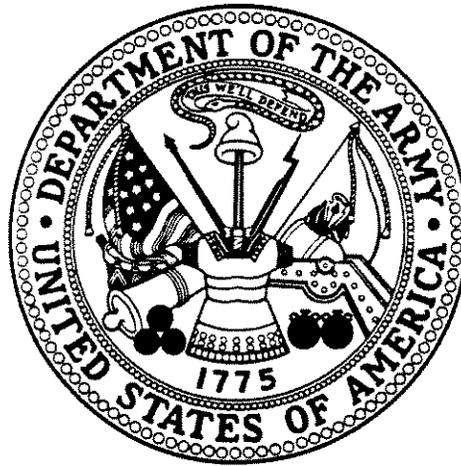


**PROPOSED MODIFICATIONS TO SUPPORT
THE DESTRUCTION OF MUSTARD AGENT
AT THE UMATILLA CHEMICAL AGENT DISPOSAL
FACILITY (UMCDF) IN OREGON**

ENVIRONMENTAL ASSESSMENT



May 2008

**U.S. ARMY CHEMICAL MATERIALS AGENCY
Aberdeen Proving Ground, Maryland**

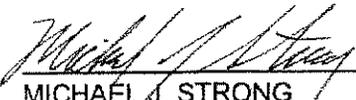
ENVIRONMENTAL ASSESSMENT

Lead Agency: Department of the Army;
Umatilla Chemical Depot

Title of Proposed Action: Proposed Modifications to Support the Destruction of
Mustard Agent at the Umatilla Chemical Agent Disposal
Facility (UMCDF) in Oregon

Affected Jurisdiction: Morrow and Umatilla Counties, Oregon

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ORGANIZATION OF THIS ENVIRONMENTAL ASSESSMENT

This Environmental Assessment (EA) evaluates the environmental effects of the Army's proposed action: installation and operation of additional equipment and systems at the Army's existing Umatilla Chemical Agent Disposal Facility (UMCDF) at the Umatilla Chemical Depot in Oregon. This new equipment will assist with the destruction of the depot's inventory of mustard agent that, in some cases, may contain significantly higher levels of mercury than previously anticipated and/or large quantities of undrainable solids and sludge-like material inside the containers that are used to store the mustard agent. This EA provides information to be considered in making decisions regarding the proposed action and its alternatives.

SECTION 1 INTRODUCTION summarizes the purpose of and need for the proposed action and provides relevant background information about the mustard agent to be destroyed at the UMCDF.

SECTION 2 PROPOSED ACTION AND ALTERNATIVES describes the proposed action and the no-action alternative, as well as other alternatives to the proposed action.

SECTION 3 THE AFFECTED ENVIRONMENT AND POTENTIAL ENVIRONMENTAL CONSEQUENCES describes the existing environmental resources that could be affected by the proposed action, identifies the potential environmental impacts of implementing the proposed action and of the no-action alternative, and identifies proposed mitigation measures, as appropriate.

SECTION 4 CONCLUSIONS summarizes the findings about the potential environmental impacts for the proposed action and no-action alternative, and makes a recommendation on whether to proceed with a Finding of No Significant Impact.

SECTION 5 PERSONS CONTACTED AND CONSULTED provides a listing of those individuals who were contacted to provide data and information for the analyses in this EA, as well as those who contributed to the preparation of this EA through their analyses and expert reviews.

SECTION 6 REFERENCES provides bibliographic information for cited reference materials.

ACRONYMS AND ABBREVIATIONS

µg	microgram
ABCDF	Aberdeen Chemical Agent Disposal Facility (in Maryland)
ACDP	Air Contaminant Discharge Permit
ACS	agent collection system
BAT	best available technology
BDS	bulk drain station
BRA	brine reduction area
CFR	<i>Code of Federal Regulations</i>
COPEC	constituent of potential environmental concern
CMA	U.S. Army Chemical Materials Agency
CWC	Chemical Weapons Convention
DCD	Deseret Chemical Depot (in Utah)
DEQ	[State of Oregon] Department of Environmental Quality
DFS	deactivation furnace system
DOD	U.S. Department of Defense
DOT	U.S. Department of Transportation
dscm	dry standard cubic meter
EA	environmental assessment
EPA	U.S. Environmental Protection Agency
g	gram
gal	gallon
GB	a nerve agent, also called “sarin”
HD	mustard agent, also called “distilled mustard”
HEPA	high-efficiency particulate air (filter)
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
JACADS	Johnston Atoll Chemical Agent Disposal System
°K	degrees Kelvin
kg	kilogram
L	liter
LIC	liquid incinerator (there are two of these at the UMCDF)
m	meter

m ³	cubic meter
MACT	maximum achievable control technology
MDB	munitions demilitarization building
mg	milligram (one thousandth of a gram)
MPF	metal parts furnace
NEPA	National Environmental Policy Act
NESHAPS	National Emission Standards for Hazardous Air Pollutants
PAS	pollution abatement system
PCB	polychlorinated biphenyl
PFS	PAS filtration system
PMCD	Program Manager for Chemical Demilitarization (a predecessor of the U.S. Army Chemical Materials Agency)
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RMA	Rocky Mountain Arsenal (in Colorado)
s	second
SAIC	Science Applications International Corporation
SDS	spent decontamination solution
SIC	sulfur-impregnated carbon
SLERA	screening-level ecological risk assessment
TC	ton container
TCLP	Toxicity Characteristic Leaching Procedure
TOCDF	Tooele Chemical Agent Disposal Facility (in Utah)
TSDF	treatment, storage, and disposal facility
UMCD	Umatilla Chemical Depot (in Oregon)
UMCDF	Umatilla Chemical Agent Disposal Facility (in Oregon)
U.S.	United States
USACHPPM	U.S. Army Center for Health Promotion and Preventive Medicine
VX	a nerve agent

1. INTRODUCTION

The U.S. Army Chemical Materials Agency (CMA) is charged with safely storing and destroying the U.S. inventory of chemical warfare agents and munitions while protecting the public, the workers, and the environment. Under the terms of an international disarmament treaty, known as the Chemical Weapons Convention (CWC), the United States must destroy its entire inventory of chemical weapons by April 2012. The CMA is presently destroying the lethal unitary chemical agents and munitions at designated chemical weapons storage sites. One of these storage sites is the Umatilla Chemical Depot (UMCD), near Hermiston, Oregon, where one of the Army's chemical agent incineration facilities [i.e., the Umatilla Chemical Agent Disposal Facility (UMCDF)] began to destroy chemical weapons in September 2004. The UMCDF uses a reverse-assembly, high-temperature incineration process [called the baseline process in this Environmental Assessment (EA)] to destroy chemical warfare agents.

Baseline incineration provides a flexible approach to the safe and effective destruction of a variety of munition types and chemical agents, including those stored at the UMCD. To date, the Army's chemical weapons destruction systems have destroyed almost 2 million munitions containing over 32 million pounds of chemical warfare agents, which represents over 50% of the declared U.S. stockpile (CMA 2007a).

The CMA has determined that a portion of the inventory of distilled mustard agent (i.e., the blister, or vesicant, agent HD) in storage at the UMCD may have characteristics that could complicate the ability of the UMCDF to treat the material with the existing baseline processes while maintaining compliance with applicable emissions limits and regulations. The mustard agent at the UMCD is stored in liquid form inside large cylindrical steel containers (called "ton containers" or TCs). The problematic characteristics of the mustard agent inside some of these TCs include significantly higher levels of mercury than previously anticipated and/or large accumulations of solids that are difficult to drain from the TCs with the liquid mustard agent.

This EA pertains to proposed modifications to the UMCDF that would allow for the timely processing of the TCs and the destruction of the mustard agent they contain.

1.1 BACKGROUND

The potential impacts associated with the destruction of the UMCD chemical weapons stockpile (including the mustard-filled TCs) at the UMCDF have been previously reviewed in an Environmental Impact Statement (U.S. Army 1996) and in a subsequent review of that document (Zimmerman et al. 2006). These two previous reviews each concluded that the mustard agents could be destroyed at the UMCDF without causing significant environmental impacts; however, those conclusions were obtained without considering the recent identification of significantly higher levels of mercury than previously anticipated or the large amount of solids in some of the mustard-filled TCs. This EA has been prepared to augment the previous environmental reviews.

The chemical agent inventory at the UMCD includes 2,635 TCs that contain almost 4.68 million pounds of mustard agent (DOD 1996). To date, the UMCDF has destroyed the UMCD's entire inventory of nerve agent GB (over 2 million pounds), and the campaign to destroy the depot's inventory of nerve agent VX is in progress.

A generalized schematic of the baseline process is shown in Figure 1. Baseline processing of the TCs involves the following procedures:

- A few TCs are removed from their storage igloos (i.e., earth-covered concrete storage structures) and brought inside the UMCDF. At a bulk drain station (BDS) inside the UMCDF, the liquid mustard agent is drained from individual TCs, accumulated in agent collection system (ACS) tanks, and then fed into one of the two liquid incinerators (LICs) at the UMCDF for destruction.
- The drained TCs are placed into a metal parts furnace (MPF) for thermal decontamination and to destroy any residual agent remaining after the draining process.
- Each of the two LICs and the MPF has its own pollution abatement system (PAS). Each PAS uses wet scrubber technology to clean the incinerator gases before discharge. The spent liquids (also called scrubber brines) from these PASs are accumulated in tanks.
- Each PAS is followed by a PAS filtration system (PFS) which uses activated carbon to remove organic compounds from the exhaust gases. The atmospheric emissions from each PFS must comply with regulatory limits.
- Water is removed from the scrubber brines in a brine reduction area (BRA), and the resulting brine salt wastes are sent off-site for further management at a treatment, storage, and disposal facility (TSDF) that is permitted to handle such wastes.

Mustard-filled TCs, similar to those in storage at the UMCD, are also being stored at the Deseret Chemical Depot (DCD) near Tooele, Utah. The Army is currently using the baseline process at the Tooele Chemical Agent Disposal Facility (TOCDF) to destroy the

DCD’s inventory of mustard-filled TCs. However, the processing of mustard-filled TCs at the TOCDF has revealed two problems: (1) the TCs can developed undrainable “heels”¹ which contain sludge-like solid materials and (2) a portion of the liquid mustard agent, as

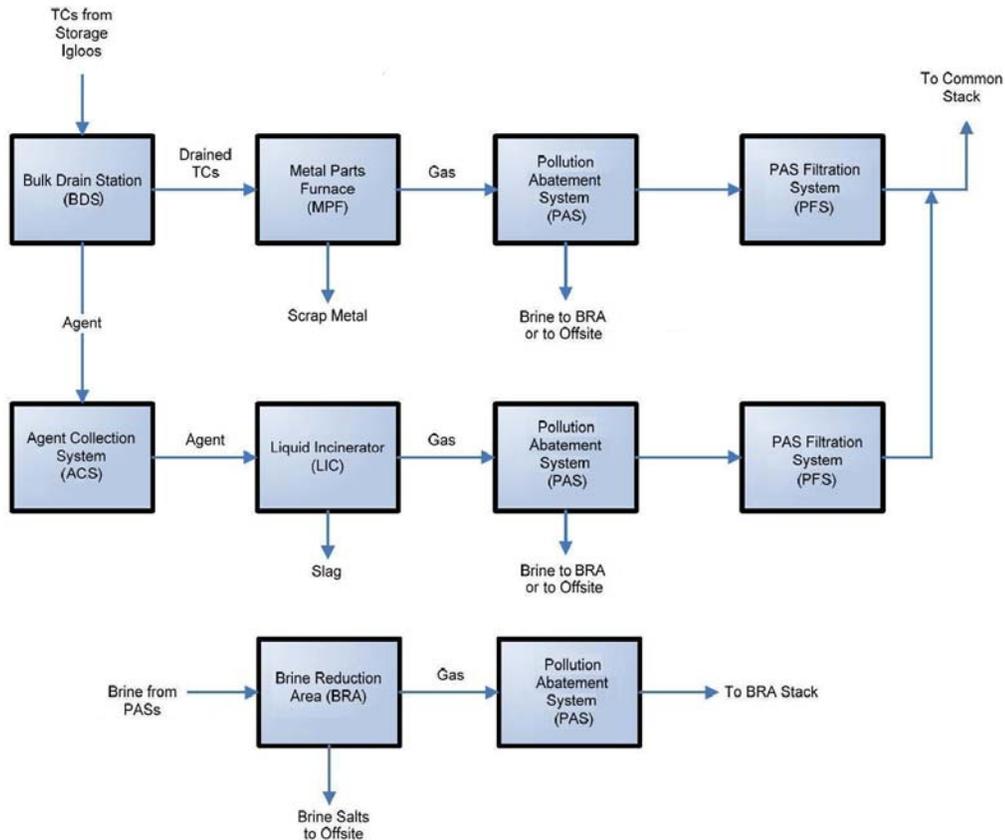


Figure 1. Schematic diagram of the baseline incineration processes at the Umatilla Chemical Agent Disposal Facility (UMCDF). Note there are two LICs (not shown) at the UMCDF. *Source:* Adapted from SAIC 2008.

¹ “Heels” are the leftover portions of the chemical agent that remains in the storage container after the draining operation is completed. Some portion of the liquid agent simply sticks to the walls of the containers and is difficult to remove. Also, mustard agent can sometimes solidify or can develop sludge-like residues that settle to the bottom of the container after prolonged periods of storage. In either case, the “heel” represents that portion (both liquid and solid) of the contents of a container that cannot be completely drained.

well as the solids, in some TCs are contaminated with significantly higher levels of mercury than previously anticipated (EG&G 2004).

While the baseline design for the UMCDF included consideration of some small quantity of undrainable heels in the TCs, the quantities encountered at the TOCDF have been higher than expected. Such high heel content could present a challenge to the processing of the TCs in the MPF. In regard to mercury, the carbon filtration in the existing PFSs was designed to remove organic compounds from the gas stream; however, mercury is a volatile metal that may not be very effectively removed by the existing carbon filters.

All of the mustard agent stored in the TCs at the DCD is agent HD, and it originated at the Rocky Mountain Arsenal (RMA) in Colorado. The TC inventory at the UMCD also originated at the RMA. It is expected that the problems with the TCs at the DCD will also be present in the inventory of mustard-filled TCs at the UMCD. There is evidence that the RMA production facilities and some of the TCs used at RMA were possibly contaminated during the manufacture of Lewisite (an arsenic-based chemical warfare agent) (SAIC 2007). The production of Lewisite used a mercuric chloride catalyst which is the likely source of the mercury contamination in the mustard agent. Furthermore, the contamination has been linked to specific lot numbers (i.e., mustard agent manufactured in the same production batch) and serial numbers (i.e., the numbering system used with individual TCs as they were filled).

Based on the on-going sampling of TCs at the DCD, approximately 14% of the DCD inventory of TCs is expected to contain elevated mercury concentrations, with or without high solid heels, and approximately 40% of the DCD inventory of TCs is expected to contain high amounts of solids but low concentrations of mercury (W.S. Lessig, Science Applications International Corporation, Stockton, Utah, e-mail communication to G.P. Zimmerman, Oak Ridge National Laboratory, Oak Ridge, Tenn., February 4, 2008).

Based on the DCD data, a statistical model has been developed to predict the anticipated mercury concentrations in TCs by lot number and serial number. When applied to the inventory of TCs at the UMCD, the model predicts that about 16% (i.e., about 430 TCs) will have higher mercury concentrations than previously anticipated, and the remaining 84% will have mercury concentrations suitable for processing with the baseline UMCDF operations (SAIC 2008).

Based on the sampling of TCs at the DCD, up to 30% (i.e., about 790 TCs) of the UMCD inventory would be expected to contain high solid heels that could present a challenge to the processing of these TCs in the MPF. However, information obtained at the TOCDF about the processing of low-mercury, low-heel TCs and regarding the sampling of incineration exhaust gases has confirmed that the TOCDF can safely process those TCs which meet the criteria for incineration and can remain within regulatory standards for mercury emissions.

UMCDF incineration operations are regulated by both the Resource Conservation and Recovery Act (RCRA) and the Clean Air Act [National Emission Standards for Hazardous Air Pollutants for Hazardous Waste Combustion, which are based on Maximum Achievable Control Technology (MACT)] with oversight of the U.S. Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (DEQ). The UMCDF is required to perform extensive exhaust gas sampling as part of trial burns and comprehensive performance tests to verify that emissions are in compliance with all applicable standards.

The mustard TC campaign at the TOCDF to date reflects the situation at the UMCDF that the combination of elevated mercury content and undrainable solids may challenge the existing baseline incineration process in terms of throughput rates and PAS performance. The mercury content in some of the mustard TCs may be too high to process in the UMCDF's MPF using existing controls or without exceeding compliance limits established by regulatory authorities under the provisions of RCRA or the Clean Air Act. In addition, TCs with high solids content could require lengthy MPF processing times². As described further below, those TCs which will require additional processing equipment are the subject of this EA.

1.2 OVERVIEW OF THE PROPOSED ACTION

The CMA proposes to employ additional equipment and to implement changes to processes and procedures that would provide greater operational flexibility at the UMCDF to augment the baseline process for destroying those mustard agents which have higher levels of mercury contamination than previously anticipated and/or high solid heels.

The following overview briefly describes the equipment modifications at the UMCDF and process changes that are being considered under this proposed action. Additional details can be found in Section 2.1.1.

- **Sulfur-impregnated carbon filtration.** To control atmospheric emissions from the UMCDF, the two LICs and the MPF each have an existing PAS with a PFS that includes activated carbon filters. In addition, three spare PFS units are available at the UMCDF. Under the proposed action, one or more of these six existing PFSs would be upgraded by replacing some or all of the activated carbon currently in the PFSs with

² Attachment 4 of the existing RCRA permit for the UMCDF (DEQ 2005) specifies the procedures to be followed when processing a TC with a heel content greater than 5% (by weight) (i.e., about 85 pounds). The UMCDF staff is currently investigating the implications of these procedures for TCs with heel quantities significantly greater than 5%, such as those addressed by the proposed action in this EA.

sulfur-impregnated carbon (SIC) which would remove mercury from the stack gases. Either a few carbon beds in the existing PFSs would be replaced with SIC or one of the spare PFS units would be filled with SIC and the air flow exiting the activated carbon PFS would be routed into the PFS containing the SIC. The new SIC filter media would thus augment the existing activated carbon media.

The Army previously evaluated various technologies for mercury removal and concluded that SIC filters are the preferred technology and that substitution or addition of SIC for the conventional activated carbon in the current PFS designs would reduce mercury emissions by 80% (U.S. Army 2001). Higher removal rates would require larger SIC filters that allow longer gas residence times. Based on current testing, a 12-inch bed of SIC filter media with a 2.5-second gas residence time would be expected to achieve near 100% mercury removal (i.e., current testing shows 99% mercury removal over a 2,500-hr test period). The proposed new SIC filter media would be capable of reducing mercury emissions to regulatory levels.

- **Expanded capacity for sampling drained mustard agent.** In order to ensure compliance with RCRA requirements for the agent to be destroyed, the drained mustard agent in the ACS tanks would be sampled before being fed into one of the two LICs. Currently, drained agent accumulates in two existing ACS tanks at the UMCDF; however, additional tank capacity would be needed to accommodate the time required for the sampling and analysis of the drained agent to assure that it is acceptable for feeding into the LICs. To provide the required additional capacity, an existing spent decontamination solution (SDS) tank would be converted for use as an ACS tank so that three ACS tanks would then be available to hold drained mustard agent.
- **Ton container heel transfer capability.** The proposed new heel transfer capability would consist of the equipment necessary to break up and mobilize the solid heel inside the subject TC and then transfer part of that heel into an alternate TC. This would be accomplished by physical or mechanical means using hot water jets and pumps to effect the transfer. The proposed procedure would result in a reduction in the amount of solid heel in the subject TC to a quantity that is suitable for processing through the MPF. The removed portion of the original heel would be transferred into a different TC whose contents, when combined with the portion of the solid heel removed from the original TC, would also be suitable for processing through the MPF.
- **Alternatives for management of liquid scrubber brines.** As described in Section 1.1, the liquid brines from the PASs are currently sent to the BRA, and the resulting brine salts are shipped off site for further management. During the processing of mercury-contaminated mustard agent, the scrubber brines would be expected to remove some of the mercury from the exhaust gases, and the brines might then become contaminated with mercury. Because the existing BRA was designed to reduce the overall waste

volume by evaporating the water from the brines, the operation of the BRA with mercury-contaminated brines would likely result in the emission of mercury during the drying process. Thus, the BRA would not be operated under the proposed action. Instead, all scrubber brines would be shipped off site in liquid form, and no brine salts would be generated at the UMCDF.

At this time, the TCs that appear suitable for baseline processing are those with little or no mercury contamination and with small heels (i.e., based on previous tests and experience from the TOCDF: less than about 32 ppm mercury and less than about 600 pounds of heel). The proposed action would be implemented via the installation of the new SIC filter media, the conversion of an existing SDS tank for use as an additional ACS tank, the addition of a heel-transfer capability, and the off-site shipment of liquid brines.

Mercury-contaminated TCs that do not have large solid heels would not be processed using the heel-transfer capability. Such drained, low-heel TCs would be expected to be capable of being processed in the MPF using baseline processing. A demonstration and shakedown period would be needed to determine which TCs could be processed through the MPF (with its new SIC filter media) and which TCs may require heel transfers prior to processing through the MPF.

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

The purpose of the proposed action is to provide the UMCDF with the additional equipment and changes in processes that are needed for the safe and timely destruction of the UMCD's entire inventory of mustard agents and to dispose of the associated wastes in a safe and environmentally acceptable manner. This action is needed to meet current U.S. obligations under the CWC and Congressional directives in Public Law 99-145 for destroying the entire chemical weapons stockpile being stored at the UMCD³. These destruction activities must be completed on a schedule in agreement with the deadline specified in the CWC. Furthermore, the completion of the proposed action would eliminate the risk to the public from continued storage of these chemical agents and munitions. Completion of stockpile destruction activities would also eliminate the need for continued surveillance and maintenance of the mustard agents currently being stored at the UMCD.

³ As of July 8, 2007, the UMCDF had completed the destruction of all recoverable GB nerve agent and munitions stored at the UMCD. Following the completion of the current campaign to destroy all of the agent VX at the UMCD, the mustard campaign would then become the last significant agent/munition campaign for the UMCDF. Thus, the successful completion of the proposed action described in this Environmental Assessment would result in the elimination of the entire UMCD inventory of chemical agents and munitions.

The presence of significantly higher levels of mercury than previously anticipated in some mustard-filled TCs would require the UMCDF to (1) reduce its processing rate for these items, (2) risk compromising permit requirements, and/or (3) cause potentially unacceptable human health or ecological effects due to increased mercury emissions. The addition of new SIC filter media to the existing PFSs is needed to allow the processing of mercury-contaminated items in an environmentally safe manner and in compliance with regulatory standards established under RCRA and under the Clean Air Act.

The presence of unanticipated, high solids content (i.e., heels) in some mustard-filled TCs may prevent the timely destruction of these items due to the reduction in throughput rates that could be required to process these TCs in the MPF. That is, a TC with a large solid heel might require lengthy processing time inside the MPF to ensure that its contents have been destroyed and that the empty TC has been adequately decontaminated. The proposed new TC heel-transfer capability is needed to provide for more efficient use of the existing MPF throughput capacity and to prevent significantly extending the schedule for processing the problematic TCs in the MPF. The installation and operation of the TC heel-transfer equipment would allow for the appropriate tradeoff between economic and schedule considerations for the UMCDF.

1.4 SCOPE OF THIS ENVIRONMENTAL ASSESSMENT

This EA has been prepared by the U.S. Army Chemical Materials Agency to evaluate the significance of the potential environmental impacts of the proposed modifications to the UMCDF to accomplish the destruction of mustard-filled TCs with significantly higher levels of mercury than previously anticipated and/or a high solids content. This EA has been prepared in compliance with Council on Environmental Quality regulations for implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969 (see 40 CFR Parts 1500–1508) and Army Regulation 200-2 on *Environmental Analysis of Army Actions* (see 32 CFR Part 651).

To avoid redundancy and to comply with the intent of the Council on Environmental Quality's guidance at 40 CFR 1500.4 on reducing paperwork, this EA relies upon the findings of the Army's previous assessments of the destruction of mustard agent (i.e., U.S. Army 1996, Zimmerman et al. 2006), rather than presenting new analyses. Where a simple comparison between the previous assessments and the proposed action is not sufficient to determine the relative magnitude or significance of the potential impacts, additional analysis is presented in Section 3 of this EA.

Scenarios for Analysis. For the purpose of analyzing the fate of the mercury in the TCs in this EA, two sets of assumptions have been made for two separate and distinct scenarios:

- *Scenario A (as assessed in Section 3.1):* In order to assess the potential impacts of the atmospheric emissions from the UMCDF, the PFS filter media is assumed to be the sole mechanism for the removal of the mercury during the destruction of the entire inventory of mercury-contaminated TCs stored at the UMCD, regardless of any operations involving scrubber brines that might also remove mercury, and
- *Scenario B (as assessed in Section 3.2):* In order to assess the potential impacts of wastes generated at the UMCDF, the scrubber brines are assumed to remove 100% of the mercury from the stack gases.

While in reality these two assumptions are contradictory—but not mutually exclusive—they will separately provide an appropriate basis for the analyses that will bound the resulting impacts. Thus, the potential environmental impacts assessed in Chapter 3 of this EA represent an upper bound on the full range of operational options available under the proposed action.

Human Health and Ecological Risk Assessments. A human health risk assessment (HHRA) (Ecology and Environment 1997) was completed for the hypothetical atmospheric emissions from the UMCDF prior to the start-up of the UMCDF. The 1997 HHRA examined the potential human health effects, as well as the potential effects on ecological resources. The 1997 HHRA included an estimation of the mercury emissions from the UMCDF, as well as an assessment of the risks posed by those emissions. The 1997 HHRA also included a screening-level ecological risk assessment (SLERA) to evaluate the potential effects of the emissions from the UMCDF on ecological resources. This EA incorporates the findings of the 1997 HHRA and the SLERA (see Sections 3.1.1 and 3.1.2, respectively).

When the 1997 pre-trial burn HHRA was being prepared, construction of the UMCDF had not been completed, and site-specific emissions data were not available. The 1997 HHRA was therefore based on emissions from similar Army incineration facilities, such as the Army's Johnston Atoll Chemical Agent Disposal System (JACADS). When the 1997 HHRA was prepared, the state of Oregon anticipated that a post-trial burn assessment would be prepared after the UMCDF completed its trial burns on each furnace with each chemical warfare agent. These updated HHRAs would include a comparison of the actual UMCDF trial burn results with estimated emissions and operating parameters as used in the

1997 HHRA. Such an updated, post-trial burn HHRA is currently in progress; however, the results are not yet available for incorporation into this EA.

The post-trial burn HHRA incorporates a methodology adapted from the EPA's latest guidance for hazardous waste combustion facilities (EPA 2005). The post-trial burn HHRA includes both direct and indirect exposure pathways for a lengthy list of constituents of interest, including metals, halogens, acid gases, and products of incomplete combustion. These constituents can be categorized into the following broad classifications: (1) volatile organic compounds, (2) semi-volatile organic compounds, (3) non-volatile organic compounds, (4) dioxins and furans, (5) metals, including mercury, and (6) tentatively identified compounds, such as compounds identified in gas chromatography analysis of emissions sampled during the actual trial burns.

The in-progress post-trial burn risk HHRA for the UMCDF also includes a SLERA. This new SLERA uses habitat-specific food webs (i.e., interlocking food chains within an ecosystem) and species-specific assessment endpoints to focus its risk analysis. Separate assessments are underway for two food webs: a freshwater food web and a shrub-steppe (grassland) food web. The representative freshwater food web represents the riparian/aquatic habitats associated with the nearby Columbia and Umatilla Rivers.

Several threatened and endangered species near the UMCDF will be explicitly included as end-point receptors in the SLERA. These species include the threatened bald eagle (*Haliaeetus leucocephalus*), the threatened or endangered salmon and steelhead (*Oncorhynchus nerka*, *O. tshawytscha*, and *O. mykiss*), as well as one candidate species: the Washington ground squirrel (*Spermophilus washingtoni*).

The in-progress SLERA will also include an evaluation of the ecological risks to surrogate species which represent the other federally-listed species near the UMCDF [i.e., the bullfrog and the western toad as surrogates for the Columbia spotted frog (*Rana luteiventris*) and the Oregon spotted frog (*Rana pretiosa*); the mourning dove and the western meadowlark for the yellow-billed cuckoo (*Coccyzus americanus*)]. It is also worth noting that two "species of concern" to the state of Oregon [i.e., the western burrowing owl (*Athene cunicularia hypugaea*) and the northern sagebrush lizard (*Sceolporus graciosus graciosus*)] are also being explicitly included as end-point receptors in the SLERA. Thus, the impacts to threatened and endangered species (as well as to candidate species) will be appropriately assessed in the in-progress SLERA.

The preliminary findings of the in-progress HHRA indicate that there would be adverse human health impacts, but only if the BRA were to be operated. The projected adverse effects would involve only the chronic, noncarcinogenic exposure scenarios. Mercury emissions from the BRA would be the principal constituent of concern. Without the BRA in operation, the preliminary findings indicate there would be no adverse human health problems for any of the hypothetical exposure scenarios (USACHPPM 2008). While the

findings of the in-progress, post-trial burn HHRA and SLERA are not yet final, the state of Oregon must review and approve the findings to allow 100% processing at the UMCDF following the completion of agent trial burns.

2. THE PROPOSED ACTION AND ITS ALTERNATIVES

This section describes the proposed action (i.e., modifications to the UMCDF for the purpose of processing mustard-filled TCs with significantly higher levels of mercury than previously anticipated and/or large solid heels), as well as the alternatives considered by the Army. Section 2.1 describes the proposed action, including the installation and operation of specialized equipment at the UMCDF. Section 2.1 also includes a description of the resource requirements and the waste streams associated with the use of this equipment and provides estimates of the quantities and characteristics of the wastes that would be generated. Section 2.2 discusses the no-action alternative; that is, not installing the modifications at the UMCDF. Section 2.3 identifies other alternatives that were considered but eliminated from detailed evaluation in this EA.

2.1 THE PROPOSED ACTION: MODIFICATIONS TO SUPPORT THE DESTRUCTION OF MUSTARD AGENTS AT THE UMCDF

To augment existing operations, several changes would be made to the UMCDF's baseline process to accommodate the mercury contamination and/or high solids content of the mustard-filled TCs. Four equipment modifications and process changes would be made:

- To prevent excess mercury emissions during operations, the existing exhaust gas filtration systems (i.e., the PFSs) would be upgraded,
- To provide additional capacity to accumulate mustard agent drained from the TCs, an existing SDS tank would be converted for use as an ACS tank,
- To address the problem of large solid heels in TCs, a heel transfer capability would be added, and
- To prevent mercury emissions from the BRA, the BRA would not be operated. Therefore, to effectively manage the scrubber brines generated by the PASs, the liquid brines which are expected to contain mercury would be shipped off site for further treatment and disposal.

Operations under the proposed action would begin after operational readiness of the new equipment has been demonstrated. The mustard agent destruction campaign at the UMCDF is currently scheduled to begin August 2009 and to be completed within three

years, with a realistic expectation of 450 days (1.5 years). The proposed new equipment and process changes are described in detail in the next subsection.

2.1.1 The Proposed Process and Its Associated Equipment

Baseline processing at the UMCDF is expected to be capable of destroying an estimated 60% of the TCs in storage at the UMCD (i.e., the TCs having both low-mercury and small solid heels). The mustard-filled TCs that are suspected of presenting problem for baseline processing include those with high solid heels (i.e., greater than about 600 pounds) regardless of their mercury content and/or with mustard agent mercury concentrations above about 32 ppm. The proposed modifications to the PFSs (as described in the following subsections) would allow for the safe and efficient processing of all the mustard agent drained from TCs with elevated mercury concentrations. However, the MPF might not be capable of processing some of the TCs with high solid heels at baseline throughput rates because of the time required to ensure that the TC's contents have been destroyed and the empty TC has been adequately decontaminated. To avoid problems with reduced throughput rates in the MPF, the TCs with high solid heels would be processed using the proposed new heel-transfer capability, as described in the subsections below.

Upgrades for the existing PFSs. The MPF and each of the two LICs have an existing PAS and PFS for treating exhaust gases from the UMCDF's incinerators (see Figure 1). The existing PAS units consists of a quench tower, a venturi scrubber, a packed bed scrubber tower, and a demister. Each PAS is designed to remove at least 99% of hydrogen chloride and 99.8% of the particulate matter from the stack gases.

The PFSs further treat the exhaust gases after they leave the PAS units. Each PFS consists of a pre-filter, followed by a high-efficiency particulate air (HEPA) filter and a dual-bank activated carbon filter, and then another HEPA filter. Under the proposed action, SIC would replace some or all of the activated carbon currently used in one or more of the PFSs. Either a few carbon beds in the existing PFSs would be replaced with SIC or one of the spare PFS units would be filled with SIC and the air flow exiting the activated carbon PFS would be routed into the PFS with the SIC.

Under the proposed action, SIC would only be installed in the PFSs for the MPF; the PFSs for the LICs are not expected to require SIC upgrades due to the plan to control the feed of mustard into the LICs so as to comply with applicable mercury emissions limits and regulations. Nevertheless, the existing piping configuration for the PFSs at the UMCDF would allow an SIC-enhanced PFS unit to be added readily into the exhaust gas stream for either of the two LICs.

The SIC media consists of activated carbon treated with sulfur so that the SIC media would capture elemental mercury that would not be captured by the untreated activated carbon media alone.⁴ The proposed SIC filter media is expected to remove at least 99%⁵ of the mercury from the exhaust gas stream. The UMCDF plans to process the high-heel TCs in the MPF only after the new SIC filter media has been installed.

Conversion of an SDS tank for use as an ACS tank. Currently, drained agent accumulates in two existing ACS tanks at the UMCDF; however, additional tank capacity would be needed to accommodate the sampling and analysis of the drained agent to assure that its mercury content is acceptable for feeding into one of the two LICs. To provide the required additional capacity, an existing SDS tank⁶ would be converted for use as an ACS tank so that three ACS tanks would be available.

Surrogate trial burns have demonstrated that agent with as much as 32 ppm mercury can be processed at the UMCDF without exceeding the RCRA and MACT emissions values (CMA 2005b and 2006). The mustard agent inside most of the TCs in storage at the UMCDF has a mercury concentration below 1 ppm. Because some TCs are expected to have higher concentrations of mercury in the agent, UMCDF proposes to blend agent from low-mercury TCs with agent from high-mercury TCs. The average mercury concentration in the resulting blend of mustard agent would then be acceptable for feeding into the LICs under existing RCRA and MACT limits without the need for SIC filter media in the PFSs. The anticipated ratio of low- to high-mercury TCs to be processed via agent blending at the UMCDF is approximately 6:1.

During mustard agent destruction operations at the UMCDF, one ACS tank would be in the process of being filled with agent drained from the TCs, while a second ACS tank would be supplying agent for feed into the LICs. The third ACS tank, which would have been filled from a combination of high- and low-mercury TCs, would be standing by awaiting the results of the analytical sampling on its mercury content. Because approximately 12 hours are required for the UMCDF laboratory to determine mercury concentrations in mustard agent, one ACS tank would thus be standing by awaiting the

⁴ The Army's on-going tests of the PFS media indicate that untreated activated carbon may be able to remove up to 40% of the mercury in the exhaust gases without further SIC enhancement.

⁵ Tests of the proposed sulfur-impregnated carbon indicate mercury removal rates of 99% after 2,500 hours of testing; therefore, the analysis in this EA assumes a value of 99%.

⁶ The existing SDS tank is currently used to provide spill containment as required by RCRA. That capability will be replaced by new tanks or by other tankage within the munition demilitarization building.

laboratory results at all times. It would therefore not be possible to maintain baseline processing rates with only two ACS tanks; hence, the proposed third ACS tank is needed.

If the sampling results indicate that the blend of mustard agent in the subject ACS tank has a mercury concentration greater than the acceptable level for feeding into the LICs, then a portion of the agent in that tank would be transferred into the empty ACS tank, and low-mercury agent would be added to the subject ACS tank, thereby reducing its mercury concentration to an acceptable level. The resulting concentration of mercury in the mustard agent would then be suitable for feeding into one of the two LICs.

Addition of a heel-transfer capability. Under baseline processing at the UMCDF, TCs would be received at the munitions demilitarization building (MDB) and then transferred to one of two BDSs where the horizontal TC would have holes punched in the uppermost region of its side so that the agent can be drained through an eduction tube. Under the proposed action, a TC with a high heel would be processed at one BDS, while a low-heel TC is being simultaneously processed at the other BDS.

Additional equipment would be installed at the BDS to break up and mobilize the solid heel in those TCs with a heel content greater than about 600 pounds. This new equipment would include a lance capable of injecting a high-pressure, hot water spray or other organic media, such as ethylene glycol⁷, into the drained TC. Up to 20 gallons would be used per TC. Some portion of the dislodged heel would then be transferred into the low-heel TC at the other BDS, so that the resulting heel in each of the two TCs would be suitable for processing in the MPF. The new transfer equipment would consist of ancillary piping and pumps connecting the two existing BDSs. Following the heel-transfer operations, each of the two TCs would be sent individually to the MPF for thermal decontamination and to destroy any residual mustard agent.

Management of liquid scrubber brines. As shown schematically in Figure 1, the liquid brines from the PASs are currently sent to the BRA, where water is removed by evaporation. The resulting brine salts are shipped off site for further management. Under the proposed action, the BRA would not be operated because of the anticipated difficulty in maintaining compliance with applicable permit requirements for the mercury emissions from the BRA. All scrubber brines would therefore be shipped off site in liquid form, and no brine salts would be generated at the UMCDF. Because these scrubber brines would be expected to

⁷ Ethylene glycol is already being used at the UMCDF as a liquid coolant for existing equipment. Approximately 11,000 gallons of ethylene glycol are routinely stored at UMCD to support operations at the UMCDF. Organic compounds, such as ethylene glycol, would be better suited than water for disposal by incineration following the rinsing of the high-heel TCs.

contain some of the mercury removed from the stack gases, these liquid wastes would be shipped to a commercial TSDF that is licensed and permitted to manage such wastes.

Liquid brines have previously been shipped from the UMCDF during earlier agent destruction campaigns. Therefore, the systems already exist at the UMCDF to collect these brines and transport them to a location where they can be loaded into a truck for off-site shipment. No new equipment would need to be installed at the UMCDF to collect and ship the liquid brines to an off-site TSDF; however, the existing loading/unloading station may require minor upgrades.

2.1.2 Proposed Site, Layout, and Installation

The new equipment that is part of this proposed action would be installed within existing buildings at the UMCDF; hence, no disturbance of the areas outside the existing footprint of the UMCDF would occur.

The SIC filter media would be a replacement for some of the existing activated carbon media that is currently in use in the PFSs at the UMCDF. The SDS tank that is to be converted into an additional ACS tank already exists inside the MDB. The transfer piping for the proposed heel transfer capability would be located at the BDSs within the existing munitions processing bay in the MDB. The existing brine collection system and the existing off-site transfer station would be used to load the trucks transporting liquid brines off-site.

2.1.3 Waste Management

In addition to the wastes generated routinely by baseline operations at the UMCDF, the principal types of solid and liquid wastes to be generated under the proposed action include: (1) expended SIC filter media used in the upgraded PFSs and (2) mercury-contaminated scrubber brines. Each of these waste streams will be characterized and will be managed in accord with its hazardous characteristics. This practice is identical to what has been conducted for other UMCDF waste streams during previous chemical agent and munition destruction campaigns.

The quantity of activated carbon filter media in each PFS is about 10,000 pounds. Under the proposed action, some or all of this carbon media would be replaced with SIC media. Thus, about 60,000 pounds (30 tons) of SIC would be required to fill all six of the available PFS units. Up to four SIC filter changes would be expected annually during the mustard campaign; hence, up to 120 tons of SIC filter media would require disposal each year. Because this spent filter media could be considered to have been derived from the destruction of mustard agent, it might not be able to be released for disposal without

confirming that it meets the criteria for off-site disposal. Because this spent filter media would be contaminated with mercury, it may not be suitable for incineration. The SIC filter media used for the LIC might be burned in the MPF, provided the added mercury does not exceed regulatory requirements. After the SIC filter media has been characterized and determined to meet the criteria for off-site disposal, the filter media could be packaged for shipment to an off-site TSDF.

Based on the operation of the PASs during the other chemical agent destruction campaigns at the UMCDF, approximately 13 million gallons of liquid brine would require disposal during the 1.5-year mustard campaign. This would be a total of approximately 116 millions pounds (58,000 tons) of liquid brines. On an annual basis, about 8.7 million gallons of brine, weighing about 39,000 tons, would be generated and would require disposal.

Construction wastes would be generated during the installation of the proposed new equipment; however, the quantities of such wastes would be small in comparison to the other types of waste routinely generated during baseline processing at the UMCDF. All construction wastes would be initially placed into “roll-off” containers and then transferred to an off-site waste management vendor.

2.1.4 Resource Requirements

The use of manpower and electric energy during the proposed action would not be significantly different than what would be required during baseline processing of the mustard-filled TCs; hence, these resources are not discussed further in this EA. However, the use of natural gas and water would be different under the proposed action.

By not operating the BRA and by shipping the liquid brines off-site, the quantity of natural gas used at the UMCDF would be reduced by 45% when compared to the amount of gas used during baseline processing. Under the proposed action, the energy costs of operating the UMCDF would thus be reduced, and the quantity of natural gas not used by the UMCDF would then become available for sale by the natural gas vendor to other customers.

Water use at the UMCDF would increase as a result of the proposed operational modifications, as follows. Less than 20 gallons of water per TC would be needed to break up and mobilize the solid heel before transfer to another TC. Under the assumption that about 50% of the UMCDF inventory of TCs will require heel transfers, the total water required for these washout operations would be about 26,000 gallons total, or about 70 gal/day over the anticipated 1.5-year mustard campaign at the UMCDF. This quantity represents an insignificant increase in the daily usage of water (primarily for scrubber brines) under baseline processing at the UMCDF. Hence, the use of additional water under the proposed action is not discussed further in this EA.

2.1.5 Approvals, Permits, and Conditions

The mercury emission limits applicable to the UMCDF are summarized in Table 1. The UMCDF currently operates under the conditions imposed by a RCRA permit issued by the State of Oregon. RCRA permit modifications will be required to address the installation and operation of the new equipment that is part of the proposed action. The Army would not be allowed to proceed with the proposed action without receiving approval in the form of a revised RCRA permit from the Oregon DEQ.

The UMCDF has an existing Air Contaminant Discharge Permit (ACDP) issued by the State of Oregon. The proposed action would be conducted in compliance with the conditions imposed by this permit. Also, the EPA has promulgated the National Emission Standards for Hazardous Air Pollutants (NESHAPS) at 40 CFR 63.1203. This rule stipulates emissions standards based on the performance of the MACT. This rule and the emission standards contained therein are commonly referred to as the MACT rule and MACT standards, respectively. Under the MACT rule and interim standards, mercury emissions from new incinerators are limited to 45 $\mu\text{g}/\text{dscm}$ [see 40 CFR 63.1203(b)(2)]. This compliance limit is being used for mercury emissions from the UMCDF. Monitoring of the UMCDF's exhaust gas will include sampling to determine the concentration of mercury being emitted as compared to the MACT standard.

The limits for mercury emissions as specified in the RCRA permit for the UMCDF are expressed in units of mass per unit of time (i.e., g/s), while the units under the MACT are expressed on a volumetric basis (i.e., $\mu\text{g}/\text{dscm}$) (see Table 1). However, a calculation can be made to place these units on a comparable basis. Table 2 shows the results of such a calculation.

A comparison of the numerical emission rates in Table 1 with the value computed in Table 2 shows that for the UMCDF, the RCRA permit limits are more restrictive than the MACT limits for mercury emissions. Therefore, compliance with the mercury emissions limits specified in the RCRA permit would also result in compliance with the MACT limits.

2.2 THE NO-ACTION ALTERNATIVE: CONTINUED STORAGE OF THOSE TON CONTAINERS THAT CANNOT BE DESTROYED BY EXISTING PROCESSES AT THE UMCDF

Under the no-action alternative, the new equipment (i.e., the SIC filters, the new ACS tank, and the TC heel-transfer capability) would not be installed or operated at the

Table 1. Mercury emission limits as prescribed for the Umatilla Chemical Agent Disposal Facility (UMCDF).

Source of Emissions	Emission Limit for Mercury	
	RCRA Permit ^a	MACT ^b
LIC1	3.1×10^{-5} g/s	45 µg/dscm
LIC2	3.1×10^{-5} g/s	45 µg/dscm
MPF	4.28×10^{-5} g/s	45 µg/dscm

Note: N/A = not applicable; LIC = Liquid incinerator (for chemical agent); MPF = Metal parts furnace; RCRA = Resource Conservation and Recovery Act; MACT = Maximum Achievable Control Technology.

^a Values obtained from Table 6-16 in the UMCDF's RCRA permit (DEQ 2007).

^b Value obtained from *National Emission Standards for Hazardous Air Pollutants (NESHAPS)* for new sources in 40 CFR 63.1203(b)(2).

UMCDF. It is believed that at least 50% of the TCs at the UMCD (i.e., those TCs with low mercury concentrations and also low heels) could be destroyed in the UMCDF using the existing processes. However, based upon the current characterization of the UMCD stockpile, the remaining TCs may not be able to be processed under the no-action alternative in a manner that ensures compliance with the MACT emission standard for mercury and/or a manner that does not create lengthy schedule delays due to slow MPF throughput processing rates for the drained TCs. Therefore, the UMCDF might not be able to destroy this remaining portion of the stockpile in compliance with CWC deadlines. Current estimates are that at least 16% of the TCs (i.e., about 430 TCs, containing about 750,000 pounds of mustard agent) at the UMCD could not be processed because of elevated mercury content and would thus remain in storage.

As long as the TCs remain in storage, they would continue to be monitored for leaks and other signs of deterioration. If leaks were detected, the leaking TC would be repaired or its contents would be repackaged to contain the leak. These continued surveillance, monitoring, and maintenance activities would consume financial and other resources for as long as the mustard-filled TCs remained in storage at the UMCD. Also, if the TCs remain in long-term storage, the Army would not be able to meet the U.S. obligations under the CWC and under Public Law 99-145.

Table 2. Regulated mercury emissions from the Umatilla Chemical Agent Disposal Facility (UMCDF) as calculated using maximum emission rates allowed under the Maximum Achievable Control Technology (MACT) rule

UMCDF Source	<u>Stack Parameters (i.e., common stack for LICs and MPF)</u>				Calculated Mercury Emission Rate at MACT Limit ^a (g/s)
	Gas Temperature (°K)	Gas Velocity (m/s)	Stack Exit Diameter (m)	Volumetric Flow at Exit Temperature (m ³ /s)	
LICs and MPF	396	8.1	1.52	14.70	2.41 × 10 ⁻⁴

Acronyms: LIC1 and LIC2 = the two liquid agent incinerators at the UMCDF; MPF = metal parts furnace.

Notes and assumptions: To convert volumetric flow at exit temperature into flow in units of dscm/s, a moisture content of 50% was assumed.

^a The MACT limit for mercury emitted from new sources is 45 µg/dscm.

Sources: Gas temperature, gas velocity, and stack exit diameter obtained from Table 3-1 in Ecology and Environment (1997).

2.3 ALTERNATIVES TO THE PROPOSED ACTION

This section describes alternatives to the proposed addition of new equipment to the UMCDF's existing processes. Several alternatives were identified: (1) control the feed rates into the LICs and MPF so as to maintain compliance with regulatory emission rates and to remain within the operational control limits of the MPF, (2) add only SIC filtration to the existing PFSs to remove/contain excessive mercury emissions from the UMCDF (i.e., add no heel transfer capability), (3) conduct drain and washout activities for those TCs which contain an elevated mercury content or a high solid content, followed by removal of mercury from the resulting washout by-products, (4) use a chemical neutralization process instead of the incineration process to destroy the mustard agent, and (5) use some method of mercury emissions control other than SIC. The strengths and weaknesses of each alternative are discussed in the following subsections, and for the reasons given below, these alternatives were not pursued or evaluated in any further detail.

2.3.1 Reduce the Feed Rates to the LICs and the MPF

Under this alternative, baseline processing in the UMCDF would be used, but in order to process the mercury-contaminated items, the feed rate of mustard agent into the LIC and the feed rate of drained TCs into the MPF would both be reduced as necessary to remain in compliance with the regulatory limit for mercury emissions. The schedule of the mustard campaign would be correspondingly lengthened to accommodate the reduction in throughput.

This alternative was found to have the potential to unnecessarily delay the Army's continued progress in destroying the chemical weapons stockpile and in reducing the risk presented by the aging mustard TCs in storage at the UMCD. Also, while this alternative addresses the mercury emissions problem, it does not address the high solids content known to exist in some TCs because the MPF might not be able to process such items efficiently. That is, a TC with a large solid heel might require lengthy processing time inside the MPF to ensure that its contents have been destroyed and that the empty TC has been adequately decontaminated. The heel-transfer capability, which is included as part of the proposed action, avoids the potential problems with throughput rates in the MPF and would provide maximum flexibility for the UMCDF to meet schedule requirements.

2.3.2 Install and Operate Only an Enhanced PAS Carbon Filtration System (for Mercury Abatement)

Under this alternative, new SIC filters would be added to the existing PFS on the MPF, but no further changes to the UMCDF would be made (i.e., no heel-transfer capability would be added).

The initial assessment indicated that properly designed SIC filters would be expected to handle the highest anticipated levels of mercury contamination in the TCs. However, it may not be possible to process TCs with high solid heels in a timely manner in the MPF. The TC heel-transfer capability, which is included as part of the proposed action, avoids the potential problems with throughput rates in the MPF and would provide maximum flexibility for the UMCDF to meet schedule requirements.

2.3.3 Drain and Washout with Mercury Removal

Under this alternative, each of the TCs with high mercury concentration and/or high solid heels would be drained of agent, and the agent would be destroyed in the LICs using reduced feed rates as necessary to control mercury emissions. Those drained TCs with high solid heels would then be put into a washout process (i.e., rinse and drain) based on the techniques employed at the Aberdeen Chemical Agent Destruction Facility (ABCDF), which used hydrolysis⁸ to destroy mustard agent. Any residual mustard agent inside the drained TCs would thus be destroyed by this process. The hydrolysis process would be followed by an aqueous-based mercury removal step, as well as filtration to remove solid residues. After the removal of mercury, the liquid by-product (i.e., hydrolysate) of the hydrolysis reaction would either be destroyed in the LIC or sent off-site for further management at a TSDF permitted to handle such waste. The empty TCs could be thermally treated in the MPF using baseline processing.

The principal advantages of this alternative are: (a) it would not require the addition of PFSs to control mercury emissions, and (b) the MPF would be able to treat all of the drained and rinsed TCs. However, due to the time required to rinse and drain each of the

⁸ These types of processes would be based upon an improved version of the chemical neutralization process used to destroy the entire inventory of HD agent stored in TCs at the Aberdeen Proving Ground in Maryland (U.S. Army 1998; PMCD 2001, 2002a). Over 3 million pounds of mustard agent were chemically neutralized between April 2003 and March 2005 at the Aberdeen facility (DOD 1996; CMA 2005a). The principal by-products of the hydrolysis reaction (involving mustard agent and hot water or steam) are hydrochloric acid and an organic compound called thiodiglycol, which is a common ingredient in writing pen ink.

subject TCs, this alternative was found to involve a significant reduction in the overall TC throughput rate, equating to an unacceptable extension of the mustard destruction campaign. Furthermore, the hydrolysis and washout approach was determined to require a lengthy procurement and installation period before the equipment would be ready to operate, thereby jeopardizing the ability of the UMCDF to meet the stockpile destruction deadlines established by the CWC and Public Law 99-145.

2.3.4 Chemical Neutralization

Under this alternative, a non-incineration chemical neutralization (i.e., hydrolysis) process would be used to destroy all or part of the mustard agent in storage at the UMCD. This alternative would be similar to the “drain and washout” alternative described in Section 2.3.3, except that no incineration of the drained mustard agent (or hydrolysate) would occur at the UMCDF, and some heat-treatment process other than the MPF would be needed to decontaminate the empty TCs.

Under this alternative, all of the mustard agent drained from the TCs would be placed into a new reaction chamber where the hydrolysis reactions would take place. The resulting liquid hydrolysate could require additional treatment for mercury removal prior to the hydrolysate being further treated or shipped off-site for further management at a TSDF permitted to handle such wastes.

The principal advantages and disadvantages of this alternative are the same as those described in Section 2.3.3; however, additional equipment would be required for the thermal decontamination of the drained TCs. Furthermore, it should be noted that the hydrolysate from the ABCDF required additional waste treatment at a commercial TSDF prior to discharge, and such an off-site TSDF would need to be identified and contracted to manage the UMCD wastes. Moreover, during the on-going mustard campaign at the TOCDF, the TOCDF safely destroyed by incineration in one year the same amount of mustard agent neutralized at the ABCDF during two years of operation.

A detailed evaluation of the chemical neutralization alternative was conducted as part of the Best Available Technology (BAT) study for the mustard inventory at the UMCD (SAIC 2008). The BAT study concluded that the existing UMCDF incineration processes are preferable to any replacement chemical neutralization processes, because (1) neutralization would discharge a greater total amount of materials, including process wastes, than incineration; (2) the overall length of time needed for the campaign to destroy the mustard agent would be longer with neutralization than with baseline incineration due to the need for process adjustments/refinements and the additional time required for design, permitting construction, systemization, and workforce training; (3) considerable time (estimated as 5 to 7.5 years) would be required to procure the chemical neutralization equipment, to install it,

and to conduct systemization tests prior to its operation thereby extending the Umatilla mustard destruction campaign beyond the CWC deadline of April 2012; and (4) the costs associated with the construction of an entire new neutralization process would be significantly greater than the cost of adding mercury emission controls and heel-transfer capabilities to the UMCDF's existing incineration process.

2.3.5 Employ Other Technologies to Remove Mercury from Stack Gases

The Army has examined four technologies for controlling mercury emissions from incinerators (see U.S. Army 2001): activated carbon injection, wet scrubbing of mercury, sodium sulfide injection, and adsorption onto SIC filters. Because of technical immaturity, process complexity and/or inability to meet MACT limits with elevated-mercury feedstocks, the report recommended against all of these technologies, except SIC filtration. A subsequent report (PMCD 2002b) reached substantially the same conclusion: "Fixed bed chemisorption using impregnated carbon adsorbents is the most mature and extensively demonstrated mercury control technology in industry. All technologies based on wet scrubber absorption and adsorbent injection would require major equipment upgrades to the PAS, many of which would have uncertain mercury performance." Based on the above studies, the Army concluded that further consideration of technologies other than SIC for removal of mercury from stack gases was not warranted.

3. THE AFFECTED ENVIRONMENT AND POTENTIAL ENVIRONMENTAL CONSEQUENCES

This EA addresses proposed modifications to the existing UMCDF, a facility which has been examined in two previous environmental reviews (see Section 1.4). In comparison to the environmental impacts previously assessed, the proposed action would create negligible or no new impacts upon the following categories of environmental resources, which are not discussed further in this EA.

- **Land use.** The proposed new equipment would be installed within the footprint of the existing facilities and would therefore not affect current uses of land.
- **Air quality impacts from construction activities.** There would be no disturbance of surface soils and negligible generation of dust from construction and/or equipment-installation activities. The emissions from construction vehicles would be incidental, short-term, and small.
- **Air quality impacts during operations.** The proposed action would not result in a significant increase in the emissions of criteria pollutants (i.e., nitrogen oxides, carbon monoxide, sulfur dioxide, volatile organic compounds, particulate matter, and lead) from the UMCDF. Furthermore, under this proposed action the UMCDF would still be operated in compliance with applicable air emission limits under the terms and conditions of its existing RCRA and air permits that encompass MACT and Title V.
- **Surface water resources.** No surface waterbodies are located in the immediate vicinity of the UMCDF, and no surface water would be consumed, diverted or affected by the proposed action.
- **Groundwater resources.** Wells at the UMCD currently withdraw groundwater for use at the UMCDF. However, as discussed in Section 2.1.4, the additional water requirements of the proposed action would represent an insignificant increase in the daily usage of water at the UMCDF.
- **Wetlands.** No wetlands areas would be disturbed by the proposed activities.
- **Socioeconomic resources.** The existing labor force is adequate for the installation and operation of the proposed new equipment. There would be no influx of new workers, nor would the proposed action have any effects upon existing infrastructures, utilities or other socioeconomic resources in the vicinity of the UMCD.

- **Cultural (i.e., archaeological and historic) resources.** Because all of the proposed activities would occur within the footprint of the existing facility, no potential exists for the proposed action to disturb or affect cultural resources.
- **Environmental justice populations.** The nearest UMCD boundary is located about 2 miles from the UMCDF. The proposed action would not create any significant impacts to populations near the depot (see Section 3.1.1). In the absence of such impacts, there would be no disproportionately high and adverse impacts to any nearby minority or low-income populations.
- **Safety and risks.** The hazards of installing the new equipment would be similar to those of any small-scale industrial construction project and would not be significant or unique. The hazards of the mustard agent have been well documented in the previous NEPA reviews for the UMCDF (see Section 1.4), and the Army has developed and implemented engineering barriers (such as filtered ventilation systems and protective clothing), procedures, and administrative controls to deal appropriately with these hazards.

If atmospheric emissions of mercury escape the new SIC filter media and/or if the scrubber brines become contaminated with mercury in the existing PASs, then potential environmental impacts could occur. The following types of impacts from the proposed action warrant additional evaluation: potential impacts to **human health and ecological resources** (including threatened and endangered species) due to possible mercury emissions (see Section 3.1) and **management of mercury-bearing wastes**, such as the mercury-contaminated scrubber brines (see Section 3.2).

The conversion of the existing SDS tank for use as an ACS tank and the addition of the TC heel-transfer capability represent engineering modifications to the existing baseline process, and their installation is not expected to create any significant environmental impacts because each of these items would be installed and operated inside the existing MDB. No significant emissions or wastes are associated with the construction or operation of this new equipment; hence, the new ACS tank and the TC heel-transfer capability are not evaluated in any further detail in this EA.

3.1 HUMAN HEALTH AND ECOLOGICAL RESOURCES

Section 3.1.1 summarizes the findings from an HHRA prepared for the UMCDF in compliance with the licensing conditions of RCRA. The HHRA also included a SLERA, whose results are summarized in Section 3.1.2.

3.1.1 Human Health Risk Assessments for the UMCDF

As part of its RCRA permitting process, the State of Oregon prepared an HHRA for the emissions expected during the operational lifetime of the UMCDF. The State of Oregon finalized its pre-trial burn HHRA and issued a final report in February 1997 (Ecology and Environment 1997). The 1997 HHRA considered human exposures to chemical compounds emitted from the UMCDF's stacks and included both direct and indirect exposure pathways for 73 constituents of interest.

The hypothetical receptors for the analysis included: (a) an adult resident, (b) a child resident, (c) a subsistence farmer, and (d) a subsistence fisher. With the exception of the subsistence fisher, the health risks were evaluated at two locations: at the point of maximum concentration and at the nearest downwind fence line of the UMCD. The location of the subsistence fisher was at the maximally impacted water body. The subsistence fisher was assumed to catch fish from the Umatilla River (which was predicted to be more highly impacted than the Columbia River) while residing at the most highly impacted point along the river. This point was determined to be approximately 5 km (3 miles) south of the confluence of the Umatilla and Columbia rivers.

For the hypothetical residents and the subsistence farmer, the point of maximum concentration was used regardless of whether this location was inside or outside of the UMCD boundaries. The location of maximum airborne concentration rarely coincided with the location of maximum deposition; nevertheless, for the purposes of the 1997 HHRA, both concentrations were assumed to occur at the same hypothetical location. Thus, maximum impact was investigated. The exposure pathways included the various applicable combinations of inhalation, soil ingestion, and consumption of fish, beef, milk, and above-ground and below-ground produce.

In the 1997 HHRA, emissions from the UMCDF were predicted based upon extrapolations from measurements obtained at JACADS, which was operated from 1990 through 2000 to destroy the chemical agents and munitions stored on Johnston Island in the Pacific Ocean. A modifier was also included in the analysis to account for abnormal combustion conditions that might occur during startup, shutdown, or production upsets.

Findings from the 1997 HHRA. For the hypothetical adult and child residents, the subsistence farmer, and the subsistence fisher, the results of the 1997 HHRA indicated that the risks to current populations were less than the regulatory benchmarks established by the Oregon DEQ. At the maximum-impact location, risks to hypothetical residents and to the hypothetical subsistence farmer were greater than the benchmarks. However, this location is only about 100 m (328 ft) from the UMCDF and well inside the nearest UMCD boundary. The 1997 HHRA found that none of the other potentially affected populations in the vicinity

of the UMCDF were expected to be exposed to emissions constituents at levels in excess of regulatory benchmarks.

Mercury emissions from the UMCDF were evaluated as part of the 1997 HHRA, but mercury was not found to be a significant contributor to any of the computed numerical health risk values.

Oregon's Environmental Quality Commission met in February 1997 and made a statutory finding that the proposed UMCDF would not adversely affect public health and safety or the environment. In part, the Commission issued this finding based on the results of the 1997 HHRA (Ecology and Environment 1997).

3.1.2 Ecological Risk Assessments for the UMCDF

The state of Oregon's 1997 HHRA (see Section 3.1.1) included a SLERA focused upon the chemicals and compounds emitted by the UMCDF and their modeled concentrations in air, soil, water and sediment near the UMCD. The SLERA incorporated screening-level multi-chemical, multi-pathway analyses of the potential impacts from facility emissions upon ecological communities. That is, the SLERA attempt to determine if ambient concentrations of airborne and deposited constituents (as emitted from the proposed facilities) pose a threat to ecological communities, as opposed to specific individuals of any species.

The constituents of potential environmental concern (COPECs) in the SLERA were a subset of those used in the HHRA. The receptor locations in the SLERA were generally the same as those for hypothetical human receptors in the 1997 HHRA, with one exception: the Conforth Ranch, as described in the following paragraph.

To assess potential impacts to aquatic species and wetlands, the SLERA included the Conforth Ranch as one location of ecological receptors. The Conforth Ranch is about 6 miles northeast of the UMCDF and lies adjacent to the south shore of the Columbia River. This area contains appropriate foraging habitats for the peregrine falcon and bald eagle, two bird species of special concern. Because of the wetland characteristics of this area (i.e., low water flow rates and limited dilution potential), the Conforth Ranch area was postulated to accumulate the highest water and sediment concentrations of chemicals of interest to ecological resources within the study area.

The screening-level analysis in the 1997 SLERA employed a hazard quotient (HQ) and hazard index (HI) approach, as follows. A numerical HQ value was computed as the mathematical ratio for each calculated COPEC-specific concentration in a specified media (e.g., soil, water, sediment) to the threshold value of that same COPEC at which adverse effects would be expected to occur. A media-specific HI value was then computed as the sum

of all HQ values for all COPECs in the specified media. According to the methodology employed in the 1997 SLERA, any modeled HQ or HI values numerically greater than 1.0 would warrant further evaluation.

Findings from the 1997 SLERA. The 1997 SLERA concluded that there was little or no potential for the COPECs to negatively impact terrestrial vegetation or soil invertebrates. The potential effects of mercury on soil macroinvertebrates represented the only HQ value that exceeded the numerical benchmark of 1.0; however, this was predicted to occur only in the area of highest impact—about 328 feet downwind of the UMCDF, well within the boundaries of the UMCD.

No potential adverse effects—as indicated by the computed HQ values—were predicted in the 1997 SLERA for aquatic species or benthic (sediment-dwelling) organisms in the nearby Umatilla River; however, the total HI value indicated a slight potential for effects on aquatic species in nearby wetlands at the Conforth Ranch.

Threatened and Endangered Species. The 1997 SLERA made no attempt to assess the direct effects of UMCDF emissions on threatened, endangered, or otherwise sensitive species. Understandably, protected species are rarely if ever the subjects of deliberate toxicological studies. The 1997 SLERA assumed that federally-listed birds of prey would experience only low exposures to contaminants because they would spend so little time in the highest impact area around the UMCDF. Similarly, the SLERA concluded that federally-listed salmon in the Columbia River would not be at risk because other aquatic species in area streams (which were included as an assessment endpoint) were shown to experience little risk.

Because direct effects of COPECs on endangered, threatened, or sensitive species were not assessed as part of the 1997 SLERA, two follow-up studies of ecological risk near the Umatilla facility were conducted (ChemRisk 1996; Chambers Group, Inc. 1996). These two studies used the media concentrations from the draft version (i.e., the 1996 version) of the 1997 SLERA as a basis and focused on emissions of mercury, dioxins, and polychlorinated biphenyls (PCBs)—three chemicals that are known to bioaccumulate in organisms and are transported through the food chain. The receptors included the then-listed threatened and endangered species near the UMCD: bald eagle (*Haliaeetus leucocephalus*), peregrine falcon (*Falco peregrinus*), Snake River sockeye salmon (*Oncorhynchus nerka*), and Snake River chinook salmon (*Oncorhynchus tshawytscha*). The receptor locations were taken as the points of maximum concentration as determined in the 1997 SLERA. A direct and indirect exposure analysis was conducted for the two bird species.

The risks from inhalation of the predicted routine, daily emissions from the UMCDF were found to be negligibly small. A food chain analysis was also conducted using the

maximum (i.e., fence-line) concentrations of contaminants in air, soil, and plants to characterize the risks of biomagnification and bioaccumulation of persistent chemicals to the listed species. The total risk, as measured by the ratio of computed exposures to the benchmark levels of concern, indicate that the risks to the two bird species are at least eight times lower than the levels of concern.

For the two fish species, the maximum waterbody concentrations in the Umatilla River (i.e., the maximally affected waterbody) were compared with ambient water quality criteria and were found to be several orders of magnitude below levels of concern. As a result of these analyses, it was determined that the anticipated daily emissions from the UMCDF would pose a negligible risk to the listed threatened and endangered species.

3.1.3 Impacts of the Proposed Action upon Human Health and Ecological Resources

The new SIC filter media to be installed in the existing PFSs is expected to adequately control emissions of mercury from the UMCDF. Nevertheless, for the purpose of analysis in this document, a bounding calculation is used to illustrate the effects of the proposed action on human health and ecological resources (see the discussion of *Scenario A* in Section 1.4). The following calculation and analysis are therefore largely theoretical and not representative of the way the proposed action would actually be implemented. The calculation merely serves to establish an upper bound on the magnitude and extent of the potential environmental impacts, and thereby to demonstrate that such impacts would not be significant.

Limits for Total Mercury Emitted from the UMCDF. The 1997 HHRA used the RCRA permit limits for mercury emissions (see Section 2.1.5) as the basis for its risk calculations for mercury. Table 3 shows the total quantity of mercury assumed in the 1997 HHRA and SLERA to be emitted to the environment over the 3.2-year lifetime of the UMCDF. That is, the emission of approximately 33.5 pounds of mercury over the lifetime of the UMCDF would result in no adverse impacts to human health as described in Section 3.1.1 or to ecological resources as described in Section 3.1.2. This quantity of mercury therefore establishes the threshold at which any additional mercury introduced in the environment around the UMCDF would warrant further, detailed evaluation. The threshold value of 33.5 pounds is used in the following bounding analysis.

Table 3. Mercury emissions from the Umatilla Chemical Agent Disposal Facility (UMCDF) as assumed in the 1997 Human Health Risk Assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA)

UMCDF Source	Mercury Emission Rate ^a (g/s)	Data Source in 1997 HHRA	Duration of Emissions (years)	Mercury Emitted (pounds)
LIC1 plus LIC2	6.19×10^{-5}	Table B-1, Item #206	3.2	13.8
DFS	5.24×10^{-6}	Table B-1, Item #206	3.2	1.2
MPF	4.28×10^{-5}	Table B-1, Item #206	3.2	9.5
DUN ^b	1.62×10^{-5}	Table B-1, Item #206	3.2	3.6
BRA	2.47×10^{-5}	Table B-1, Item #206	3.2	5.5
TOTAL				33.5

Note: Numerical values may not sum to the totals shown because of rounding.

Acronyms: BRA = brine reduction area (which will not be operated at the UMCDF during the proposed action); DFS = deactivation furnace system; DUN = dunnage furnace (which was never operated at the UMCDF); HHRA = human health risk assessment (see Ecology and Environment 1997 in the list of references in Section 6); LIC1 and LIC2 = the two liquid agent incinerators at the UMCDF; MPF = metal parts furnace.

^a The values in the table above are listed in the HHRA document as the numerical inputs to the risk calculations.

For the two LICs and the MPF, these values also match the permissible emission under RCRA (see Table 1).

^b The DUN was never constructed at the UMCDF, and, hence, it is not a source of actual emissions.

Mercury to be Emitted During the Mustard Campaign. Appendix A presents the calculations for the quantity of mercury emitted from the UMCDF's stacks during the now-completed GB campaign, as well as an estimate of the amount to be emitted over the duration of the in-progress VX campaign. Appendix A shows this quantity of mercury has an upper-bound value of 6 pounds. By subtracting this 6 pounds from the UMCDF threshold value for total mercury emissions (i.e., 33.5 pounds), the limiting value for mercury emissions during the forthcoming mustard campaign can be obtained as 27.5 pounds. Thus, if less than 27.5 pounds of mercury were to be emitted during the mustard campaign at the UMCDF, then the basis for the mercury risk calculations in the 1997 HHRA and SLERA would be upheld, and the findings of the HHRA and SLERA regarding the UMCDF's

lifetime emission risks from mercury would still remain valid. The following paragraphs evaluate the estimated quantity to be emitted from the UMCDF during the mustard campaign.

By using the observed average value for the mercury concentration in the TCs sampled at the DCD, the total quantity of mercury in the inventory of mustard agent at the UMCDF has been estimated to be about 350 pounds [i.e., estimated as approximately 8 pounds of mercury in the liquid mustard agent, plus an estimated 335 pounds in the solid heels; see CMA (2007b)]. However, for the purpose of establishing an upper bound for analysis in this EA, an alternate concentration has been assumed that is higher than the observed average for the DCD inventory by two standard errors. The resulting upper-bound estimate for the UMCDF inventory is about 500 pounds of mercury (assumed to exist as 12 pounds in the liquid mustard agent, plus 488 pounds in the solid heel). The use of two standard errors provides 98% confidence that the actual value would not exceed 500 pounds.

The value of 500 pounds clearly exceeds the 27.5-pound limit described in the preceding paragraph for the quantity of mercury that can acceptably be emitted during the mustard campaign; hence, the ability of the proposed SIC filter media to remove some of this mercury must be investigated. Without SIC media installed in the existing PFS units for the LICs, all of the mercury in the liquid mustard agent (i.e., 12 pounds of mercury) might be emitted into the environment. If a 99%⁹ mercury removal efficiency is assumed for the new SIC media to be installed on the MPF, then approximately 4.9 pounds of mercury (i.e., 1% of the 488 pounds in the solid heels) would escape the MPF's PFS units. The upper-bound quantity of mercury emitted from the UMCDF's stacks during the entire mustard agent campaign would be the sum of these two numbers, or about 16.9 pounds. This upper-bound value is well below the limiting value of 27.5 pounds for mercury that could acceptably be emitted from the UMCDF during the mustard campaign without concern (i.e., according to the findings of the 1997 HHRA and SLERA).

The emissions from the UMCDF with the addition of the new SIC filter media would therefore not be expected to exceed the quantities of mercury already accounted for in the 1997 HHRA and SLERA; hence, no significant impacts to either human health or ecological resources as a result of mercury emissions to the atmosphere would be expected during the proposed action.

⁹ Tests of the proposed sulfur-impregnated carbon indicate mercury removal rates of 99% after 2,500 hours of testing; therefore, the analysis in this EA assumes a value of 99%.

3.1.4 Compliance with Regulatory Emission Limits

MACT Limits. In regard to the consequences of operating the UMCDF incinerators at the MACT emission level for mercury (see Section 2.1.5), a calculation can be made using the regulatory limit of 45 µg/dscm. Table 2 shows the regulatory MACT limit is equivalent to a mercury emission rate of about 2.41×10^{-4} g/s. If the UMCDF were to be operated at this level for the entire 1.5-year mustard campaign, about 25 pounds of mercury would be emitted to the atmosphere. This quantity is close to, but less than, the limiting value 27.5 pounds of mercury that could acceptably be emitted during the mustard campaign (see Section 3.1.3). Thus, compliance with the MACT limits for a 1.5-year campaign duration would result in less mercury being emitted from the UMCDF than was assumed in the 1997 HHRA, and no human health or ecological effects would be expected to occur from such emissions.

RCRA Limits. The calculation in Section 2.1.5 shows that the UMCDF's mercury emission limits in the RCRA permit (i.e., 3.1×10^{-5} g/s for each LIC and 4.28×10^{-5} g/s for the MPF; see Table 1) are more restrictive than the MACT limit for mercury (2.41×10^{-4} g/s; see Table 2). Because the risk calculations for mercury in the 1997 HHRA were based on these same numerical RCRA limits, the operation of the UMCDF in compliance with the emissions limits permitted under RCRA should ensure agreement with the findings of the 1997 HHRA regarding the absence of significant human health and ecological risks. However, the 1997 HHRA was based upon an operational lifetime total of 3.2 years for the UMCDF.

If the UMCDF were to be operated at the RCRA emission limits over the entire 1.5-year mustard campaign, about 10.8 pounds of mercury (i.e., about 3.2 pounds from each of the two LICs, plus about 4.4 pounds from the MPF) would be emitted to the atmosphere. This quantity is well below the limiting value 27.5 pounds of mercury that could acceptably be emitted during the mustard campaign (see Section 3.1.3). Thus, compliance with the RCRA limits for a 1.5-year campaign duration would result in less mercury being emitted from the UMCDF than was assumed in the 1997 HHRA, and no human health or ecological effects would be expected to occur from such emissions.

3.1.5 Findings about Human Health and Ecological Risks

The calculations in Section 3.1.3 show that the anticipated performance of the proposed SIC filter media during the mustard campaign would reduce the quantity of mercury emitted from the UMCDF to levels compatible with those used as the basis for the favorable findings in the 1997 HHRA. Operation of the PFSs with the new SIC media would ensure the emissions from the UMCDF would remain in compliance with applicable regulatory limits.

In regard to compliance with emissions limits during the mustard campaign, the RCRA permit limits for the UMCDF would be more restrictive than the MACT limit. That is, compliance with the RCRA permit limits would also result in compliance with the MACT limit. Compliance with the permitted RCRA limit during the mustard campaign would result in the UMCDF emitting a quantity of mercury that is less than the value of concern, as obtained from the basis of the risk calculations in the 1997 HHRA, which offered favorable findings regarding the absence of any significant human health and ecological risks associated with the emissions from the UMCDF. Because the UMCDF will be operated in compliance with the aforementioned limits, no significant human health or ecological impacts would be expected to occur during the proposed action.

3.2 WASTE MANAGEMENT

The chemical form of mercury as it exits the incinerators and moves through the PASs and PFSs is complicated and depends upon the temperature, phase (liquid or gas) and chemistry of the particular location in the system. Mercury in its elemental form is a silvery, liquid metal that is exceptionally volatile. However, mercury is also readily oxidized and forms compounds with sulfur and halide elements (e.g., chlorine, bromine, iodine). Elemental mercury is not strongly sorbed onto activated carbon; however, the SIC filters take advantage of the reaction of the mercury with sulfur. SIC filters have been shown to be effective at removing mercury from exhaust gases, and such filters are in use in other industries.

The mercury will likely react to some extent with the chlorine in the UMCDF's exhaust gases to form particulates that can be captured in the brine used in the wet scrubber. Evidence exists that the scrubber brines in the existing PASs remove some mercury from the stack gas streams [see, for example, the three surrogate trial burn reports for the UMCDF (CMA 2004, 2005b, and 2006)]. On the other hand, the PASs have not been demonstrated to be an effective pollution control technology for mercury.

As shown in Figure 1, the PASs precedes the PFSs in the series of pollution controls for the UMCDF. Consequently, it is not known how much mercury will be captured by the PAS brines and how much will pass through the PAS to be captured by the proposed SIC filter media inside the PFS. For the purpose of analysis of waste management impacts, this EA makes assumptions to bound the impacts of mercury captured by either the scrubber brines or the SIC filter media (see the discussion of Scenarios A and B in Section 1.4). Thus, the calculations presented in this section serve to establish an upper bound on the magnitude and extent of the potential impacts associated with management of these wastes.

Mercury-contaminated wastes may be of two types: scrubber brines and SIC filter media. The scrubber brines generated during the proposed action would be characterized as a wastewater. (Note that in the baseline process, brines are dried in the BRA to the point that they become a solid waste that could be disposed of in a landfill.) The SIC filter media is a solid waste.

3.2.1 Waste Characteristics

Expended SIC Filter Media. The EPA classifies mercury-contaminated solid wastes by their mercury concentration and by the extent to which mercury can be leached from the material. Solid wastes that contain mercury at a concentration equal to or greater than 260 mg/kg (equivalent to 260 ppm by mass) must be treated by roasting or retorting in a thermal processing unit that is capable of volatilizing the mercury and subsequently condensing it for recovery (40 CFR Part 268). The EPA regulations require that residues from retorting processes have a mercury concentration less than 260 ppm, and that they have a leach rate no higher than 0.20 mg/L, measured using the Toxicity Characteristic Leaching Procedure (TCLP). All other mercury-contaminated solid wastes must have a leach rate that does not exceed 0.025 mg/L using the TCLP. This second limit applies to solid wastes generated by UMCDF.

The proposed new SIC filter media is designed to capture and remove mercury from the stack gases. If the total quantity of mercury (estimated to be about 500 pounds) in the TC inventory at the UMCD were to be captured by the estimated 60,000 pounds of SIC media in all six PFS units, the average concentration of mercury in the expended SIC media would be about 8,300 mg/kg. [Note that if the 500 pounds of mercury were to be captured by the SIC media in a single PFS (i.e., 10,000 pounds of SIC), then the concentration of mercury would be about 50,000 ppm.] Because the mercury concentration would exceed 260 mg/kg, treatment of the SIC media would be required in a retort facility or by incineration. Incineration of expended SIC media would require capture of the resulting mercury, either in another exhaust gas filter or in a wastewater. Consequently, recovery of the mercury from the

spent SIC media in a retort facility appears to be the most likely treatment method for the spent SIC media from the UMCDF.

Scrubber Brines. Because the scrubber brines could not be dried in the BRA without risking the emission of most of the mercury captured in those brines, the analysis in this EA assumes the scrubber brines would be disposed of as wastewater. EPA regulations require that wastewater have a mercury concentration that does not exceed 0.15 mg/L (40 CFR Part 268).

If the total quantity of mercury (i.e., 500 pounds) in the TC inventory at the UMCD were to be captured by the estimated 116 million pounds of PAS scrubber brines expected to be generated during the mustard campaign, the average concentration of mercury in those liquid brines would be about 4.3 mg/kg (4.3 mg/L, assuming a brine density of 1.0 kg/L). Because the concentration of mercury in wastewater cannot exceed 0.15mg/L, specialized treatment to remove mercury would be required before these brines could be disposed of as wastewater.

3.2.2 Waste Quantities

Table 4 shows the estimated quantities of wastes to be generated during the mustard campaign at the UMCDF. This table includes the wastes from baseline processing, as well as the spent SIC media and liquid brines to be generated by the proposed action. The wastes shown in Table 4 will be shipped off-site for management at a commercial, permitted TSDF. The specific options for treatment and disposition of these wastes are discussed in the following paragraphs. The analysis assumes that both the spent SIC media and the liquid brines would be classified as hazardous wastes because of mercury contamination. If these wastes were found not to be hazardous, the analysis presented below would nevertheless bound the quantities of waste to be disposed of.

According to the UMCDF Hazardous Waste Permit, Condition II.C.4, scrap metal will either be sent to a smelting facility (recycled) or to a RCRA permitted hazardous waste disposal facility (Subtitle C landfill). At no time will any process waste from the UMCDF be sent to a non-hazardous waste landfill, under agreement with the Oregon DEQ. The analysis in this section assumes landfill disposal for the scrap metal.

Untreated SIC filter media would not be suitable for landfill disposal because it is anticipated to have a mercury concentration above 260 mg/kg. The likely treatment for SIC media would be retorting for mercury recovery. Following the retorting process, the residual SIC media may be suitable for disposal by incineration or landfill. The mercury recovered

Table 4. Estimates of waste quantities to be generated during the one-year mustard agent campaign at the UMCDF

Types of waste	Possible disposal method(s)	Estimated waste quantities (in tons per year)
<i>Liquid Wastes</i>		
Liquid scrubber brines	Mercury recovery, stabilization, or deep-well injection	39,000
<i>Solid Wastes</i>		
Spent SIC filter media	Retort for metal recovery	120
Scrap metal	Landfill	1,850 ^a
<i>Sum of All above Wastes if Landfilled^b</i>		118,970 ^b

^a Derived from 2,635 empty ton containers, each weighing approximately 1,400 pounds.

^b The liquid brines would not be suitable for direct landfill without additional treatment. To be stabilized for landfill disposal, the brines would have to be combined with a binder, such as Portland cement. For the purpose of this analysis, stabilization is assumed to increase the mass of the brine wastes by a factor of 3, resulting in a stabilized brine contribution to landfill use of 117,000 tons/yr.

from the SIC media is a commercial product that may have value. The U.S. Congress and the European Union are considering bans on the exportation of mercury. If U.S. exports were to be banned, any recovered mercury would be stockpiled because the domestic supply exceeds demand, and no acceptable method for disposal of mercury has yet been developed.

The liquid brines to be shipped off-site could be treated by metals recovery, stabilization with landfill of the residuals, or deep-well injection. Because of the mercury content, disposal by utilizing a discharge regulated by the Clean Water Act is prohibited. Metals recovery would use chemical and/or physical processes to separate the mercury from the brine. After mercury removal, the brine may be suitable for other methods of treatment and disposal. After removal of mercury, the brines may be suitable for disposal as wastewater. The Army's chemical weapons incinerator at the Anniston Army Depot in Alabama has examined this option for brine disposal after treatment to remove metals.

Brine produced at the TOCDF is shipped to a facility in Texas where it is disposed of by deep-well injection. Mercury-contaminated brines may also be suitable for deep-well

injection. If the UMCDF brines were to be stabilized before being disposed in a landfill, the stabilization process would increase the mass and volume of the material.

Table 5 shows the best available EPA data (EPA 2006) for the types of hazardous waste management facilities in Oregon and in the four surrounding states (i.e., California, Idaho, Nevada, and Washington) plus Utah, a state which has previously managed wastes from the Army's TOCDF incinerator. The following analysis compares the anticipated annual waste quantities with the quantities of similar wastes managed within this six-state region.

If the liquid brines from the UMCDF were to require stabilization as part of their management strategy, the data in Tables 4 and 5 show that the liquid brines from the UMCDF would increase the quantities of stabilized wastes in the six-state region by about 57% (i.e., 39,000 tons/year compared to a regional capacity of 68,142 tons/year). While existing nearby commercial hazardous waste management facilities might be able to expand their operations to accommodate this large quantity of such waste from the UMCDF, it is not clear whether the additional waste from the stabilization process would have significant effects on TSDf stabilization capabilities in the region.

Stabilization would produce a solid waste that could be disposed of in a landfill. Because stabilization would involve combining the brines with a binder such as Portland cement, both the mass and volume of the stabilized brine would be greater than the brine itself. For this analysis, the mass of the stabilized waste is assumed to be about three times that of the brine [see Section 4.6.1.1 in Zimmerman et al. (2006)]; that is, 39,000 tons/yr of brines would become 117,000 tons/yr of stabilized waste. Because the retorted SIC media and scrap metal might also be disposed of in landfills, these quantities of UMCDF landfilled wastes must be added—giving a total of about 118,970 tons/yr (see Table 4). Disposal of that much hazardous waste would greatly exceed the quantities of such waste already managed by landfill or surface impoundment¹⁰ in Oregon (see Table 5). However, it would represent an increase of about 20% of the quantity of hazardous wastes already managed regionally in landfills (576,417 tons/yr as shown in Table 5). While landfill disposal of that much additional solid waste would tax the waste management facilities in Oregon, it probably could be accommodated by the facilities in the region without adverse consequences.

As shown in Table 5, the latest available EPA data indicate that, among Oregon and the other nearby states, only California manages hazardous wastes by deep-well or

¹⁰ The EPA's waste management source data (EPA 2006) provide only a single numerical entry for the combined categories of "landfill" and "surface impoundment." Therefore, no further breakdown is available for use in this analysis, even though some types of wastes from the UMCDF which would be appropriate for landfill might not be appropriate for disposal by surface impoundment.

Table 5. RCRA hazardous waste managed in Oregon and five nearby states during 2005
[units are tons per year]

Management method	Oregon	California	Idaho	Nevada	Utah	Washington	Total ^a
Aqueous inorganic treatment	3,394	25,525	3	1,560	0	3,856	34,338
Aqueous organic treatment	3,366	231,737	—	—	21	2,395	237,519
Deepwell or underground injection	—	2,130	—	—	—	—	2,130
Energy recovery	—	18,496	—	—	2,330	88	20,914
Fuel blending	—	289,342	—	—	—	4,831	294,173
Incineration	1,905	6,599	—	—	103,593	1,486	113,583
Land treatment/application/farming	—	24	—	—	0	—	24
Landfill/surface impoundment ^c	71,842	117,030	113,266	51,487	222,322	470	576,417
Metals recovery	6	204,421	—	5	—	46	204,478
Other disposal	3,802	962,280	—	—	—	19	966,101
Other recovery	8	96,374	0	—	—	9	96,391
Other treatment	1,093	58,181	879	5,283	982	28,424	94,842
Sludge treatment	36	974	95	225	36	62	1,428
Solvents recovery	669	22,565	—	0	18	1,234	24,486
Stabilization	16,093	48,074	1	379	—	3,595	68,142
Total ^b	102,215	2,083,754	114,245	58,939	329,301	46,515	2,734,969

Note: “—” indicates that no data are available for the indicated category. An entry of “0” indicates that the data round to a numerical zero.

^a Waste quantities may not sum to the number shown due to rounding.

^c EPA no longer distinguishes between landfill and surface impoundment in the biennial reports; therefore, no further breakdown is available.

Source: *State Detail Analysis: The National Biennial RCRA Hazardous Waste Report (Based on 2005 Data)*, EPA 530-R-06-007, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C., December 2006; Available on-line at <http://www.epa.gov/epaoswer/hazwaste/data/br05/index.htm> (Note: The waste quantities used here are from Item 11 of each state report).

underground injection; however, the quantity of liquid brines to be generated during the mustard campaign at the UMCDF would exceed the quantity managed by deep-well/underground injection facilities in California in 2005. The Army's TOCDF in Utah has shipped liquid brines to a facility in Texas, a state where 11,933,179 tons of hazardous wastes were managed by deep-well or underground injection in 2005 (EPA 2006). If it were cost effective to ship the UMCDF's liquid brines over large distances, then those brines could be shipped to Texas. In that case, the 39,000 tons of UMCDF brines would represent only about 0.3% of the hazardous wastes already managed annually by deep-well or underground injection in Texas.

Based on the above analyses, the disposal of PAS brines may strain the ability of TSDFs in the region to manage such wastes; however, adequate waste management capacity appears to exist outside the region immediately surrounding Oregon.

3.2.3 Off-site Shipments of Hazardous Waste

The 13 million gallons of liquid scrubber brines to be generated during the entire mustard campaign at the UMCDF would require a total of approximately 3,300 trucks, containing 4,000 gallons each, to transport this quantity of liquid waste to an off-site TSDF. This total number of shipments would average about 42 shipments per week from the UMCDF, which is about 7 shipments per day over a 6-day working period. Such a small amount of additional truck traffic on the roads surrounding the UMCD would not be significant.

Two other issues (i.e., in addition to the waste management and shipping issues discussed earlier) have been identified as being relevant to the potential environmental impacts of off-site shipment of wastes from the UMCDF: the risk of an accident during transportation, and the potential human health and environmental impacts in the event of a spill or release during such a transportation accident. Both of these issues are discussed in the following paragraphs.

The number of potential accidents during off-site waste shipments by truck has been evaluated against statistics available from the U.S. Department of Transportation (DOT) in regard to the transportation of hazardous materials (SAIC 2002). The study found that there are at least 800,000 hazardous waste shipments each day in the United States, of which approximately 770,000 are transported by truck. Ten years of data (i.e., from 1992 through 2001) from the DOT Office of Hazardous Materials Safety were averaged to determine that 11.4 fatalities occur annually during highway transportation of hazardous materials. In a "worst case" analysis, in which the scrubber brines from the UMCDF were assumed not to be dried but to be shipped in liquid form, the SAIC study found that, statistically, an additional 4.3×10^{-4} fatalities would be expected from the off-shipment of the brine wastes

from the UMCDF over its lifetime. This number is small and clearly not significant. The computed number of highway fatalities for only the mustard campaign would be less than that computed in the SAIC study.

In the event of an accident involving liquid brines, the brines could spill and escape into the environment. If mercury were well mixed in the shipped brine, each 4,000-gallon truckload of brine would contain only about 0.15 pound (70 g) of mercury. The principal environmental impacts from spills would be contamination of local surface soils and/or to liquid run-off that might reach surface waters or groundwater.

The containers and vehicles used for hazardous waste transport from the UMCDF would be appropriately placarded and labeled prior to leaving the facility. Furthermore, wastes shipped off-site would be accompanied by either a hazardous waste manifest or bill of lading. All shipping papers would conform to applicable federal, state, and local regulations in order to provide first responders with the necessary information in the event of an accidental spill or release. In such instances, emergency responders are trained to establish isolation and protective action distances for accidents involving hazardous material and to take appropriate actions to limit the impact of such accidents.

Under the provisions of DOT regulations at 49 CFR Part 172, licensed carriers and shippers are required to provide information to emergency responders about the hazardous nature of their shipments. Specifically, Subpart G of these regulations relates to *Emergency Response Information* that is to be carried by each transporter, and Subpart H relates to *Training* for hazardous waste transport personnel.

In the unlikely event of an accidental spill during the transport of UMCDF brines, the first response effort would be to contain and capture the free liquids. Any liquids not captured would likely move into exposed soils. Those soils would be removed and transferred to an appropriate disposal or treatment site immediately after all of the free liquid is contained. The potential impacts to groundwater from such a spill would be expected to be minimal due to the relatively small volumes that would be transported in each truck and that would be available for release in an accidental spill. Between the liquid and soil removed, virtually all of the spilled brines could be removed and properly disposed of.

Nationwide, there are millions of highway shipments of hazardous materials each year, for which the states already provide capable emergency response, and some of these shipments involve chemicals (such as sulfuric acid) that present far more acute toxic hazards than the brines that would be shipped from the UMCDF.

3.3 IMPACTS OF THE NO-ACTION ALTERNATIVE

Under the no-action alternative (see Section 2.2), the proposed alternative processes and equipment (i.e., the new SIC filter media, the converted SDS/ACS tank, and the TC heel-transfer capability) would not be added to the existing UMCDF. At the end of baseline operations, the UMCDF would be shutdown, and all of the mustard-filled TCs with elevated mercury content and/or high solids content would remain in storage. This no-action alternative would prevent the Army from complying with CWC obligations to destroy the entire U.S. stockpile and would also require continued monitoring and surveillance of the stored mustard agent for the indefinite future. The risks of accidental releases of mustard agent during storage activities would continue until such time as the mustard agent was eventually destroyed.

Under the no-action alternative, there would be no changes in land use and no potential for disturbance of cultural (i.e., historic and archaeological) resources. Nor would there be any adverse effects from modifications to or disturbances of existing terrestrial and/or aquatic communities, wetlands, or threatened and endangered species habit areas. Impacts to such resources would therefore be negligible. There would be no new water consumption requirements for the no-action alternative; hence, there would be no effects on water resources. No additional workers would be required under the no-action alternative, and no socioeconomic impacts would be anticipated. No disproportionate impacts to minority or low-income populations would be expected during baseline operations of the UMCDF.

No additional solid or liquid wastes—beyond those currently generated during baseline operations—would be produced under the no-action alternative. Thus, there would be no need for additional treatment or disposal of any new wastes. The only wastes generated under the no-action alternative would be those very small quantities associated with continued monitoring, maintenance, and storage of the TCs that could not be processed by the baseline UMCDF.

4. CONCLUSIONS

The information and analyses presented in this EA indicate that the proposed action of installing new SIC filter media in the existing PFSs at the UMCDF and operating these PFSs during the campaign to destroy mercury-contaminated mustard agent would produce no significant environmental impacts. Operation of the PFSs with the new SIC media would ensure the emissions from the UMCDF would remain in compliance with applicable regulatory limits. The emissions from the UMCDF with these PFSs in operation would not result in significant impacts to human health or to ecological resources.

The conversion of an SDS tank for use as an additional ACS tank and the installation of new TC heel-transfer equipment would be done inside the existing MDB at the UMCDF. Operation of this equipment would not generate any significant additional atmospheric emissions, nor would any unique or unusual wastes be generated. Thus, no significant environmental impacts would be associated with this new equipment.

Consumption of additional resources, such as water, to support the proposed action would involve incremental quantities that are small fractions of the UMCDF's baseline consumption requirements. By not operating the BRA and by shipping the liquid brines off-site, the quantity of natural gas used at the UMCDF would be reduced by 45% when compared to the amount of gas that would be used during baseline processing. Under the proposed action, the energy costs of operating the UMCDF would thus be reduced.

The additional waste streams to be created by the proposed action include spent SIC filter media and liquid scrubber brines potentially contaminated with mercury. The management and disposal of the SIC wastes would not be expected to significantly affect the capacity of waste management facilities in the region. However, based on the analysis in this EA, the disposal of mercury-contaminated PAS brines might strain the ability of TSDFs in the region to manage such wastes; however, adequate waste management capability appears to exist outside the region immediately surrounding Oregon.

An evaluation of the no-action alternative (i.e., continued storage of the TCs that cannot be processed in the baseline UMCDF without installing the aforementioned new equipment) indicates that no significant impacts would occur; however, the no-action alternative could jeopardize the United States' ability to comply with deadlines established under the CWC. Furthermore, choosing the no-action alternative would require the continued commitment of resources for stockpile monitoring, surveillance, and maintenance for as long as the mustard TCs remained in storage at the UMCD.

Based on the above considerations and the lack of significant adverse environmental effects, it is concluded that the most desirable course of action would be to proceed with the installation of SIC media in some or all of the existing PFSs and to operate those PFSs so as to control mercury emissions from the UMCDF during the campaign to destroy mustard agent. Also, plans should continue for the conversion of an existing, spare SDS tank for use as an ACS tank and for the installation and possible operation of heel-transfer equipment to handle those TCs containers with a high solids content that cannot be officially managed by the MPF.

This proposed action would create no significant impacts. A finding indicating this conclusion will be prepared and published for public comment.

5. PERSONS CONTACTED AND CONSULTED

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APPENDIX A

ESTIMATES OF THE QUANTITY OF MERCURY EMITTED FROM NERVE AGENT DESTRUCTION CAMPAIGNS AT THE UMATILLA CHEMICAL AGENT DISPOSAL FACILITY

Evaluation of the inventory of mustard agent (i.e., agent HD) in storage at the Umatilla Chemical Depot (UMCD) in Oregon has revealed the presence of unexpected concentrations of mercury. The mercury is believed to have been inadvertently introduced as a contaminant when the storage containers were originally filled with the mustard agent. The destruction of this mustard agent by incineration is planned in the existing Umatilla Chemical Agent Disposal Facility (UMCDF) at the UMCD.

The UMCDF successfully destroyed the entire inventory of nerve agent GB stored at the UMCD during its GB campaign which began in September 2004 and continued through July 2007. The campaign to destroy the depot's inventory of nerve agent VX began in November 2007, is now in progress, and is scheduled for completion in mid-2009.

This appendix provides the basis for the calculations necessary to produce an estimate of the quantity of mercury that has been emitted from the UMCDF's stacks during the GB campaign, as well as the quantity of mercury that will be emitted during the VX campaign. The calculation for quantities emitted to date is shown in Table A.1. An additional calculation is presented below for the remainder of the in-progress VX campaign.

A.1 UMCDF MERCURY EMISSIONS THROUGH 2007

Table A.1 shows the actual number of operating hours for each of the UMCDF's four furnaces during 2004 through 2007. The table also shows the upper-bound quantity of mercury that would have been emitted if the UMCDF were operated at the maximum permissible limit for mercury emissions [i.e., the emission rate established by the UMCDF's Resource Conservation and Recovery (RCRA) permit]. This quantity is called the "potential to emit." The table also shows the quantity of emitted mercury as computed from the actual emission rates obtained during the agent trial burns for each specific furnace. In Table A.1, this quantity is labeled "actual emissions."

Table A.1. Estimated mercury emissions from the UMCDF during the agent GB and VX campaigns

Furnace	Annual operating hours	Potential to emit		Actual emissions ^a	
		RCRA emission limit (g/s)	Mercury emitted (pounds)	Emission rate from trial burns (g/s)	Mercury emitted (pounds)
<i>During 2004:</i>					
Liquid incinerator 1	142	3.10×10^{-5}	0.03	7.19×10^{-7}	0.001
Liquid incinerator 1	0	3.10×10^{-5}	0.00	7.65×10^{-7}	0.000
Deactivation furnace	200	5.24×10^{-6}	0.01	2.21×10^{-6}	0.004
Metal parts furnace	0	4.28×10^{-5}	0.00	1.33×10^{-6}	0.000
TOTAL	342		0.04		0.004
<i>During 2005:</i>					
Liquid incinerator 1	2,092	3.10×10^{-5}	0.51	7.19×10^{-7}	0.012
Liquid incinerator 1	0	3.10×10^{-5}	0.00	7.65×10^{-7}	0.000
Deactivation furnace	2,472	5.24×10^{-6}	0.10	2.21×10^{-6}	0.043
Metal parts furnace	230	4.28×10^{-5}	0.08	1.33×10^{-6}	0.002
TOTAL	4,793		0.70		0.058
<i>During 2006:</i>					
Liquid incinerator 1	1,517	3.10×10^{-5}	0.37	7.19×10^{-7}	0.009
Liquid incinerator 1	1,572	3.10×10^{-5}	0.39	7.65×10^{-7}	0.010
Deactivation furnace	3,134	5.24×10^{-6}	0.13	2.21×10^{-6}	0.055
Metal parts furnace	2,705	4.28×10^{-5}	0.92	1.33×10^{-6}	0.029
TOTAL	8,928		1.81		0.102

(table continues on next page)

Table A.1. (continued)

Furnace	Annual operating hours	Potential to emit		Actual emissions ^a	
		RCRA emission limit (g/s)	Mercury emitted (pounds)	Emission rate from trial burns (g/s)	Mercury emitted (pounds)
<i>During 2007^b:</i>					
Liquid incinerator 1	90	3.10×10^{-5}	0.02	3.30×10^{-6}	0.002
Liquid incinerator 1	1,791	3.10×10^{-5}	0.44	3.30×10^{-6}	0.047
Deactivation furnace	2,230	5.24×10^{-6}	0.09	2.91×10^{-6}	0.052
Metal parts furnace	2,501	4.28×10^{-5}	0.85	1.24×10^{-5}	0.246
TOTAL	6,613		1.41		0.347
GRAND TOTALS	20,676		3.95		0.511

Note: The values in this table may not sum to the totals shown due to rounding.

^a “Actual emissions” are those computed by using the emission rate measured during trial burns with actual chemical agent, which is shown in the above table.

^b During 2007, the UMCDF processed both agent GB and agent VX. The calculation for “actual emissions” for 2007 assumes that the higher emission rates from the VX trial burns (as compared to those from the GB trial burns) for each furnace were applicable to the operations for the entire year. Thus, an upper-bound calculation is presented for year 2007.

Sources: RCRA emission limit values obtained from Table 6-16 in Oregon Department of Environmental Quality (DEQ), “Module VI,” *Permit for the Storage and Treatment of Hazardous Waste, Umatilla Chemical Agent Disposal Facility*, Permit No. ORQ 000 009 431, issued by DEQ, Hermiston, Ore., July 16, 2007. Trial burn emission rates obtained from S. Barber, Washington Demilitarization Company, Hermiston, Ore., via e-mail communication to G. Zimmerman, Oak Ridge National Laboratory, Oak Ridge, Tenn., February 21, 2008.

According to the data in Table A.1, the mercury emissions from the UMCDF through the end of 2007 are as follows: the “potential to emit” was 3.95 pounds, and the actual emissions were 0.51 pounds.

A.2 FUTURE MERCURY EMISSIONS DURING THE VX CAMPAIGN

The data in Table A.1 stop at the end of 2007. The VX campaign at the UMCDF will continue throughout 2008 and should be completed in mid-2009. In order to estimate the

quantity of mercury that would be emitted during 2008 and 2009, a calculation was made using the largest quantity of mercury emitted from the UMCDF in the years 2004 through 2007. As displayed in Table A.1, the value emitted in 2007 is the largest.

The estimated quantity of mercury to be emitted from the UMCDF's furnaces during the on-going VX campaign in 2008 was assumed to be equal to that emitted in 2007 (i.e., the largest annual quantity among all the years of UMCDF operation). For the "potential to emit," this value is 1.41 pounds, and for "actual emissions" the value is 0.35 pounds.

The estimated quantity of mercury to be emitted from the UMCDF in 2009 was assumed to be one half of that emitted in 2007. For the "potential to emit," this value is 0.71 pounds, and for "actual emissions" the value is 0.17 pounds.

A.3 ESTIMATED TOTAL MERCURY EMISSIONS FROM THE UMCDF DURING BOTH THE GB AND VX CAMPAIGNS

The total estimated quantity of mercury emitted from the UMCDF during both the GB and VX campaigns can be computed as the quantity emitted during the years 2004 through 2007 (as shown in Table A.1), plus the quantities estimated for 2008 through the middle of 2009 when the VX campaign is expected to be completed (see Section A.2). The computation is as follows: the estimated quantity for the "potential to emit" would be 6.07 pounds (= 3.95 pounds for 2004 through 2007 + 1.41 for 2008 + 0.71 for 2009) and for the "actual emissions" would be 1.03 pounds (= 0.51 + 0.35 + 0.17).

An appropriate estimate of the value for the total quantity of mercury emitted from the UMCDF through the completion of the agent GB and VX campaigns, and prior to the beginning of the mustard agent campaign, would be approximately 1 pound, with an upper-bound value of about 6 pounds.