Several S:N ratios were greater than 10:1, with some approaching 30:1 (Table 1.

2. With the available analytical data at the time of this review one *cannot confirm or deny the presence of GB on the 33 DAAMS tubes whose analyses produced the discernible peaks observed in the perimeter-monitoring data.* Analytically, the discernible peaks in the analyses of the perimeter monitoring samples are *not dissimilar* from the peaks observed in the analyses of GB spiked QP or QL samples analyzed in the same analytical run.

3. Relationship(s) *cannot* be demonstrated between the release of GB from the common stack and the occurrence of a "discernible peak" at the RT of GB from the analysis of the "A" DAAMS tube from Station 905.

4. During April 1, 2000 to May 17, 2000, the data exhibit two, somewhat ill-defined, clusters of discernible peaks. One cluster started with the sampling period of 6:00 am to 6:00 pm (0600 to1800 hours) on April 3, 2000 and ended with the sampling period of 6:00 am to 6:00 pm (0600 to 1800 hours) on April 5, 2000. Six discernible peaks were observed during this approximately 48-hour period. The second "cluster" started with the sampling period of 6:00 am to 6:00 pm (0600 to 1800 hours) on May 7, 2000 and ended with the sampling period of 6:00 pm to 6:00 am (1800 to 0600 hours) on May 9, 2000. Eight discernible peaks were observed during this approximately 60-hour period. Also, 4 of the 8 discernible peaks observed in the second "cluster" occurred during the 6:00 am to 6:00 pm (0600 to1800 hours) sampling period on May 7, 2000, which was approximately 30 to 36 hours before the agent release incident. A careful evaluation of the meteorological data for April 4 and May 7, 8, and 9 *could not* demonstrate any relationship between the occurrence of the discernible peaks at the RT of GB; the direction and speed of the winds at Meteorologic Station 9; and the locations of the perimeter-monitoring stations, TOCDF, CAMDS, or Area 10.

5. General evaluation of the meteorologic data supports the position that the compound(s) causing the discernible peaks at the RT of GB in the perimeter monitoring *is not GB.*

6. With the exception of two peaks observed on April 4, 2000, all discernible peaks represented a found-mass for GB well below the "reportable limit" of 0.2 GPL, when calculated over a 12-hour sampling period and an average sample flow of 0.5 liters per minute. Two peaks observed on April 4, 2000 (Station 912 with an area count of 1153 and Station 903 with an area count of 1344), could represent levels approximately at the 0.2 GPL. These two samples were analyzed on the same day and the same GC as the sample from Station 904 where a discernible peak with an area count of 842 was equal to a found mass of 0.15 ng and a 0.14 GPL. Based on these data, the area count of 1153 for Station 912 is approximately equivalent to 0.19 GPL and the area count of 1344 for Station 903 is equivalent to 0.22 GPL.

Based on the fact that an 1.0 GPL QP sample analyzed with the samples from Stations 912 and 903 gave an area count of 5601, one would estimate an area count of 1153 (Station 912 data) would be equivalent to a 0.21 GPL, and an area count of 1344 (Station 903 data) would be equal to a 0.24 GPL. (Note: The accuracy of these estimates is uncertain because the low quantity of agent found and the values are not calculated from an established calibration curve.)

7. No apparent relationship was identified between the occurrence of the discernible peaks and the GC instrument used in the analysis. Of the 33 perimeter-monitoring samples that showed discernible peaks at the RT of GB, 11 samples were analyzed on gas chromatograph #1, 12 samples were analyzed on gas chromatograph #2, and 10 samples were analyzed on gas chromatograph #3.

8. There does not appear to be a relationship between the occurrence of the discernible peaks and the specific sampling period. Of the 33 discernible peaks, 14 occur during the 6 am to 6 pm (0600 to 1800 hours) sampling period, and 19 occur during the 6 pm to 6 am (1800 to 0600 hours) sampling period.

9. All quality control data were not available in the data set. Several "out of control" QP and/or QL were observed. On at least two occasions, both the QP and QL were "out of control;" there is no indication of corrective actions being taken and the data from the field sample is reported as valid. Review of the available QC data indicated that the "observed RT" for GB was not consistent with the "Exp. RT" for GB. Apparently, the "Exp. RT" value in the computer file is not updated with the latest quality control data.

10. A limited number of VX analyses were included in the data set. At least three of these showed discernible peaks at the RT of GB.

11. A background compound is present in most perimeter monitoring samples. Its response level ranges from non-detected (ND) to the equivalent of 4 to 5 GPL if it were GB. In several perimeter monitoring samples, high quantities of this compound made observing low-level response at the RT of GB difficult. (Note: During the latter half of April, the laboratory had a problem with this background compound interfering with the analysis of VX on gas chromatograph #2. Apparently, the laboratory made some changes to correct or improve this problem.)

12. Meteorological data from Station 9 (MS-9) were used because this station is centrally located between CAMDS, TOCDF, and Area 10. This station is located in an open area and provided data at the 2-meter, 15-meter, and 30-meter elevations. A review of meteorologic data from the 12 stations showed a wide variation in wind speed and direction, with Station 9 tending to be close to the mean of all stations. Comparison of the data taken at 2 meters, 15 meters, and 30 meters showed minimal variation in wind direction associated with height. The 15 meter data were chosen for the evaluation of the discernible peaks.

Comments:

The Army can administratively establish "reporting limits" or "action limits or levels" for an analytical process; however, the "LOQ" or "MDL" cannot be administratively set for an analytical process or method. The "LOQ" is a statistically defined operational characteristic of an analytical method. A "discernible peak," that is, a peak or response with a S:N ratio of 3:1 or greater at the RT of the analyte of interest, *cannot* be administratively defined as a "non-detected." To do so would be of questionable scientific validity. The compound(s) causing the responses observed at the RT of GB in the perimeter monitoring data may, or may not, be GB. However, without valid analytical data or other technically defensible information to confirm the identity of the compound(s), or it least confirm that they are not of GB origin, the current problem(s) of how to programmatically respond to these chromatographic responses will continue.

Attachment A, Table 1
Summary of Low Level Responses in Perimeter Monitoring Data
March 31, 2000 to May 17, 2000

Date	Station **ID**	GC **Inst.**	Start/End **Times**	Area **Counts**	Mass **Found (ng)**	Comments
3/31	905	GC-2	0600/1800	------[(1)]	------	Discernible Peak: S:N >4:1
3/31	901	GC-2	0600/1800	------	------	Discernible Peak: S:N >3:1
4/1	904	GC –3	1800/0600	------	------	Small Peak: S:N = 3:1
4/2	912	GC-2	0600/1800	132	0.06	Discernible Peak: S:N > 10:1
4/3	905	GC-3	1800/0600	------	------	Small Peak: S:N = 3:1
4/3	911	GC-1	0600/1800	209	(0.03)[(2)]	"VX Run" with Discernible Peak at RT of GB: S:N >10:1
4/4	910	GC-1	1800/0600	240	(0.04)	"VX Run" with Discernible Peak at RT of GB: S:N >20:1
4/4	912	GC-1	1800/0600	1153	(0.21)	"VX Run" with Discernible Peak at RT of GB: S:N >30:1
4/4	904	GC-1	1800/0600	842	0.15	Discernible Peak: S:N >30:1
4/4	903	GC-1	1800/0600	1344	(0.24)	Discernible Peak: S:N >30:1
4/5	903	GC-1	0600/1800	------	------	Discernible Peak: S:N >5:1
4/9	908	GC-1	0600/1800	320	0.07	Discernible Peak: S:N >10:1
4/11	905	GC-3	1800/0600	------	------	Small Peak: S:N = 3:1
4/14	906	GC-3	1800/0600	------	------	Discernible Peak: S:N >5:1
4/15	907	GC-1	1800/0600	------	------	Very Small Peak: S:N – 3:1
4/15	907	GC-2	0600/1800	------	------	Small Peak: S:N = 3:1
4/22	906	GC-1	1800/0600	------	------	Discernible Peak: S:N >6:1
4/23	910	GC-2	1800/0600	------	------	Small Peak: S:N = 3:1
4/25	906	GC-1	1800/0600	217	0.05	Discernible Peak: S:N >20:1

Attachment A Table 1: (Continued)

Date	Station ID	GC Inst.	Start/End Times	Area Counts	Mass Found (ng)	Comments
4/29	906	GC-3	1800/0600	------	------	Small Peak: S:N = 4:1
5/5	903	GC-2	1800/0600	------	------	Small Peak: S:N = 3:1
5/7	901	GC-3	0600/1800	155	0.04	Discernible Peak: S:N >10:1
5/7	905	GC-3	0600/1800	533	0.12	Discernible Peak: S:N >20:1
5/7	908	GC-3	0600/1800	202	0.05	Discernible Peak: S:N >10:1
5/7	912	GC-1	0600/1800	296	0.04	Discernible Peak: S:N >5:1
5/8	902	GC-2	0600/1800	127	0.04	Discernible Peak: S:N > 5:1
5/8	904	GC-2	0600/1800	------	------	Small Peak: S:N = 3:1
5/8	905	GC-2	1800/0600	201	0.05	Discernible Peak: S:N can not be estimated due to high background peak
5/9(3)	**905**	**GC-2**	**1800/0600**	**83**	**0.03**	**Discernible Peak: S:N >5:1**
5/10	906	GC-3	1800/0600	395	0.05	Discernible Peak: S:N >20:1
5/15	910	GC-2	1800/0600	122	0.05	Discernible Peak: S:N >5:1
5/16	904	GC-2	0600/1800	77	0.03	Discernible Peak: S:N = 4:1
5/17	907	GC-3	1800/0600	614	0.15	Discernible Peak: S:N >20:1

Notes: (1) "Area Counts" and "Mass Found" values shown as "------" were not provided in the data set from the CAMDS laboratory. Because the "Area Counts" for these discernible peaks were apparently not integrated at the time of analysis, "Mass Found" values cannot be calculated or even estimated for these samples.

(2)"Mass Found" values shown in ( ) were not provided in the data set from CAMDS but were calculated using recovery data from QP and QL samples analyzed on the same day and on the same GC instrument as the perimeter samples. These "Mass Found" values should only be considered as estimate values.

(3) The sampling period of this perimeter-monitoring sample coincided with the release of 18 to 20 mg of GB agent from the common stack from 2300 hours on May 8 and 0100 hours on May 9.

Attachment B

Chronological order of analysis

Analytical Date: 7 May 2000 GC #1

Analytical Time	Station ID	Aspiration Date	Aspiration Time
1339	CalChk 1261390		
1347	901	7-May-00	1800/0600
1352	902	7-May-00	1800/0600
1356	903	7-May-00	1800/0600
1403	904	7-May-00	1800/0600
1408	905	7-May-00	1800/0600
1412	906	7-May-00	1800/0600
1416	QP906	7-May-00	1800/0600
1420	QL906	7-May-00	1800/0600
1424	907	7-May-00	1800/0600
1428	908	7-May-00	1800/0600

Analitical Date: 8 May 2000 GC #1

Analytical Time	Station ID	Aspiration Date	Aspiration Time
1345	CalChk 1291193		
1353	910	7-May-00	0600/1800
1357	911	7-May-00	0600/1800
1401	912	7-May-00	0600/1800
1405	910	8-May-00	1800/0600
1410	911	8-May-00	1800/0600
1414	912	8-May-00	1800/0600

Analytical Date: 9 May 2000 GC #1

Analytical Time	Station ID	Aspiration Date	Aspiration Time
702	CalChk 1291194		
708	906	9-May-00	1800/0600
712	907	9-May-00	1800/0600
716	908	9-May-00	1800/0600
719	906	8-May-00	0600/1800
724	907	8-May-00	0600/1800
727	908	8-May-00	0600/1800

Chronological order of analysis

Analytical Date: 8 May 2000 GC #2

Analytical Time	Station ID	Aspiration Date	Aspiration Time
1420	CalChk 1291196	8-May-00	1800/0600
1425	901	8-May-00	1800/0600
1429	902	8-May-00	1800/0600
1433	QL902	8-May-00	1800/0600
1437	903	8-May-00	1800/0600
1441	904	8-May-00	1800/0600
1445	905	8-May-00	1800/0600
1448	906	8-May-00	1800/0600
1453	907	8-May-00	1800/0600
1456	908	8-May-00	1800/0600

Analytical Date 9 May 2000 GC #2

1325	CalChk 1301245		
1336	901	8-May-00	0600/1800
1340	902	8-May-00	0600/1800
1344	903	8-May-00	0600/1800
1347	904	8-May-00	0600/1800
1351	905	8-May-00	0600/1800
1355	910	8-May-00	0600/1800
1359	911	8-May-00	0600/1800
1405	912	8-May-00	0600/1800
1410	CalChk 1301242		
1416	901	9-May-00	1800/0600
1421	902	9-May-00	1800/0600
1424	903	9-May-00	1800/0600
1428	904	9-May-00	1800/0600
1433	905	9-May-00	1800/0600
1437	910	9-May-00	1800/0600
1441	911	9-May-00	1800/0600
1444	912	9-May-00	1800/0600

Analytical Date: 10 May 2000 GC #2

1446	CalChk 1311188		
1451	910	9-May-00	0600/1800
1456	911	9-May-00	0600/1800
1459	912	9-May-00	0600/1800
1503	910	10-May-00	1800/0600
1510	911	10-May-00	1800/0600
1515	912	10-May-00	1800/0600

Chronological order of analysis

Analytical Date: 7 May 2000 GC #3

Analytical Time	Station ID	Aspiration Date	Aspiration Time
1143	CalChk 1261391		
1256	910	6-May-00	0600/1800
1259	911	6-May-00	0600/1800
1304	912	6-May-00	0600/1800
1309	910	7-May-00	1800/0600
1314	911	7-May-00	1800/0600
1318	912	7-May-00	1800/0600
1324	CalChk 1281070		
1331	901	6-May-00	0600/1800
1335	902	6-May-00	0600/1800
1340	903	6-May-00	0600/1800
1345	904	6-May-00	0600/1800
1350	905	6-May-00	0600/1800
1357	906	6-May-00	0500/1800
1401	QP906	6-May-00	0600/1800
1405	QL906	6-May-00	0600/1800
1408	907	6-May-00	0600/1800
1413	908	6-May-00	0600/1800

Analytical Date: 8 May 2000 GC #3

Analytical Time	Station ID	Aspiration Date	Aspiration Time
1249	CalChk 1281068		
1255	901	7-May-00	0600/1800
1259	902	7-May-00	0600/1800
1304	903	7-May-00	0600/1800
1308	904	7-May-00	0600/1800
1314	905	7-May-00	0600/1800
1319	QP906	7-May-00	0600/1800
1324	QL906	7-May-00	0600/1800
1328	906	7-May-00	0600/1800
1334	907	7-May-00	0600/1800
1339	908	7-May-00	0600/1800

Chronological order of analysis

Analytical Date: 9 May 2000 GC #3

1310	CalChk 1301241		
1321	QP902	8-May-00	0600/1800
1325	QL902	8-May-00	0600/1800
1345	QP902	9-May-00	1800/0600
1349	QL902	9-May-00	1800/0600

Analytical Date: 10 May 2000 GC #3

1306	CalChk 1311187		
1313	901	9-May-00	0600/1800
1317	902	9-May-00	0600/1800
1320	QP902	9-May-00	0600/1800
1324	QL902	9-May-00	0600/1800
1332	903	9-May-00	0600/1800
1335	904	9-May-00	0600/1800
1339	905	9-May-00	0600/1800
1343	906	9-May-00	0600/1800
1346	907	9-May-00	0600/1800
1354	908	9-May-00	0600/1800
1405	CalChk 1311190		
1409	901	10-May-00	1800/0600
1420	902	10-May-00	1800/0600
1425	QP902	10-May-00	1800/0600
1429	QL902	10-May-00	1800/0600
1434	903	10-May-00	1800/0600
1438	904	10-May-00	1800/0600
1442	905	10-May-00	1800/0600
1446	906	10-May-00	1800/0600
1451	907	10-May-00	1800/0600
1456	908	10-May-00	1800/0600

Attachment C

Detailed Review of Modeling Parameters,
TOCDF Release on May 8, 2000

The EPA SCREEN3 model (version dated 96043) was used to examine the downwind concentration potential exposure levels for the approximate 30-minute duration agent GB release from the TOCDF incinerator stack.

The following information was used to run the SCREEN model:

1. Full array meteorology was used to identify worst-case air dispersion conditions.

2. The model was run under the rural option, without fumigation.

3. Stack gas temperature was 388.7 degrees Kelvin (K).

4. Measured ambient air temperature was 285.4 degrees K.

5. Stack gas flow rate was 49,826 ACFM (average flow rate over duration of release event, adjusted for stack gas temperature).

6. Actual stack and local building dimensions were used to run the model.

For the modeling, the duration of the stack release was considered to be 30 minutes. To yield the most conservative (highest possible) results, the model was run using the highest reported 3-minute stack release rate of 3.63 ASC for the entire 30 minutes to examine the possible acute or short-term exposure impacts. The average concentration over the approximate 30-minute release was actually about half the concentration used for this analysis. One ASC is equivalent to 0.0003 milligram of agent GB per cubic meter (mg/m^3) of exhaust gas emitted from the stack.

The results of the peak-release model run showed the maximum ground level concentration (MGLC) of agent GB to be 1.3×10^{-7} mg/m^3 at a distance of 391 meters downwind from the stack**.** The 72-hour General Population Level (GPL) for GB is 3.0×10^{-6} (mg/m^3). This concentration is a very low level of agent that is considered by CDC to be safe for exposure to the general public for a 72-hour exposure period. This stack release resulted in a maximum ground level (MGLC) concentration that was less than 1/10 of that standard GPL concentration, and it lasted for a relatively brief duration. Considering the actual duration of the release, if a member of the public had been at the MGLC location for the entire event, he/she would have had an exposure that was under 1/10 of 1% of safe exposure for the general public. Based upon the results of this model and the observation that the general public lives considerably farther from the emission source than 391 meters, where ground level concentrations would be lower than the MGLC, CDC believes this event poses no adverse impacts to worker or public health.

To examine the potential impact on worker health from this release, the 3-minute peak agent level was used in the SCREEN3 model with the downwash option selected. Although actual meteorologic conditions did not suggest downwash conditions over the duration of the release, downwash conditions would result in the highest levels of agent concentration occurring fairly close to the plant where workers could be located. Accordingly, to examine the worst case for possible agent exposures, CDC elected to do a separate run of the model with this option implemented. The maximum 1-hour concentration (if the release had continued for an hour) was $2.7x10^{-6}$ mg/m^3 at a distance of 82 meters from the plant stack. The 8-hour occupational exposure limit TWA for agent GB is $1x10^{-4}$ mg/m^3. This exposure would have been less than 1% of the TWA if an employee remained unmasked at the MGLC point for the entire event. Given the relatively short duration of the release and the magnitude of the maximum potential exposure level below the worker TWA, the level of employee exposure would have been minimal. Additionally, the site was masked within a few minutes of the release alarm, thereby reducing potential exposure to shorter durations than shown above.

To summarize, both of the scenarios for potential public and worker exposures were considered using conservative assumptions and worst-case conditions. **When considering both level and duration of exposure, both exposure scenarios resulted in maximum estimated potential exposures that were well under 1% of the concentrations accepted by CDC as posing no adverse human health impact.**

This evaluation was prepared by CDC on May 16, 2000, using the best data available.