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Subject: *Chemical Demilitarization: Actions Needed to Improve the Reliability of the Army's Cost Comparison Analysis for Treatment and Disposal Options for Newport's VX Hydrolysate*

The U.S. stockpile of 1,269 tons of VX nerve agent[1] stored at the Newport Chemical Depot (Newport), Indiana, is one of nine stockpiles that the Department of Defense (DOD) must destroy in response to congressional direction initially provided in 1985. In addition, the stockpile must be destroyed to comply with the requirements of the Chemical Weapons Convention,[2] which the United States became a party to in 1997. The stockpile at Newport is the first U.S. stockpile containing VX that will be destroyed by using neutralization—a process that mixes hot water and sodium hydroxide (a caustic chemical) with VX to change the chemical composition to a less toxic form. The resulting by-product is a liquid wastewater commonly referred to as hydrolysate that consists mostly of water but also has a caustic component and organic salts that need further treatment to meet Chemical Weapons Convention requirements and to meet federal and state environmental requirements for disposal. The Army, DOD's designated executive agent, began neutralizing Newport's VX stockpile on-site in May 2005 and, as of December 1, 2006, reports neutralizing about 34 percent of the stockpile.

None of the generated hydrolysate—expected to be about 2 million gallons when the neutralization process is completed—has been treated. The hydrolysate is being stored on-site until a post-treatment plan can be implemented. The Army has been evaluating options for treating the hydrolysate since the mid-1990s. Through these evaluations, on-site supercritical water oxidation (SCWO) was initially selected as the preferred option in 1999, but the preferred option was subsequently changed in 2002 to using an off-site commercial treatment facility because of concerns about the continued storage of the stockpile after the September 11, 2001, terrorist attacks and numerous technical challenges identified during one-tenth scale engineering testing. The Army's plan for the treatment and disposal of the hydrolysate was to transport it from Newport to an off-site commercial treatment and disposal facility—the DuPont

[1] VX is a rapid-acting, lethal nerve agent that affects the nervous system by interfering with the signals sent from the brain to vital organs. Nerve agents are the most toxic and rapidly acting of known chemical warfare agents.

[2] The Chemical Weapons Convention prohibits the use of chemical weapons and specifies deadlines for signatories, of which the United States is one, to destroy unitary stockpiles. The final deadline to destroy existing stockpiles is April 29, 2012.

Secure Environmental Treatment Facility (DuPont) in Deepwater, New Jersey—which would use a pretreatment process that would include various chemical processes, including oxidation followed by chemical precipitation to further break down the hydrolysate. The remaining liquid effluent would be treated in the facility's biodegradation-based waste treatment plant. This plan has generated concerns about its safety and cost. However, on January 5, 2007, DuPont announced that it will not participate in the treatment of Newport's hydrolysate, citing a "lengthy and arduous" approval process. Army officials stated that the Army will explore all available on-site and off-site options to treat Newport's hydrolysate.

The House Committee on Armed Services Report on the National Defense Authorization Act for Fiscal Year 2006, H.R. Rep. No. 109-89, directed the Secretary of the Army not to proceed with any action to transport or relocate hydrolysate from Newport until health and environmental concerns raised by the Environmental Protection Agency and the Centers for Disease Control and Prevention were addressed in a manner that would not result in substantial ecological or human heath risk. The Centers for Disease Control and Prevention issued its report[3] in July 2006. The report concluded, in part, that the Army/DuPont proposal sufficiently addressed critical issues related to human toxicity, transportation, and treatment of Newport's hydrolysate. The committee report also required that the Secretary of the Army certify to the congressional defense committees that sending the hydrolysate off-site for treatment would result in significant cost and schedule savings compared to on-site disposal of the hydrolysate before transport. The report further required that the Secretary of the Army conduct and provide the congressional defense committees a detailed cost-benefit analysis to include an analysis comparing the proposed off-site treatment option with eight on-site options, which are discussed in detail in enclosure I.

In response to the latter requirement, the Army published its cost-benefit report[4] in April 2006, which concluded that only chemical oxidation, SCWO, and wet-air oxidation technologies were feasible for treating Newport's hydrolysate. In the cost-effectiveness analysis contained in the report, the Army determined that the cost of off-site treatment of the hydrolysate at DuPont would be from $146 million (without program risk) to $347 million (including program risk) less expensive than the on-site options. The Army also concluded that the off-site treatment option would allow the disposal of the hydrolysate to be accomplished in the shortest amount of time and would minimize the amount of time that Newport's hydrolysate must be stored at Newport.

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[3] Department of Health and Human Services, Centers for Disease Control and Prevention, *Review of the Revised Plan for Off-Site Treatment of Newport's Chemical Agent Disposal Facility's Caustic VX Hydrolysate at DuPont Secure Environmental Treatment Facility in Deepwater, New Jersey* (Atlanta. Ga.: July 2006).

[4] U.S. Army, Project Manager for Alternative Technologies and Approaches, *Cost-Benefit Analysis of Off-Site Versus On-Site Treatment and Disposal of Newport Caustic Hydrolysate* (Aberdeen Proving Ground, Edgewood Area, Md.: April 2006).

The John Warner National Defense Authorization Act for Fiscal Year 2007[5] mandated that we review the Army's *Cost-Benefit Analysis of Off-Site Versus On-Site Treatment and Disposal of Newport Caustic Hydrolysate*. Specifically, we (1) assessed the reasonableness of the Army's rationale to eliminate five of the eight technologies for treating Newport's hydrolysate; (2) determined what other options the Army considered, such as incineration; and (3) evaluated the adequacy of the cost comparison analysis presented for the three remaining technologies considered as alternatives to the Army's proposed plan. To meet the December 1, 2006, due date, we briefed or offered to brief your offices prior to that time. This report provides details of our findings and our conclusions and recommendations. We will also issue a separate letter on our assessment of the Army's cost-benefit analysis once DOD has completed its sensitivity review of the data in that letter.

To meet our objectives, we reviewed documentation and interviewed officials in the Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics); Office of the Deputy Assistant Secretary of the Army (Elimination of Chemical Weapons); U.S. Army Chemical Materials Agency (CMA), Aberdeen, Maryland; the Newport Chemical Depot, Newport, Indiana; DuPont's Secure Environmental Treatment Facility, Deepwater, New Jersey; Parsons Infrastructure and Technology Group, Inc. (Parsons); and Shaw Environmental Group, Inc. (Shaw)—the contractor that assisted the Army in performing the analysis for the Army's report. To assess the Army's methods of evaluating various options for treating hydrolysate, we relied on a review of CMA's *Newport On-Site Hydrolysate Post Treatment Estimate* report (post-treatment estimate report), which was prepared by Shaw,[6] National Research Council (NRC) reports, and other referenced documents and supporting documentation. We did not conduct an independent evaluation of these technologies. To assess the adequacy of the Army's cost comparison analysis, we compared the Army's methods and approaches with the guidance contained in Office of Management and Budget (OMB) and DOD instructions and Cost Estimating Standards and Practices developed by the Society of Cost Estimating and Analysis, and assessed the reliability of the cost estimates.[7] We reviewed and evaluated the cost analyses the Army used in preparing its cost-benefit report and interviewed Army and contractor officials regarding the data and assumptions they used in preparing their analyses. To determine the accuracy of underlying data, we independently calculated values based on provided assumptions to compare against values contained in supporting spreadsheets. We also compared values from the supporting spreadsheets to summary data provided in the supporting post-treatment estimate report prepared for CMA by Shaw. Also, we made use of information that we obtained during our ongoing review of DOD's Chemical Demilitarization Program to assess the reasonableness of certain assumptions. We conducted our review from August 2006 through November 2006 in accordance with generally accepted government auditing standards.

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[5] Pub. L. No. 109-364, § 922 (2006).

[6] Shaw Environmental, Inc., *Newport Chemical Disposal Facility On-Site Hydrolysate Post Treatment Estimate* (Edgewood, Maryland: April 2006).

[7] The Department of the Army *Cost Analysis Manual* contains criteria and a checklist that are similar to the OMB and best practices guidance. See Department of the Army, U.S. Army Cost and Economic Analysis Center, *Cost Analysis Manual* (Washington, D.C.: May 2002).

Results in Brief

The rationale that the Army used to eliminate five of the eight technologies for treating Newport hydrolysate appears reasonable. Based on our review of the supporting post-treatment estimate report and key NRC reports referenced by the Army, there was evidence of significant difficulties associated with the five eliminated options that would make them less promising than the three others that were evaluated against the proposed DuPont option in the Army's cost comparisons. For example, the Army report's finding that one alternative technology would not be well suited to treat large volumes of wastes with high concentrations of water, such as Newport's hydrolysate, was consistent with determinations made in the post-treatment estimate report and was supported by findings in a 2001 NRC report. Also, for another alternative, the Army determined that the vendor with the rights to the technology was no longer in business and further development of this alternative would call for a company to acquire the rights and start development work, creating a large cost and schedule risk.

In addition to evaluating the eight alternatives discussed in its 2006 cost-benefit report, the Army previously evaluated off-site and on-site technical solutions for treating the hydrolysate, including incineration. The Army's evaluations concluded for various reasons that these alternatives would also be difficult to implement or not viable at this time. For example, of the more than 100 commercial disposal firms that were initially considered as candidates to treat Newport's hydrolysate off-site in 2002, only 7 firms (not including DuPont) that have been determined to be qualified by the Army's contractor have provided price information through either the Army's 2002 request for proposals or a subsequent market survey. However, 5 of the 7 firms would use either of two methods: incineration or deep-well injection. Army officials believe that these two methods would garner higher levels of public concern than other methods. Moreover, while other on-site technologies were evaluated, those that were considered to be the most promising technologies in the 2001 and 2002 reports are very similar to the technologies identified in the Army's 2006 cost-benefit report. The use of any of the Army's four incinerators at its stockpile sites, while potentially technically feasible, has not been evaluated because it also has the potential for high levels of public concern, but could be evaluated if other options are no longer available.

Based on our assessment of supporting documentation and analyses, we determined that the underlying cost estimates used in the Army's report were not reliable, and the impact of this on the Army's report finding that the DuPont plan had "significant cost savings" over the three considered alternatives is uncertain. Using OMB criteria and criteria approved by the cost estimating community,[8] we determined that the estimates were unreliable because of (1) the quantity and magnitude of errors,

[8] The Society of Cost Estimating and Analysis (SCEA) is an organization dedicated to improving cost estimating and analysis and to furthering the effectiveness and efficiency of cost estimating and analysis. The characteristics of a high-quality estimate are contained in SCEA's *Cost Programmed Review of Fundamentals* © 2003 SCEA.

(2) quality control weaknesses, (3) questionable or inadequate supporting source data and documentation, and (4) the undetermined sensitivity of key assumptions. Neither the Army nor the contractor has a system in place to perform cross-checks of the costs, underlying assumptions, or the technical parameters that went into the estimates. Moreover, we have determined that the results from the Army's programmatic risk analysis are unreliable because they were generated from the previously discussed unreliable cost estimates and because the Army attributed no risk to potential permitting, legal, or other challenges to the DuPont plan. It was unclear to us whether the programmatic risks of other alternatives were understated or overstated. Overall, we could not determine the cumulative effect of these problems on the outcome or results of the Army's analysis, in large part because we did not have confidence in much of the supporting data because of the problems that we have noted. Nevertheless, without reliable underlying cost estimates, the Army, the Congress, and the public cannot have confidence that the most cost-effective solution has been selected. We are making recommendations that the Army conduct its cost-benefit analysis again using best practices so that its data and conclusions are comprehensive, traceable, accurate, and credible; correct any technical and mathematical errors in the cost estimate; establish quality control and independent review processes that check data sources, calculations, and assumptions; and perform a sensitivity analysis of key assumptions.

In written comments on a draft of this report, DOD concurred with our findings and recommendations, and stated that the Army will be preparing a new cost-benefit analysis based on a revised cost estimate, which will be independently reviewed and verified. DOD comments are discussed in more detail at the end of this correspondence and are reproduced in full in enclosure II. DOD also provided technical comments, which have been incorporated where appropriate.

Background

In 1994, the Army, in response to continued public and congressional concerns about the use of incineration as a destruction method, established the Alternative Technologies and Approaches Project under the Program Manager for Chemical Demilitarization, which became CMA in 2003. The project was tasked with investigating alternatives to incineration for the stockpiles that were located at Aberdeen Proving Ground (Aberdeen), Maryland, and Newport. These two sites were unique in that they consisted solely of chemical agent stored in bulk containers, without explosives or other munitions components.

In February 1999, the Army announced that it would establish a pilot program to destroy Newport's stockpile of VX. The treatment and disposal method chosen to be pilot tested was neutralization followed by SCWO. In making its decision, the Army considered evaluations made by the NRC and independent Army reviews of alternatives to incineration and for treating hydrolysate. Another key factor in the Army's decision was a recommendation made by the Indiana Citizens Advisory Commission that the Army consider technologies other than incineration.

In 2002, in response to heightened concerns about the storage of chemical weapons after the terrorist attacks of September 11, 2001, the Army adopted "an accelerated approach" at both its Newport and Aberdeen stockpile locations in order to eliminate the stockpiles faster. A key change resulting from this accelerated approach is that the Army would not treat the hydrolysate on-site, but would transport it off-site to commercial facilities that had the necessary environmental permits to treat and dispose of the hydrolysate. In the case of Newport, Parsons, the government's site contractor, awarded a contract to Perma-Fix of Dayton, Inc., Dayton, Ohio, through a 2002 request for proposals, to demonstrate that it could treat the hydrolysate. However, this plan generated considerable public concern, and the contract was subsequently terminated when a discharge permit could not be obtained. The Army and its contractor at Newport then began pursuing efforts to transport the hydrolysate to DuPont, which also responded to the 2002 request for proposals.

Methodology Used to Develop the Army's Cost-Benefit Analysis

In response to the committee report,[9] the Army tasked Shaw with developing technical schedule and cost information comparing the eight on-site technologies cited in the committee report to the Army's proposed off-site transportation of the hydrolysate to DuPont. A post-treatment estimate report was prepared to document the methodology, assumptions, and findings used in the analysis. In conducting its analysis, each of the eight technologies was initially evaluated to determine its applicability to process Newport hydrolysate. The Army determined that the eight cited treatment and disposal methods were the eight methods evaluated by the NRC in an assessment it prepared for the Project Manager for the Non-Stockpile Chemical Materiel Project[10] in 2001. The analysis used the evaluation criteria in the NRC report to assess benefits and risks of each method, updating information when necessary to reflect events subsequent to the report's publishing. The post-treatment estimate report also noted that the Army has been monitoring for years the development of emerging technologies for the potential application to chemical demilitarization. Schedules and cost estimates were only developed for technologies that were determined to be applicable to the volume and characteristics of the Newport hydrolysate.

Army officials stated that they selected Shaw because of its experience with various aspects of the DOD's Chemical Demilitarization Program and its familiarity with treatment methods, which provides it with the expertise to make reasoned judgments about the treatment methods contained in the Army's cost-benefit report. Shaw has supported CMA and its predecessor for more than 15 years. For example, Shaw supported the Non-Stockpile Chemical Materiel Project by participating in the identification, evaluation, and testing of methods for treating waste streams from the neutralization of recovered chemical materials and binary chemical agents. According to the Army, Shaw evaluated over 140 technologies, including all eight cited in the committee report. Moreover, Shaw was responsible for a program that

[9] H.R. Rep. No. 109-89 (2005).
[10] Non-stockpile chemical materiel are items not included as part of the nation's unitary chemical stockpile, including buried munitions and binary munitions.

monitors the development of new technologies for potential application to CMA's mission. In addition, Shaw participated in the study and testing of various candidate processes for post-treatment of Newport's hydrolysate, including SCWO.

The Rationale Used for Eliminating Technologies from Further Consideration Appears Reasonable

Although the Army's cost-benefit report did not provide specific details on the process it used to make its determination to eliminate five of the eight congressionally specified treatment technologies from further consideration, the Army's rationale for eliminating these methods appears reasonable based on our review of the findings in the post-treatment estimate report prepared by Shaw. The report's evaluations were supported by past NRC reports, past program studies, and experience that Shaw has gained through its work with the Non-Stockpile Chemical Materiel Project and its role in evaluating emerging technologies.

Army Eliminated Five Treatment Methods It Determined to Be Unsuitable for Newport Hydrolysate

The Army's cost-benefit report stated that based on a technical review conducted by Shaw's professional engineers with extensive experience in these treatment methods, five treatment methods specifically referenced in H.R. Rep. No. 109-89 were not viable because the methods were not well suited for the known properties and volumes of Newport hydrolysate. The five methods eliminated from further study were (1) electrochemical oxidation, (2) solvated-electron technology, (3) gas-phase chemical reduction, (4) plasma-arc technology, and (5) stand-alone biodegradation. Table 1 lists the five eliminated treatment methods and the factors the Army report cited as leading to their elimination.

Table 1: Rationale for the Elimination of Five Technologies from the Army's Cost-Benefit Report for Hydrolysate Treatment

Technology	Factors leading to elimination
Electrochemical oxidation	• Not appropriate for aqueous wastes. • Concern about scale-up issues and risks. • Generates large volumes of waste streams needing additional treatment.
Solvated-electron technology	• Not appropriate for aqueous wastes. • Generates hydrogen. • Uses difficult-to-handle reagents.
Gas-phase chemical reduction	• Company no longer exists. • Generates high volumes of gaseous waste. • Hydrogen reagent considered a safety risk.
Plasma-arc technology	• Not appropriate for large quantities of aqueous wastes. • Considered similar to incineration. • Limited experience with both hazardous and aqueous solutions.
Stand-alone biodegradation	• Primary reaction products in Newport caustic hydrolysate are not amenable to direct treatment by biodegradation. • Not efficient for on-site waste volumes; cannot obtain economies of scale available at commercial large-scale treatment, storage, and disposal facilities.

Source: U.S. Army.

Army's Eliminations Appear Reasonable Based on Our Review of Supporting Documents

Our review of the Army's rationale for dismissing five of the eight alternative technologies found that the findings contained in the Army's report appear to be reasonable and are supported by documentation from the post-treatment estimate report prepared for CMA by Shaw and NRC reports. The evaluation of the benefits and risks of each technology was largely based on criteria developed by the NRC in its 2001 report.[11] The NRC cited four areas as "top priority" criteria: relative process safety (low risk), technical effectiveness, permit status, and pollution prevention. Additionally, another six categories were designated "important" criteria: robustness, cost, practical operability, continuity, space efficiency, and materials efficiency. When necessary, the findings of the NRC neutralent waste report were updated within these criteria based on more recent technological developments, experience

[11] National Research Council, *Review and Evaluation of the Army Non-Stockpile Chemical Materiel Disposal Program: Disposal of Neutralent Wastes* (Washington, D.C.: 2001).

Shaw has gained working with the Non-Stockpile Chemical Materiel Project, and Shaw's role in evaluating emerging technologies. Our review of the post-treatment estimate report and key NRC reports referenced by the Army provided evidence of likely significant difficulties associated with the five eliminated options that would make them less promising than the three options that were evaluated against the proposed DuPont option in the Army's cost comparisons. Evidence used by the Army to support its rationale for eliminating each treatment method is discussed below.

Electrochemical Oxidation

- The Army report's finding that electrochemical oxidation would generate large volumes of waste is supported by findings in the NRC neutralent wastes report. In its report, the NRC noted that electrochemical oxidation generates large amounts of gaseous effluents, particularly chlorine gas, which needs to be scrubbed. The report also noted that those effluents would be corrosive and could cause operating problems. Shaw's evaluation determined that the amount of water present in Newport's hydrolysate would be too large for the electrochemical oxidation technology to process, requiring either the hydrolysate to be concentrated or the electrochemical system to be redesigned. The NRC neutralent wastes report also noted that treating large quantities of water would be an issue for this treatment method.

- The finding that an electrochemical oxidation system would require a significant scale-up is also supported by findings in the NRC neutralent wastes report. The report also stated that the one existing CerOx facility (the type of electrochemical oxidation proposed for use by the Army) could process only one 35-gallon barrel at a time. In Shaw's evaluation, it noted concerns about whether the manufacturer could easily scale up production for the 200 electrochemical cells necessary to operate at Newport, as their systems were only accustomed to handling laboratory-scale amounts of waste.

Solvated-Electron Technology

- The Army report's finding that the solvated-electron technology is not appropriate for Newport hydrolysate is supported by the NRC neutralent wastes report findings as well. The NRC determined that the solvated-electron technology process' efficiency is poor when treating aqueous waste streams, and its advantages may be outweighed by the difficulty of handling its reagents, which are toxic and have been known to cause fires. The NRC also was concerned that the solvated-electron process was less mature than some of the other treatment technologies. Shaw determined that solvated-electron

technology was evaluated by the Assembled Chemical Weapons Alternatives[12] program but that it could not successfully complete demonstration testing.

Gas-Phase Chemical Reduction

- The Army report's finding that the gas-phase chemical reduction technology is not appropriate for Newport hydrolysate is supported by Shaw's findings, which noted that the vendor who had the rights to this technology, ELI Eco Logic, went out of business in 2004. Shaw noted that further development of gas-phase chemical reduction as an option would "require finding a company to acquire the rights and start development work" and that process "would be a large risk to cost and schedule."

- The NRC's neutralent wastes report notes that gas-phase chemical reduction is a complex process that requires the management of hot hydrogen gas, which presents unique safety concerns. The NRC report cited the need to manage gases both in the reactor and as effluents and the potential for the buildup of carbon soot. The report also stated that no commercial-scale reactor of this type has received a permit to operate in the United States, which could lead to delays.

Plasma-Arc Technology

- The NRC neutralent wastes report notes concerns about the prospects for plasma-arc technology to get a permit since it has not operated in the United States and regulators may consider it to be incineration. Also, the NRC noted that tests of the technology conducted by the Army's Assembled Chemical Weapons Alternatives program on VX hydrolysate generated products of environmental concern. The NRC report also stated that this process is less efficient with wastes that contain large amounts of water.

- The post-treatment estimate report states that regulatory hurdles would need to be overcome and then technology development would need to be accomplished.

Stand-alone Biodegradation

- The NRC has repeatedly noted its concerns related to the ability of stand-alone biodegradation to treat hydrolysate from VX. For example, in its 1996 *Review*

[12] The Congress established the Assembled Chemical Weapons Assessment program in 1996 to identify and demonstrate at least two alternative technologies to baseline incineration. Omnibus Consolidated Appropriations Act, 1997, Pub. L. No. 104-208 (1996). In 2002, the program was assigned responsibility for full-scale pilot testing of neutralization technologies to destroy the chemical weapons stockpiles at the Pueblo Chemical Depot in Colorado and Blue Grass Army Depot in Kentucky. Department of Defense Appropriations Act, 2003, Pub. L. No. 107-248 (2002). In 2003, the program's name was changed to Assembled Chemical Weapons Alternatives.

and Evaluation of Alternative Chemical Disposal Technologies,[13] its 2000 *Integrated Design of Alternative Technologies for Bulk-Only Chemical Agent Disposal Facilities*,[14] and its neutralent wastes reports, the NRC noted that the primary reaction products of VX hydrolysate are not readily amenable to direct treatment by biodegradation, since they cannot be easily broken down by the microorganisms used in this process. Additionally, Shaw cited an Assembled Chemical Weapons Assessment evaluation that found biodegradation to be "inadequate for complete destruction" of VX hydrolysate.

- The Army report's finding that biodegradation could not achieve the economies of scale needed to make biodegradation efficient is supported by the findings of the NRC. In its 1996 study, the NRC found that because hydrolysate cannot serve as the primary substrate for the microorganisms in this process, substantial quantities of co-substrate need to be added to co-feed the process, making it inefficient.

- Chemical oxidation, followed by chemical precipitation in conjunction with biodegradation, is the process proposed for use in both the off-site DuPont option and the on-site chemical oxidation option.

The Army Has Evaluated Other Technical Solutions for Treating Newport's Hydrolysate

Although the Army did not discuss them in its cost-benefit report, it has evaluated other technical solutions for treating Newport's hydrolysate since its 1999 decision to use SCWO. These solutions include both off-site commercial treatment facilities and treatment technologies that would be used on-site. In general, the evaluations of off-site options have determined that there are only a few commercial treatment facilities that are qualified and interested in treating Newport's hydrolysate, but addressing public comments and concerns could be challenging. Evaluations of on-site options have determined that the most promising options are similar to those included in the Army's 2006 report, but concerns were raised about development costs and operational risks. Other solutions, such as using one of the Army's four incineration facilities, may be technically feasible but not viable at this time.

Army's Evaluation of Off-Site Commercial Treatment Facilities Found Few That Are Potentially Qualified and Interested

While there may be numerous facilities that could treat the Newport hydrolysate, only a small number have actually responded to requests for proposals. The Army began evaluating commercial treatment facilities that use various treatment methods, including those using incineration, biodegradation, and deep-well injection options subsequent to a 2001 NRC report that expressed concerns about the reliability of

[13] National Research Council, *Review and Evaluation of Alternative Chemical Disposal Technologies* (Washington, D.C.: 1996).
[14] National Research Council, *Integrated Design of Alternative Technologies for Bulk-Only Chemical Agent Disposal Facilities* (Washington, D.C.: 2000).

SCWO reactors during engineering tests. An earlier NRC report in 2000 recommended that the Army evaluate the potential off-site treatment of Newport hydrolysate both for potential costs and schedule benefits as well as a contingency in the case of start-up problems implementing SCWO.

The Army adopted an accelerated approach in 2002 that changed the planned treatment method for hydrolysate from on-site to an off-site commercial treatment facility. The Army's contractor at Newport—Parsons—conducted industry surveys to identify facilities that could transport, treat, and dispose of Newport's hydrolysate. Parsons conducted a nationwide survey and identified over 100 commercial treatment and disposal facilities in the United States as capable of handling hazardous waste. However, after considering the facilities' technology, environmental permits, safety and environmental records, and outreach initiatives, Parsons determined that only 45 of the facilities should be considered to determine their qualifications to treat and dispose of the Newport hydrolysate. These 45 facilities were sent a qualification survey by Parsons; however, only 14 firms completed and returned the survey. After a review of the responses to determine if they met minimum specified requirements, Parsons provided requests for proposals to 10 of these facilities. Ultimately, 4 facilities responded: 2 incineration-based facilities and 2 biodegradation treatment-based facilities (Perma-Fix and DuPont). None of the facilities that use deep-well injection responded to Parson's request. The range of proposed prices varied significantly with a fourfold difference in price from the least expensive to the most expensive of the four facilities.

According to the Army, during the evaluation process for the four proposals, the two commercial incineration facilities were eliminated: one withdrew its proposal and the other was deemed to be too high of a risk because of concerns about public opposition. Parsons, in its capacity as the government's contractor, awarded Perma-Fix a contract in December 2002 to demonstrate its ability to successfully treat the hydrolysate. However, before any hydrolysate could be shipped, Parsons terminated the contract for convenience of the government. This cancellation was caused by the determination that an environmental permit would not be issued to Perma-Fix by the local county government.

As part of this continuing procurement in 2005, Parsons conducted a market survey to establish an updated range of hazardous waste treatment and disposal prices at the commercial treatment facilities. The 10 commercial facilities that were surveyed were the same facilities that were provided proposal requests in 2002. In this instance, 7 of the 10 commercial facilities provided price data for processing generic hazardous waste material.[15] Of the 7 facilities that provided price data, 2 use incineration, 2 use deep-well injection, 2 use biodegradation, and 1 uses both biodegradation and deep-well injection. Program officials stated that the prices for these firms represented a broad range of pricing for hazardous waste treatment based on a range of treatment technologies, locations, and marketplace factors, such as financial risks and regulatory and environmental liabilities. The price for treating and

[15] Price data for DuPont were not included as part of Parsons' 2005 market research pricing for hazardous waste treatment.

disposing of any waste depends on the facilities' capabilities, regulatory restrictions, and permit requirements.

Past Evaluations of On-Site Technologies Yielded Similar Results regarding the Most Promising Technologies

Although the Army selected SCWO as its planned on-site treatment and disposal method for Newport's hydrolysate in 1999, the Army and its contractors conducted several more evaluations in 2001 and 2002 to consider other on-site approaches because of Army and NRC concerns about the reliability of SCWO. These evaluations included technologies other than those that were considered in the Army's recent cost-benefit report, but the technologies deemed most promising were similar to the technologies that survived elimination in the Army's 2006 report. Earlier study findings included the following.

- A 2001 Parsons report identified and assessed 8 potential on-site technologies that were capable of processing the Newport hydrolysate. Initially, more than 100 technologies were identified in literature and database searches. After screening based on several criteria, including process efficiency, technology maturity, and the extent that they were considered low pressure or temperature, 8 technologies met the criteria: two types of SCWO, electrochemical oxidation, wet-air oxidation, two types of chemical oxidation, ozone (with and without peroxide), and bleach treatment with biodegradation. Two additional technologies were added—gas phase chemical reduction and plasma arc—although they did not meet the criteria for being low-temperature processes. This report found that the two types of SCWO, wet-air oxidation, and chemical oxidation, were the most promising technologies for further consideration; these are the same three technologies that were identified in the Army's cost-benefit report.

- A 2002 Parsons report prepared for the Army compared various on-site and off-site disposal options for consideration as a potential backup plan for treating Newport hydrolysate. In its evaluation, the contractor determined that the two on-site treatment options—SCWO and the pretreatment/biological treatment option—would rate more favorably for public acceptance, but not as favorably for cost and schedule, primarily because of development and testing costs and operational risks. The evaluation also determined that pretreating the hydrolysate on-site before transporting it off-site would offer no advantage. The evaluation concluded that off-site options had more favorable ratings because of advantages in cost, schedule, and environmental compliance, but would likely be at higher risk for lack of public acceptance. Figure 1 compares the 2002 evaluation of various on-site and off-site treatment options by cost, schedule, public acceptance, and environmental compliance.

Figure 1: Comparison of 2002 Evaluation of the On-site, Off-site, and Combination Treatment Options for Newport's Hydrolysate

	Off-site incineration	Off-site biological treatment	Off-site deep-well injection	On-site pretreatment off-site biological treatment	On-site pretreatment off-site deep-well injection	On-site speedy SCWO	On-site pretreatment on-site biological treatment
Cost	●	●	●	◐	●	○	◐
Schedule	●	●	●	◐	◐	◐	○
Public acceptance	○	◐	○	◐	○	●	●
Environmental compliance	●	●	●	◐	◐	●	○

Favorable ● Neutral ◐ Unfavorable ○

Source: U.S. Army.

Using Existing Army Incineration Sites Is Not Considered a Viable Option at This Time

CMA officials acknowledged that using one of the four operating chemical agent disposal facility incinerators to process the hydrolysate is considered a technically feasible option; however, CMA has not formally assessed all its advantages and disadvantages because CMA officials do not believe incineration to be viable at this time. These officials told us that from a technical standpoint, incineration could be used to dispose of Newport's hydrolysate, and as discussed above, the Army has considered commercial facilities that use incineration. However, it is not an ideal solution for treating hydrolysate, which is primarily water (85 percent), thus leading to greater energy consumption. These officials also stated that because of the opposition to incineration of hydrolysate, both locally in Indiana and nationally, the Army has committed to pursuing nonincineration options first. However, should there be no permitted commercial treatment facility reasonably available, the Army would once again evaluate the viability/acceptability of using incineration for disposing of Newport's hydrolysate, including evaluating the potential legal and regulatory barriers.

Army's Cost Estimates and Programmatic Risk Analysis Were Not Reliable, and Impact on Results Is Uncertain

The Army's report found that the DuPont plan was significantly more cost-effective than the three considered on-site alternatives, but based on our assessment of supporting documentation and analyses, we determined that the underlying cost estimates used in the Army's report were not adequate or reliable, making the cost-effectiveness determination among options uncertain. Using OMB criteria and criteria approved by the cost estimating community to assess the methodology, key assumptions, and data used to develop cost estimates in the Army's cost-benefit report, we determined that the estimates were unreliable for reasons related to (1) the quantity and magnitude of errors, (2) quality control weaknesses,

(3) questionable or inadequate supporting source data and documentation, and (4) the undetermined sensitivity of key assumptions. Further, neither the Army nor the contractor had a system of cross-checking in place to verify computations or to substantiate the basis for some assumptions. Moreover, we determined that the results from the Army's programmatic risk analysis are unreliable because they were generated from the previously discussed unreliable cost estimates and because the Army attributed no risk to potential permitting, legal, or other challenges to the DuPont plan. It was unclear to us whether the programmatic risks of other alternatives were understated or overstated. Overall, we could not determine the cumulative effect of these problems on the outcome or results of the Army's analysis, in large part because we did not have confidence in much of the supporting data because of the stated problems and the limited time available to further test these data.

Cost Estimating Community Has Best Practices Criteria for Reliability

Guidance provided in OMB Circular A-94 and best practices established by professional cost analysts, such as those identified by the Society of Cost Estimating and Analysis, have identified characteristics of a high-quality, reliable cost estimate. These characteristics include the following.

- Comprehensive. The estimate should be at a level of detail appropriate to ensure that cost elements are neither omitted nor double counted. All cost-influencing ground rules and assumptions are detailed in the documentation of the cost estimate.
- Traceable. The estimate is thoroughly documented, including source data and significance, clearly detailed calculations and results, and explanations for why a particular method or reference was chosen. Data can be traced back to the source documentation.
- Accurate. The estimate should be unbiased, not overly conservative or overly optimistic, and based on an assessment of most likely costs. Few, if any, mathematical mistakes are present and are minor in nature.
- Credible. Any limitations of the analysis because of uncertainty or biases surrounding data or assumptions should be discussed. Major assumptions should be varied and other outcomes recomputed to determine how sensitive outcomes are to changes in the assumptions. In addition, the results of an estimate should be cross-checked with an independent cost estimate and a level of risk associated with the estimate should be identified.

Engineering Buildup Approach Was Used to Develop the Technical Cost Estimate

In developing the cost comparisons that were cited in the post-treatment estimate report, an engineering buildup approach was used, which can be an appropriate methodology for construction projects. The approach was based on conceptual design data for manpower estimates, facility sizing, construction, equipment costs, and throughput estimates for the on-site options. Cost estimates for categories, such as utilities, processing materials, and storage costs, for the accumulating hydrolysate

were also developed. For the DuPont off-site option, DuPont's past estimate was updated based on an assessment of the impacts of program changes since the estimate was originally provided in 2002. For all options, costs were grouped by the following major categories: (1) project services; (2) engineering, design, and permitting; (3) process equipment and systems; (4) facilities construction; (5) systemization; (6) operations and pilot test; (7) hydrolysate storage; and (8) closure. A contingency factor was added to each estimate to account for estimating, commercial, and technical risks.

Cost Estimates Were Unreliable Because of Inadequate Supporting Documentation and Numerous Computational Errors

The technical cost analysis that the Army used in estimating the costs of the proposed off-site option and the three on-site options contained in its cost-benefit report did not follow all applicable guidance from OMB and best practices for a cost-effectiveness analysis. Specifically, the quality of some of the underlying estimates in the technical report was affected because the supporting analysis was not comprehensive nor traceable in that data sources were frequently not provided throughout the analysis nor was it accurate because of the numerous computational errors. Neither the Army nor the contractor performed independent cross-checks of the costs or the technical parameters that went into the estimates.

Our analysis revealed numerous instances where the data were not comprehensive or traceable. We determined that the documentation provided was not detailed enough to provide an accurate assessment of the quality of each alternative's cost estimate. For example, neither the technical report nor the supporting documentation referenced the source for numerous data inputs, such as the sources for equipment installation labor hour per unit parameters or chemical reagent unit costs. Additionally, the basis of estimate documented for some data inputs were found to be inadequate for assessing estimate credibility, such as staffing estimates, labor rates, and other direct costs.

Our analysis also revealed many computation errors that affect the accuracy of the cost estimates, including an incorrect rate being applied to all labor categories for 5 years, leading to costs for one category of one option being overstated by about $34 million and another option's solid waste disposal costs being understated by approximately $3.5 million. CMA officials acknowledged that there was no system in place to independently verify the accuracy of the data. In total, the errors affected all options and led to both over- and underestimating of costs. However, to the extent that we could correct identified inaccuracies, our recalculations just for computation errors did not result in a significant variance from the Army's analysis. The estimated costs would fall in the same order that the Army had originally computed, although the net difference in costs between the DuPont option and each on-site option was reduced. Table 2 shows the relative comparison of the corrected costs versus the reported cost estimates.

Table 2: Comparison of Reported and Corrected Cost Estimates for the Three On-Site Options Relative to DuPont's Cost Estimates (without Programmatic Risk)

Treatment option	Reported cost estimates relative to DuPont's cost estimate	Corrected cost estimates relative to DuPont's corrected cost estimate	Change in relative costs of reported and corrected cost estimates
Chemical oxidation	$145,900,000	$130,625,000	**($15,275,000)**
Wet-air oxidation	$148,900,000	$133,525,000	**($15,375,000)**
Supercritical water oxidation	$200,500,000	$178,125,000	**($22,375,000)**

Source: GAO analysis of U.S. Army data.

Note: In the Army's cost-benefit report, to protect proprietary information generated by DuPont, the estimated costs for implementation of each on-site option was reported relative to the estimated cost for the DuPont option (considered the base cost) without disclosing the actual value of the DuPont cost estimate.

Our estimate corrects only for obvious mathematical and spreadsheet errors and does not account for unsubstantiated input parameters or parameters used in the spreadsheets that are in conflict with the documentation. For example, there were differences between consumption levels used in the spreadsheet model versus the level documented in the post-treatment estimate report. These discrepancies could potentially translate to an underestimate of nearly $15 million. This discrepancy and others like it are not reflected in our estimate because it is not obvious which consumption level is correct. To resolve discrepancies like these, an independent technical assessment would need to be conducted to verify the validity of inputs and assumptions used to prepare the estimates.

Uncertainty of Cost Estimate Is Not Adequately Addressed

The Army's cost analysis does not sufficiently address the uncertainty of its cost estimates, which affects the credibility of its conclusions. First, the technical report does note that the estimate is a rough order of magnitude estimate for cost and schedule that can be used to provide a basis for evaluating probable life cycle costs. CMA officials stated that the Association for the Advancement of Cost Engineering International's *Cost Engineers' Notebook* was used to develop the order of magnitude estimate. According to the technical report, the cost estimates are based on conceptual design data, and because of the breadth of technological alternatives considered, relative unique processes, and lack of processing data for Newport hydrolysate, the technical cost estimate should be considered in the range of plus 30 percent and minus 15 percent. However, neither the Army's cost-benefit report nor the supporting post-treatment estimate report provided estimates that reflect these ranges of outcomes. For example, applying the worst case to DuPont (plus 30

percent) and the best case (minus 15 percent) to one or more of the on-site options could significantly reduce the cost difference, although DuPont would still be more cost-effective. Second, the Army did not perform a sensitivity analysis to assess how variations in certain key assumptions could affect its cost estimates although there can be imprecision in both underlying data and modeling assumptions. For example, the cost estimates were based on the DuPont off-site option having about 2.5 times greater throughput capacity than each of the on-site treatment technologies. This assumption leads to a greater disparity between the on-site and off-site operation costs since the operation period, and its associated costs, would be longer for the on-site options. However, it is possible that the actual throughput could increase or decrease based on design and operational considerations. Because such uncertainty is basic to many analyses, its effects should be analyzed and reported. There was no analysis done to determine the effects of varying this assumption on the cost estimate. Third, the cost estimates also do not address the uncertainty associated with impacts that environmental permitting activities, actions of public or government agencies, or public opinion could have on program execution. This uncertainty is particularly relevant since these impacts have greatly affected the program in the past, delaying the Army's proposed plan for over 2 years.

Army's Programmatic Risk Analysis Was Not Reliable Because It Used Unreliable Technical Cost Estimates and Understated Risks

We determined that the Army's programmatic risk analysis that added additional costs to each option is also unreliable because the analysis was generated from the previously discussed unreliable technical cost estimates and because the Army attributed no risk to potential permitting, legal, or other challenges to the DuPont plan. The programmatic risk analysis is used to account for unknown risks that could affect the cost or schedule of given options. This analysis uses a statistical distribution model that typically extends the schedule durations by a scaled amount based on the level of risk (none, low, medium, and high) assigned to each of three phases: design/construction, operations, and closure.

Based on this programmatic risk analysis, the Army added additional costs to each option. The proposed DuPont plan had the least additional costs added during the programmatic analysis, while the net additional cost (total additional costs minus additional costs for DuPont) for the three options ranged from $84 million to $146 million.

Conducting a programmatic risk analysis is an acceptable method for applying unknown risk; however, it depends heavily on the judgment used when assigning risks. For example, Army officials assigned no programmatic risk to DuPont's design/construction phase because the process would use commercially available facilities and personnel. Another reason cited for not assigning risk was that the technical cost estimates contained sufficient known risk for the limited scope and design that would be needed at DuPont. However, this risk determination does not take into account the potential permitting, legal, or other challenges that may arise, which could delay construction, transport of the hydrolysate to New Jersey, or start of operations. Based on the history of delays associated with implementing the

proposed plan, it would be prudent to account for these risks. It was unclear to us whether the programmatic risks of other alternatives were understated or overstated.

Conclusions

The Army has been pursuing the off-site treatment of Newport's hydrolysate at a commercial treatment, storage, and disposal facility since it adopted an accelerated disposal approach in 2002. One of the reasons that has been frequently cited for adopting this approach is that it would provide substantial cost savings over designing, constructing, and operating an on-site treatment and disposal method. However, from the time that the accelerated approach was adopted, the Army faced resistance on many fronts because of skepticism concerning advantages attributable to the off-site treatment option. If the Army is to be successful in garnering support for its plan, then it is imperative that the Army use a transparent process to develop cost estimates that are comprehensive, traceable, accurate, and credible. Without reliable underlying cost estimates, the Army, the Congress, and the public cannot have confidence that the most cost-effective solution for the treatment and disposal of Newport's hydrolysate has been selected.

Recommendations for Executive Action

To ensure confidence in the reliability of the underlying cost estimates for the Army's decision to send hydrolysate from the Newport Chemical Depot, Indiana, off-site for treatment, which indicate significant cost and schedule savings compared to on-site disposal of the hydrolysate, we recommend that the Secretary of Defense direct the Secretary of the Army to take the following four actions.

- Conduct the Army's cost-benefit analysis again using best practices so that its data and conclusions are comprehensive, traceable, accurate, and credible.
- Correct any technical and mathematical errors in the cost estimate.
- Establish quality control and independent review processes that check data sources, calculations, and assumptions.
- Perform a sensitivity analysis of key assumptions, including, at a minimum, (1) variations in the throughput rates for various options; (2) the technological uncertainty of options; and (3) for off-site treatment and disposal options, the risks associated with potential permitting, legal, and other challenges.

Agency Comments

In written comments on a draft of this report, DOD concurred with our recommendations and stated that it fully supports the use of best practices for the development and preparation of cost estimates. DOD stated that the Army will be preparing a new cost-benefit analysis based on a revised cost estimate, which will be independently reviewed and verified, and will contain an analysis of assumptions. DOD estimated that the revised cost estimate will be available by the third quarter of fiscal year 2007 and the new cost-benefit analysis will be available by the fourth quarter of fiscal year 2007. DOD's comments are reproduced in full in enclosure II.

DOD also provided us with technical comments, which have been incorporated where appropriate. Finally, we adjusted our fourth recommendation in the draft report in light of DuPont's January 5, 2007, announcement that it was no longer interested in being considered as a potential treatment site.

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We are sending copies of this report to other interested congressional parties. We also are sending copies to the Secretary of Defense; the Secretary of the Army; and the Director, Office of Management and Budget. We will make copies available to others upon request. In addition, the report will be available at no charge on GAO's Web site at http://www.gao.gov.

If you or your staff have any questions concerning this report, please contact me at (202) 512-5431 or by e-mail at dagostinod@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made key contributions to this report are listed in enclosure III.

Davi M. D'Agostino
Director
Defense Capabilities and Management

Enclosures – 3

The Honorable Carl Levin
Chairman
The Honorable John McCain
Ranking Minority Member
Committee on Armed Services
United States Senate

The Honorable Ike Skelton
Chairman
The Honorable Duncan Hunter
Ranking Minority Member
Committee on Armed Services
House of Representatives

The Honorable Daniel Inouye
Chairman
The Honorable Ted Stevens
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
United States Senate

The Honorable John P. Murtha
Chairman
The Honorable C.W. Bill Young
Ranking Minority Member
Subcommittee on Defense
Committee on Appropriations
House of Representatives

Description of Eight Congressionally Specified Disposal and Treatment Options for Newport's Hydrolysate

- **Chemical oxidation**. Organic wastes are mixed with an oxidizing agent (such as hydrogen peroxide) and water at low temperatures and low pressure. This process breaks down the organic components of the waste into either benign compounds or compounds that can be more easily treated by other means.

- **Electrochemical oxidation**. A similar chemical process to chemical oxidation, electrochemical oxidation uses a metallic element as an oxidizing agent within an electrochemical cell. This also is a low-temperature, low-pressure process.

- **Biodegradation**. This process uses microorganisms to destroy certain organic compounds in dilute aqueous (water) solutions. This low-temperature, low-pressure process is often used to treat sewage. Some organic compounds can be readily broken down by biotreatment, while the structure of other compounds makes them highly resistant.

- **Solvated-electron technology**. This process involves the reaction of organic waste materials with solutions of metallic sodium in anhydrous liquid ammonia. In contrast to most of the other technologies considered by the Department of Defense's Chemical Demilitarization Program, this is a reduction rather than an oxidation reaction. Solvated-electron technology is a low-temperature, low-pressure process.

- **Wet-air oxidation**. This process oxidizes organic compounds in water using dissolved oxygen and air. It operates at relatively higher temperatures and pressures than chemical oxidation. Wet-air oxidation is commercially in use worldwide to treat industrial wastes.

- **Supercritical water oxidation**. This process destroys organic compounds through oxidation by introducing air to water that has been superheated beyond its critical point (374°C). This is a high-temperature, high-pressure process.

- **Gas-phase chemical reduction**. This process uses hydrogen and steam at high temperatures to break down organic compounds into more easily treated chemicals. Like solvated-electron technology, gas-phase chemical reduction is a reduction reaction. This is a high-temperature but low-pressure process.

- **Plasma-arc technology**. This process uses electrical discharges through gases to produce intense radiant energy and high-temperatures to break down

organic compounds in a containment chamber. This is an extremely high-temperature but low-pressure process.

Comments from the Department of Defense

ASSISTANT TO THE SECRETARY OF DEFENSE
3050 DEFENSE PENTAGON
WASHINGTON, DC 20301-3050

NUCLEAR AND CHEMICAL
AND BIOLOGICAL DEFENSE
PROGRAMS

JAN 4 2007

Ms. Davi M. D'Agostino
Director, Defense Capabilities and Management
United States Government Accountability Office
441 G Street, N.W.
Washington, DC 20548

Dear Ms. D'Agostino:

This is the Department of Defense (DoD) response to the GAO draft report, GAO-07-240R, 'Review of the Cost Comparison of Off-Site Versus On-Site and Treatment and Disposal of Hydrolysate at the Newport Chemical Depot, Indiana,' dated December 6, 2006 (GAO Code 350933).

The DoD concurs with the draft report's recommendations. The Department fully supports the use of best practices for the development and preparation of cost estimates. As such, the Army will be preparing a new cost-benefit analysis with a revised cost estimate, which will be independently reviewed and verified.

The Department appreciates the opportunity to provide comments on the draft report. These comments, including technical comments, are enclosed. For further questions concerning this report, please contact Barbara Burgess, Senior Program Analyst for the Chemical Demilitarization Program, (703) 588-1983, extension 113.

Sincerely,

Jean D. Reed
Special Assistant
Chemical and Biological Defense and
Chemical Demilitarization

Enclosures:
As stated

cc:
Deputy Assistant Secretary of the Army (Elimination of Chemical Weapons)

GAO DRAFT REPORT – DATED DECEMBER 6, 2006
GAO CODE 350933/GAO-07-240R

"Review of the Cost Comparison of Off-Site Versus On-Site Treatment and Disposal of Hydrolysate at the Newport Chemical Depot, Indiana"

DEPARTMENT OF DEFENSE COMMENTS TO THE RECOMMENDATIONS

RECOMMENDATION 1: The GAO recommended that the Secretary of Defense direct the Secretary of the Army to conduct the Army's cost-benefit analysis again using best practices so that its data and conclusions are accurate, replicable, traceable, verifiable, comprehensive, and credible (p. 18/GAO Draft Report).

DOD RESPONSE: Concur. The new cost-benefit analysis, based on a revised cost estimates, will be conducted utilizing best practices to include the Association for the Advancement of Cost Engineering methods. The new cost-benefit analysis will be available during the fourth quarter of Fiscal Year 2007 (FY07).

RECOMMENDATION 2: The GAO recommended that the Secretary of Defense direct the Secretary of the Army to correct any technical and mathematical errors in the cost estimate (p. 18/GAO Draft Report).

DOD RESPONSE: Concur. The cost estimates will be revised for use in the new cost-benefit analysis. The revised cost estimates will be reviewed independently for methodology and application. The revised cost estimate will be available during the third quarter of FY07.

RECOMMENDATION 3: The GAO recommended that the Secretary of Defense direct the Secretary of the Army to establish quality control and independent review processes that check date sources, calculations, and assumptions (p. 18/GAO Draft Report).

DOD RESPONSE: Concur. The Army is directing the U.S. Army Chemical Materials Agency, which prepared the initial analysis report, to conduct an independent review of the revised cost estimates. The revised cost estimate will be available during the third quarter of FY07.

RECOMMENDATION 4: The GAO recommended that the Secretary of Defense direct the Secretary of the Army to perform a sensitivity analysis of key assumptions, including, at a minimum, (1) variations in the throughput rates for various options; (2) the technological uncertainty options; and (3) for the DuPont option, the risks associated with potential permitting, legal, and other challenges (p. 18/GAO Draft Report).

DOD RESPONSE: Concur. The independent review of cost data, estimates, and analysis will include an analysis of the assumptions. The revised cost estimate will be during the third quarter of FY07.

GAO Contact and Staff Acknowledgments

GAO Contact

Davi M. D'Agostino, (202) 512-5431 or dagostinod@gao.gov

Acknowledgments

In addition to the contact named above, Mark A. Pross, Assistant Director; Bonita Anderson; Rodell Anderson; Susan Ditto; Jennifer Echard; Neil Feldman; James Lawson; Brian Octeau; Charles Perdue; and Karen Richey made key contributions to this report.

(350933)

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