NTR 2008-61129 NOBLIS TECHNICAL REPORT

Offsite Disposal of ACWA Hydrolysates

November 2008

This document has been approved for public release.

The views, opinions and/or findings contained in this report are those of Noblis and should not be construed as an official Government position, policy, or decision, unless designated by other documentation.

3150 Fairview Park Drive South • Falls Church, VA • 22042-4519 • USA

Table of Contents

1 Introduction 1-1
1.1 Background 1-1
1.2 Objective of Study 1-1
1.3 General Analytical Approach 1-1
1.4 Report Organization 1-2

2 Generation and Treatment of Hydrolysates 2-1
2.1 ACWA Chemical Weapons Destruction Processes 2-1
2.2 Offsite Disposal 2-8

3 Stakeholder Perspectives 3-1

4 Schedule and Cost Impacts 4-1
4.1 Acquisition Program Baseline 4-1
4.2 Proposed Acceleration Assessment 4-5
4.3 Sensitivity of Cost Savings to Disposal Prices 4-12

5 Safety Impacts 5-1
5.1 Stockpile Storage Risk 5-1
5.2 Preliminary Evaluation of Shipping Hazards 5-4

6 Summary of Findings 6-1

Appendix A Stakeholder Perspectives A-1
A.1 Overarching Issues A-1
A.2 Summary of Meetings with Colorado Stakeholders A-2
A.3 Summary of Meetings with Kentucky Stakeholders A-13

Appendix B Supporting Documentation for Preliminary Evaluation of Shipping Hazards B-1
B.1 Evaluation Approach B-1
B.2 BGCAPP Preliminary Evaluation B-4
B.3 PCAPP Preliminary Evaluation B-12

List of Acronyms AC-1

List of Figures

Figure 1-1. General Approach to the Study 1-2
Figure 2-1. BGCAPP & PCAPP Process Changes for Acceleration Assessment and Offsite Hydrolysate Disposal (Simplified Block Flow Diagrams) 2-3
Figure 2-2. BGCAPP Site Layout – Facility Changes Due to Offsite Disposal of Hydrolysate 2-4
Figure 2-3. BGCAPP SCWO Processing Building (SPB) Detail (Removed Due to Offsite Disposal of Hydrolysate) 2-5
Figure 2-4. PCAPP Site Layout – Facility Changes Due to Offsite Disposal of Hydrolysate 2-6
Figure 2-5. PCAPP Biotreatment Area (BTA) Detail (Removed Due to Offsite Disposal of Hydrolysate) 2-7
Figure 2-6. pH Scale Showing Hydrolysates and Common Industrial and Household Chemicals 2-10
Figure 4-1. Use of Cost Savings to Shorten APB-Based Schedules 4-1
Figure 4-2. Offsite Impacts on APB-Based Schedule at BGCAPP 4-3
Figure 4-3. Offsite Impacts on APB-Based Life Cycle Costs at BGCAPP 4-4
Figure 4-4. Offsite Impacts on APB-Based Schedule at PCAPP 4-5
Figure 4-5. Offsite Impacts on APB-Based Life Cycle Costs at PCAPP 4-6
Figure 4-6. Offsite Impacts on Acceleration Assessment Schedule at BGCAPP 4-8
Figure 4-7. Offsite Impacts on Acceleration Assessment Life Cycle Costs at BGCAPP 4-9
Figure 4-8. Offsite Impacts on Acceleration Assessment Schedule at PCAPP 4-11
Figure 4-9. Offsite Impacts on Acceleration Assessment Life Cycle Costs at PCAPP 4-11
Figure 5-1. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (APB-Based Schedule) 5-2
Figure 5-2. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (Accelerated Assessment Schedule) 5-2
Figure 5-3. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (APB-Based Schedule) 5-3
Figure 5-4. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (Accelerated Assessment Schedule) 5-4
Figure 5-5. BGCAPP Shipments of Hazardous Materials 5-6
Figure 5-6. PCAPP Shipments of Hazardous Materials 5-7

List of Tables

Table 2-1. Process Changes for Offsite Hydrolysate Disposal – Unit Operations Eliminated, Added, and Downsized 2-8
Table 2-2. Hydrolysate Characteristics 2-10
Table 2-3. Market Survey – ACWA Hydrolysate TSDF Disposal Market Price by Technology 2-11
Table 4-1. Main Cost Adjustments Due to Offsite Disposal of ACWA Hydrolysates 4-2
Table 4-2. Breakeven Disposal Prices by Decision Year—APB Cases 4-12
Table 4-3. Breakeven Disposal Prices by Decision Year—Acceleration Assessment Cases 4-12
Table 5-1. Qualitative Ratings of Shipment Hazards 5-5
Table B-1. BGCAPP Shipments for Onsite and Offsite Treatment Alternatives B-4
Table B-2. PCAPP Shipments for Onsite and Offsite Treatment Alternatives B-13

1 Introduction

1.1 Background

The Department of Defense (DoD) and its Program Manager for Assembled Chemical Weapons Alternatives (PM ACWA) are managing the construction of the Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) in Kentucky and the Pueblo Chemical Agent-Destruction Pilot Plant (PCAPP) in Colorado. BGCAPP will destroy the chemical munitions stockpile at the Blue Grass Army Depot (BGAD). PCAPP will destroy the stockpile at the Pueblo Chemical Depot (PCD). The DoD approved chemical agent neutralization as the primary destruction technology (treatment) for the chemical weapons. Neutralization will generate large quantities of hydrolysate, a secondary waste. BGCAPP is currently designed to post-treat hydrolysates using supercritical water oxidation (SCWO); the PCAPP post-treatment technology is biotreatment in immobilized cell bioreactors (ICBs).

Since the plant technologies were selected, overall budget limitations and increases in plant life cycle cost estimates (LCCEs) have prompted the PM ACWA to examine various options for reducing costs—ranging from design improvements, to reduced plant size, to shipping ACWA hydrolysates to offsite commercial Treatment, Storage, and Disposal Facilities (TSDFs) for further treatment, as required, and final disposal. The latter option would involve foregoing SCWO treatment of agent and energetics hydrolysates at BGCAPP and/or foregoing biotreatment of agent hydrolysate at PCAPP.

1.2 Objective of Study

The objective of this study is to determine the impacts on overall life cycle costs and schedules from disposal of BGCAPP and PCAPP hydrolysates at offsite, commercial TSDFs. The impacts on life cycle costs and stockpile destruction schedules are to be determined as a function of when such a decision is made. This study also assesses the effects on public safety associated with changes in the duration of stockpile storage and provides some perspectives on the local community risks of hazardous material shipments.

PM ACWA plans to use the results of this study to support a decision regarding *onsite treatment* or *offsite disposal* of ACWA hydrolysates. This decision, while considered in the past, is being reexamined by PM ACWA because of more up-to-date technical and economic information, as well as a more comprehensive view of stakeholder perspectives.

1.3 General Analytical Approach

Figure 1-1 provides an overview of the Noblis approach for conducting this assessment of the offsite treatment and disposal of ACWA hydrolysates. Data was collected from PM ACWA, contractors, and stakeholders. In addition, Noblis conducted a limited market survey of TSDFs to determine market conditions for offsite disposal. Noblis analyzed life cycle schedule and cost information related to the approved Acquisition Program Baseline (APB), as well as a proposed Acceleration Assessment option.

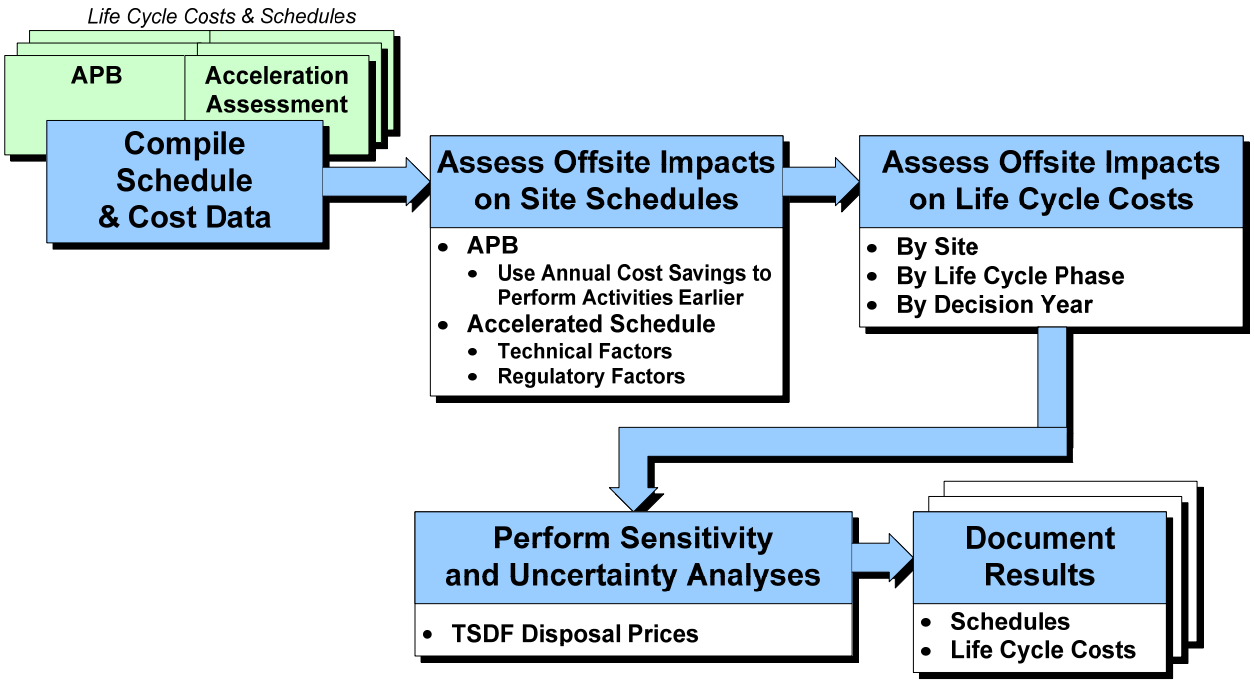


Figure 1-1. General Approach to the Study

For both the APB and proposed Acceleration Assessment cases, Noblis identified the BGCAPP and PCAPP site changes and process equipment that would be eliminated as a result of offsite hydrolysate disposal. The schedule impacts address implications from funding constraints, as well as technical and regulatory factors. The cost impacts reflect reductions in facility size, elimination of equipment, and reduced operating and maintenance (O&M) costs. To determine the impacts of uncertain market conditions, Noblis also performed sensitivity (breakeven) analyses on the TSDF price for treating and disposing ACWA hydrolysates offsite.

1.4 Report Organization

The remainder of this report contains five sections and a set of appendixes. Section 2 describes the hydrolysate treatment systems currently planned for BGCAPP and PCAPP and characterizes the ACWA hydrolysates that would be generated at those facilities. This section also summarizes potential opportunities for using commercial TSDFs as an alternative to treat and dispose of the hydrolysates. Stakeholder perspectives are summarized in Section 3. The impacts on BGCAPP and PCAPP schedules and costs for both the APB and proposed Acceleration Assessment cases are presented in Section 4. A discussion of stockpile storage risk is provided in Section 5. This section also contains a preliminary evaluation of the factors affecting local community risk from hazardous material shipments. The report concludes with major study findings in Section 6.

Appendix A summarizes the meetings that Noblis held in December 2007 with stakeholders in Kentucky and Colorado regarding the offsite disposal of ACWA hydrolysates. Appendix B provides supporting information on the analysis of hazardous material shipments.

2 Generation and Treatment of Hydrolysates

Offsite disposal of ACWA hydrolysates reduces BGCAPP and PCAPP equipment, facilities, and labor, as well as reduces the overall project and process complexity. The following section describes the basic BGCAPP and PCAPP processes for destroying chemical weapons and some insight into the changes to those processes resulting from the offsite disposal of hydrolysates. It also provides information on what hydrolysate is (and is not) as well as the available offsite, commercial disposal process options and their disposal price.

Information provided in this section assumes some preexisting knowledge of the U.S. Army's chemical demilitarization programs. For additional information on chemical weapons, the destruction processes, and other programmatic details, see the ACWA website, at www.pmacwa.army.mil, and the Chemical Materials Agency (CMA) website, at www.cma.army.mil.

2.1 ACWA Chemical Weapons Destruction Processes

Chemical weapons destruction processes consist of equipment, or "unit operations," designed to safely destroy the chemical agent. In simplified terms, these operations can be subdivided into four categories:

- **Pre-Treatment:** Prepares feeds and materials for the treatment technologies by accessing the chemical agents, physically reconfiguring, and/or segregating. This is also sometimes referred to as "accessing."
- **Treatment:** Detoxifies chemical agents and deactivates energetic materials (explosives).
- **Post-Treatment:** Changes the chemical nature of waste streams from treatment to remove any remaining hazardous characteristics.
- **Effluent Management:** Changes the physical nature of waste streams to allow final disposition.

Chemical munitions represent the primary feed to these destruction facilities. Agent and energetic components are segregated from other hardware for treatment in separate unit operations or, in the case of uncontaminated energetics, may be sent offsite for disposal. Pre-Treatment and Treatment operations are typically conducted in facilities with special engineering controls to contain agent and any accidental explosion. After Treatment, the agent has been destroyed, so any further operations can be conducted using standard, industrial facilities. The ACWA neutralization treatment processes produce hydrolysates, which will be processed by SCWO at BGCAPP and biotreatment at PCAPP. This study examines an alternative of sending these hydrolysates to offsite disposal processes at commercial TSDFs that specialize in hazardous waste disposal.

Process Bases

The following discusses the design bases and the changes resulting from offsite hydrolysate disposal that are used for the cost and schedule assessments later in this report. There are three, different processes considered as part of this study:

- **Current APB (2007 Design):** Approved by the DoD in accordance with the 2007 APB. This design uses neutralization process with effluent management processes onsite.
- **Proposed Acceleration Assessment (2008 Design):** Proposed option that represents changes to the current APB design (2007) targeting an agent destruction deadline of 2017.
- **Offsite Hydrolysate Disposal (Offsite Design):** Conceptual processes based on sending hydrolysates offsite, allowing for the removal of post-treatment and effluent management operations associated with onsite hydrolysate disposal.

Simplified Block Flow Diagrams (BFD) representing the major steps for these three processes are shown side-by-side for BGCAPP and PCAPP in Figure 2-1. Process units (blocks) and streams that are eliminated as a result of the Acceleration Assessment option and as a result of offsite hydrolysate disposal are shaded out. The black boxes indicate where, in the process, the hydrolysates are generated.

Proposed Acceleration Assessment Case

For the Acceleration Assessment case, Noblis assumed that the Explosive Destruction Technology (EDT) facility will be implemented at BGCAPP for processing the 155-mm mustard artillery shells and the Non-Contaminated Rocket Motor (NCRMs), as shown and annotated in Figure 2-1. The primary equipment and facility changes resulting from this include removal of mustard-processing equipment in the Projectile Handing System (PHS) from the Munitions Demilitarization Building (MDB), the addition of an EDT Facility, and the corresponding adjustment of the associated process streams. These, and other, changes have already been factored into the Acceleration Assessment case. Although a specific EDT has not been selected, candidates have been identified as part of other ACWA studies, which provided a reliable cost allowance for the life cycle cost estimates. The Accelerated Assessment case also has process equipment changes to PCAPP, but these relate only to increasing the capacity of the Biotreatment Area (BTA) to support the associated increase in processing rate and the corresponding adjustment of the associated process streams.

Process Changes for Offsite Hydrolysate Disposal

Offsite hydrolysate disposal would result in significant equipment and facility changes to both sites since, for the most part, nearly the entire post-treatment and effluent management unit operations are eliminated. These modifications are used in the cost and schedule assessments of this report. The primary equipment and facilities changed are listed in Table 2-1. The affect of these changes on the site layout are also illustrated in Figure 2-2 for BGCAPP and Figure 2-4 for PCAPP. Detailed views of the post-treatment processes that would be eliminated are shown in Figure 2-3 for BGCAPP's SCWO Processing Building (SPB) and in Figure 2-5 for PCAPP's BTA.

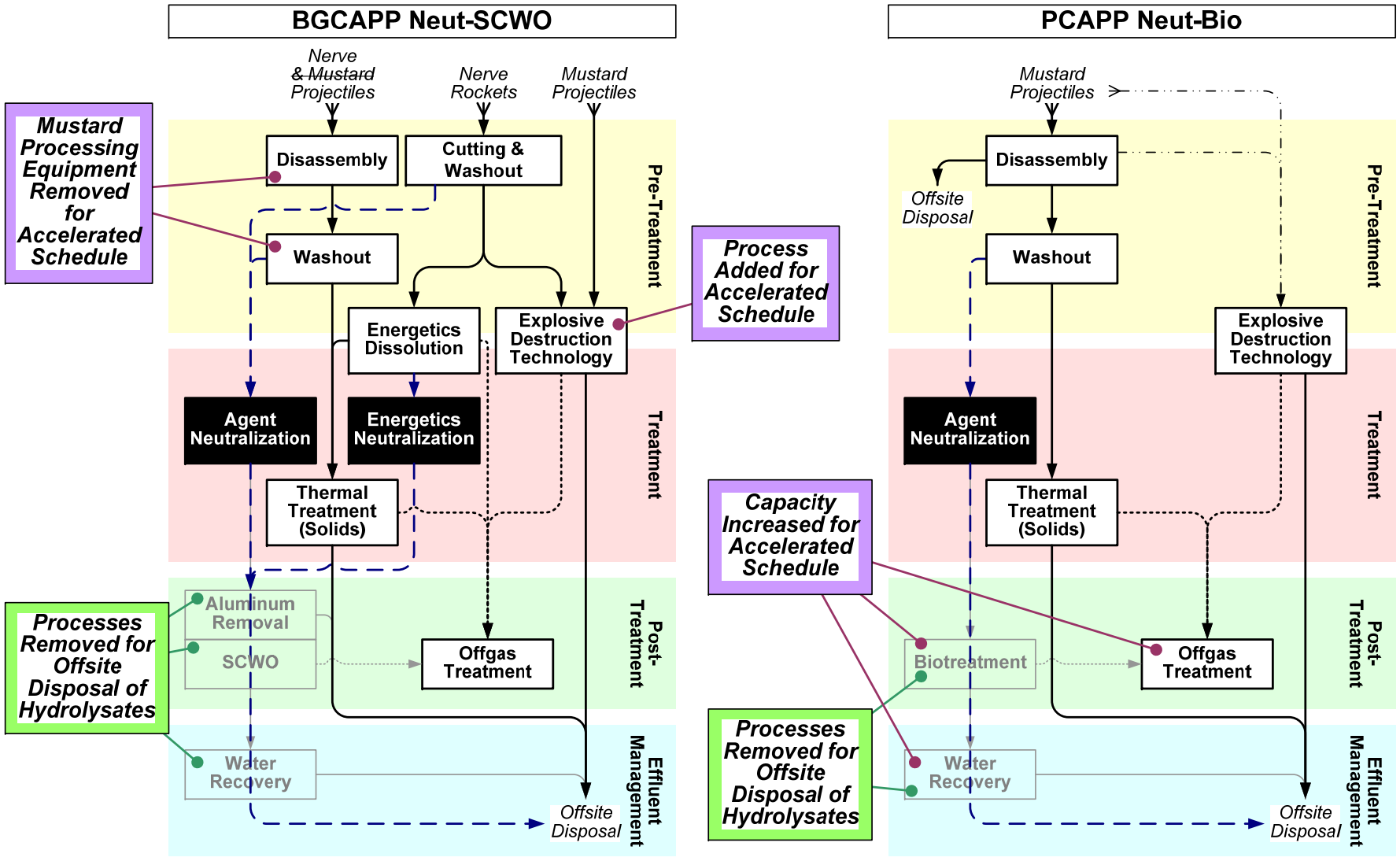


Figure 2-1. BGCAPP & PCAPP Process Changes for Acceleration Assessment and Offsite Hydrolysate Disposal (Simplified Block Flow Diagrams)

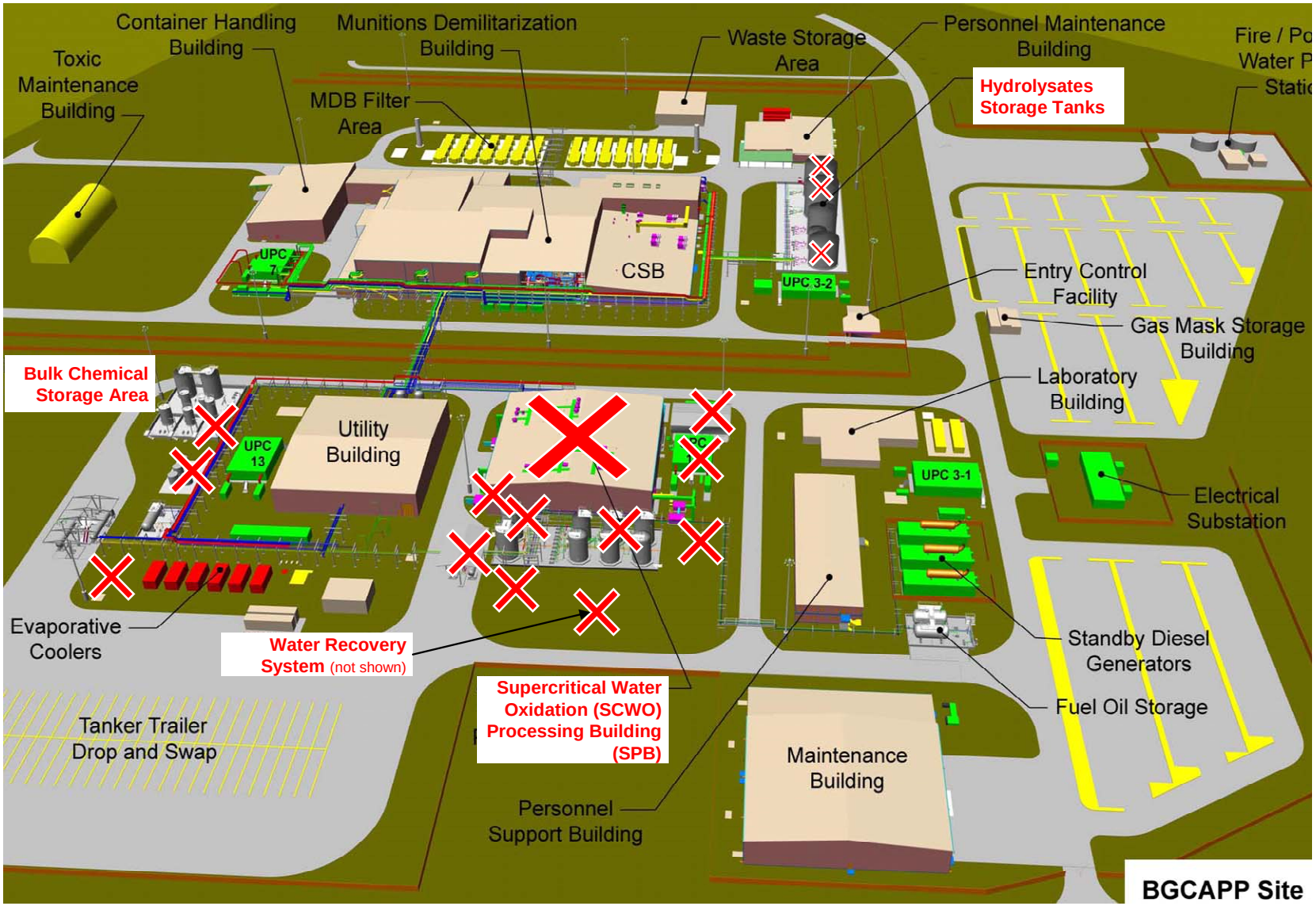


Figure 2-2. BGCAPP Site Layout – Facility Changes Due to Offsite Disposal of Hydrolysate

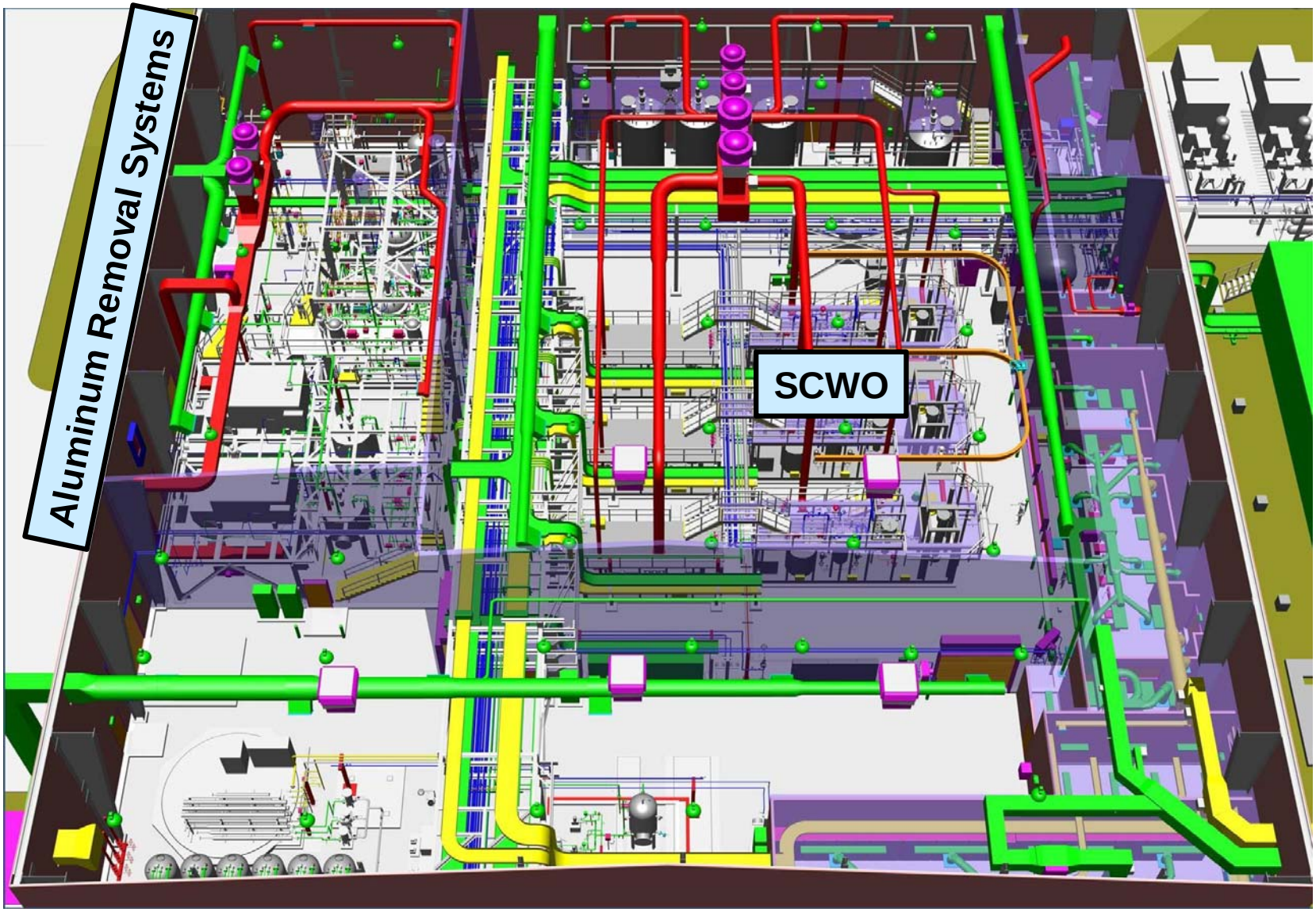


Figure 2-3. BGCAPP SCWO Processing Building (SPB) Detail (Removed Due to Offsite Disposal of Hydrolysate)

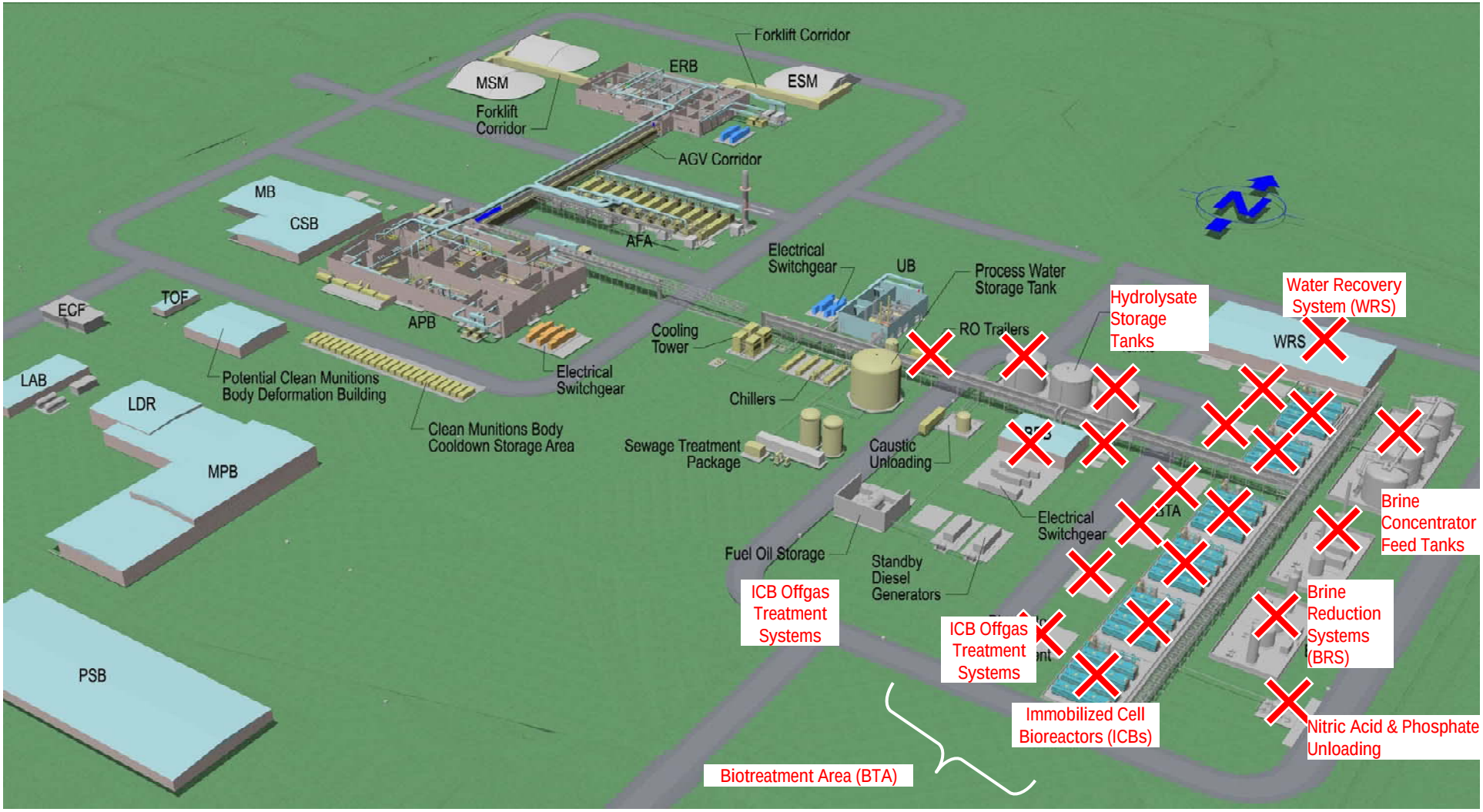


Figure 2-4. PCAPP Site Layout – Facility Changes Due to Offsite Disposal of Hydrolysate

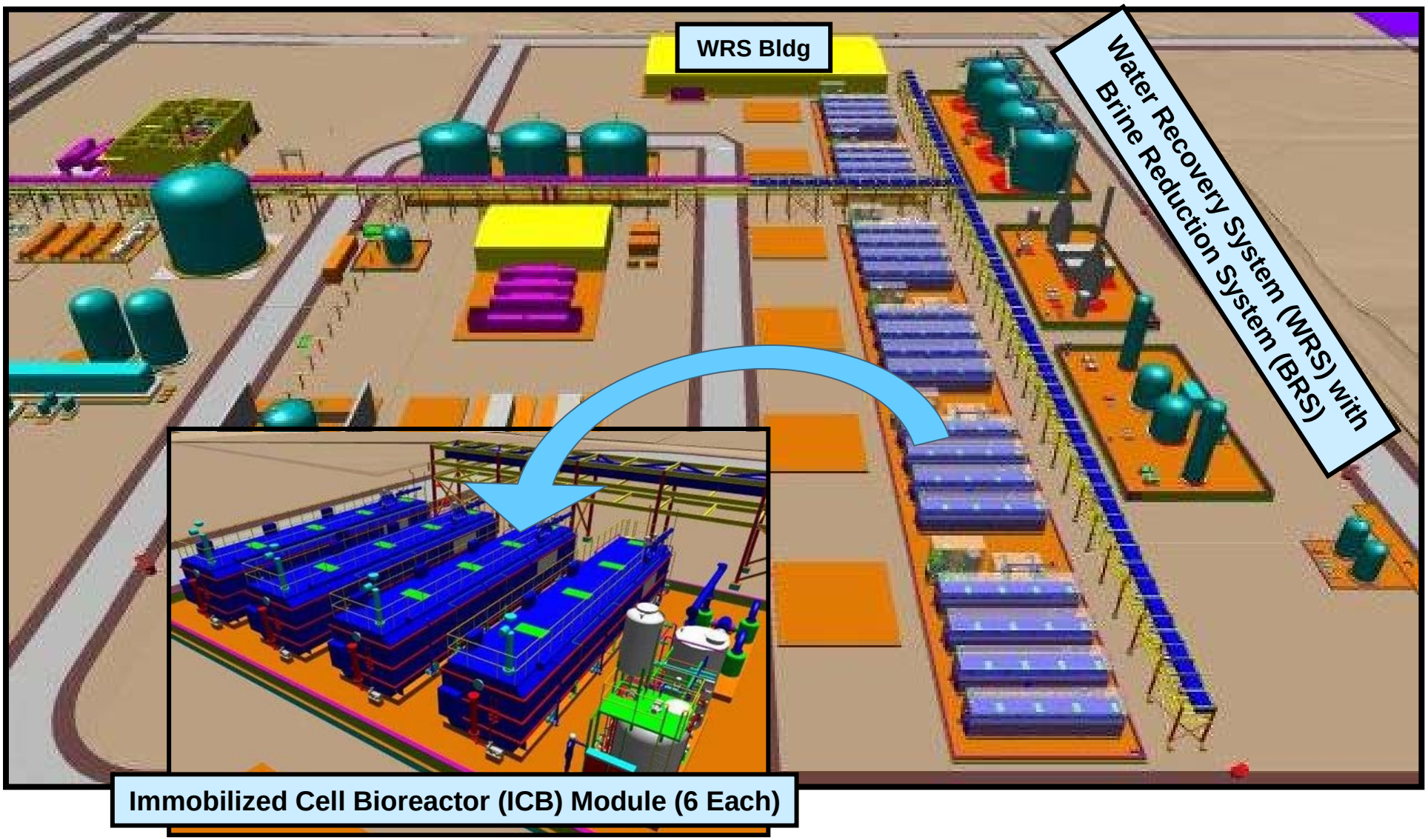


Figure 2-5. PCAPP Biotreatment Area (BTA) Detail (Removed Due to Offsite Disposal of Hydrolysate)

As shown in these figures, a significant portion of the site would no longer be used. However, it should be noted that the most complex (and expensive) part of the plant resides in the Pre-Treatment and Treatment portions of the facility, where munitions, chemical agent, and energetics are processed, not the Post-Treatment and Effluent Management areas. The processes are all designed with buffering to minimize the impact of potential delays and downtimes on the operations schedule. For example, the Hydrolysate Storage Areas (HSAs) have a buffer capacity of 30 days to mitigate the effect of Treatment or Post-Treatment downtimes. In addition, these facilities, on the whole, are very complex. Any reduction in complexity makes them more manageable, with possible intangible benefits, and better allows PM ACWA to focus on the primary mission—the safe destruction of lethal chemical agents.

Table 2-1. Process Changes for Offsite Hydrolysate Disposal – Unit Operations Eliminated, Added, and Downsized

Type of Change	Site	
	BGCAPP	**PCAPP**
Eliminated:	• Aluminum Precipitation System (APS) and Aluminum Filtration System (AFS) • Supercritical Water Oxidation (SCWO) and SCWO Processing Building • Water Recovery Systems (WRS)	• Immobilized Cell Bioreactor (ICB) modules and corresponding Biotreatment Offgas Treatment Systems (OTS) • Biotreatment Area (BTA) Support and Infrastructure • Water Recovery Systems (WRS)
Added:	• Hydrolysate Loading Station • Hydrolysate Storage Tank at TSDF	• Hydrolysate Loading Station • Hydrolysate Storage Tank at TSDF
Downsized:	• Bulk Chemical Storage (BCS) • Hydrolysate Storage Area (HSA) • Residue Handling Area (RHA) • Balance of Plant*	• Bulk Chemical Storage (BCS) • Hydrolysate Storage Area (HSA) • Residue Handling Area (RHA) • Balance of Plant*

** - General Process Equipment and Materials; Infrastructure, etc.*

2.2 Offsite Disposal

Offsite disposal of hydrolysates must be conducted by permitted TSDFs. Noblis conducted a market survey to establish TSDF availability and the market price for hydrolysate disposal. The market price includes two cost factors: transportation and TSDF disposal. In conducting the survey, Noblis collected data, compiled hazardous waste profiles, prepared a questionnaire, and then identified and contacted TSDFs. Candidate TSDFs were identified by capability (which is a function of technology), capacity, and permitting, as well as by a clear willingness to accept the waste. Three commercially-available technologies currently appear to be candidates for offsite disposal of ACWA hydrolysates: deep-well injection, biotreatment, and incineration.

2.2.1 Approach

Noblis conducted a limited market survey for offsite disposal of the PCAPP and BGCAPP hydrolysates to ensure that the range of costs used in this assessment are reasonable and realistic,

and to ensure there was a firm willingness to accept the wastes. Due to non-disclosure agreements and vendor confidentiality, any individual responses provided by the TSDFs must be withheld from this report.

Several literature searches were conducted to collect information relevant to hydrolysate characterization, previous market surveys, the ACWA Technical Risk Reduction Program (TRRP), previous life cycle cost estimates, and current offsite disposal activities employed by CMA.

2.2.2 Hydrolysate Characterization

The ACWA hydrolysates are considered hazardous wastes in Kentucky and Colorado due to the derived-from rule, which governs residues resulting from treatment, storage, and disposal of hazardous waste—in this case, the chemical warfare material (CWM) at each site. In addition, they are likely to be assigned toxicity characteristics based on their composition. TSDFs base their acceptance (and much of their disposal price) of wastes on the material's hazardous waste profile, which characterizes the chemical compounds in the waste. Noblis compiled Hazardous Waste Profiles for each hydrolysate using data obtained from various sources. Chemical characterization data available at this time for the ACWA hydrolysates was detailed and accurate enough for the TSDFs to provide reliable disposal prices.

Hydrolysate is a byproduct of the BGCAPP and PCAPP neutralization processes. BGCAPP will generate three hydrolysates—GB, VX, and warhead/energetics—while PCAPP will only generate mustard hydrolysate. The processes detoxify the chemical agents and deactivate the energetics using a treatment recipe, which is verified by sampling and analysis of the hydrolysate after treatment. After treatment, the hydrolysate is no longer chemical warfare materiel or explosive. The recipes used also ensure it is not flammable.

Prior to contacting the TSDFs, Noblis reviewed previous offsite chemical weapons waste disposal activities and market surveys. Next, Noblis compiled Hazardous Waste Profiles, which have a somewhat standardized content that provides the waste's physical and chemical characteristics, as well as a variety of general information. Noblis generated four, separate hydrolysate profiles: mustard, GB, VX, and warhead (energetics). Official chemical compositions had recently been published for GB and VX, but Noblis had to generate compositions for mustard and warhead hydrolysates. This was accomplished by merging all constituents to ensure everything that might be present was accounted for. From this, Resource Conservation and Recovery Act (RCRA) Hazardous Waste Codes were identified. The results are shown in Table 2-2.

As shown in Table 2-2, the quantities generated for the four hydrolysates vary notably, with a total of approximately 10.75 million gallons. The hydrolysates are primarily water with mostly dissolved organic and inorganic chemicals, as well as a notable amount of dissolved solids. There were no RCRA Listed HW (Hazardous Waste) Codes (F, K, P, U) and very few RCRA Characteristic HW Codes. Due to the fact that GB, VX, and energetics are treated using concentrated caustic (sodium hydroxide), their resulting hydrolysates are expected to have a pH greater than 12.5, indicating a RCRA characteristic hazardous waste code of D002 (corrosive).

Figure 2-6 shows how the ACWA hydrolysates compare to some common industrial and household chemicals.

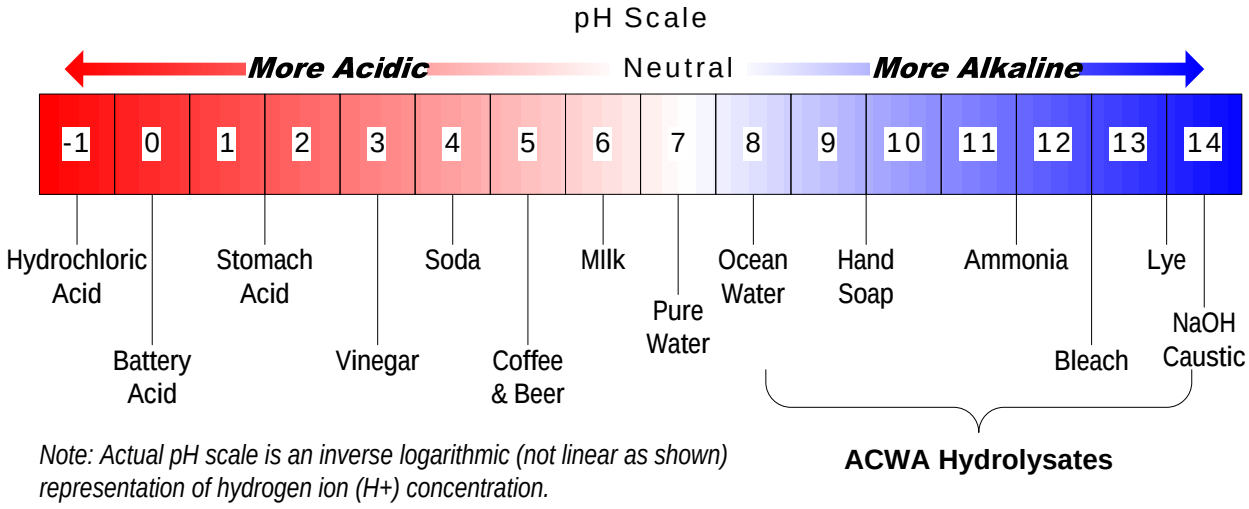
Table 2-2. Hydrolysate Characteristics

Hydrolysate	Approximate Quantity (gallon)	Estimated Approximate Composition in Aqueous Solution [(a)]			RCRA Codes [(b)]
		Solids	Organics	Inorganics	
GB	920,000	13% (99% dissolved)	11% (mostly salts)	6% (mostly sodium & phosphorus)	D002 D004
VX	158,000	21% (>99% dissolved)	18% (15% Dissolved; <3% Layered)	14% (mostly sodium & phosphorus)	D002
Warhead/ Energetics	1,569,000	74% (95% Dissolved) (mostly aluminum compounds)	22% (mostly sodium compounds)	7% (mostly sodium compounds)	D002 D006 D007 D008
Mustard	8,100,000[(c)]	18% (95% Dissolved)	5% (mostly thiodiglycol)	26% (mostly salts)	D007 D008 D028

(a) From Noblis' Hazardous Waste Profiles. Note: Solids percentage includes solid organics and inorganics, with the balance as water.

(b) RCRA Characteristic Hazardous Waste Codes: D002 = pH <0.2 or >12.5; D004 = >5 PPM arsenic; D006 = >1 PPM cadmium; D007 = >5 PPM chromium; D008 = >5 PPM lead; D028 = > 0.5 PPM 1,2-dichloroethane

(c) PCAPP only. BGCAPP mustard munitions are processed in the EDT (no hydrolysate) for the Acceleration Assessment case.



Note: Actual pH scale is an inverse logarithmic (not linear as shown) representation of hydrogen ion (H+) concentration.

Figure 2-6. pH Scale Showing Hydrolysates and Common Industrial and Household Chemicals

2.2.3 TSDF Technology Research

In 2006 Noblis researched technologies available for treating and disposing of hydrolysates offsite at commercial TSDFs; that study included the potential for using SCWO and biotreatment, the ACWA-certified technologies for treating agent and energetics hydrolysates, as well as wet-air oxidation, deep-well injection, and incineration. The 2006 study concluded that biotreatment, deep-well injection, and incineration were the only commercially-available technologies with sufficient capacity to treat hydrolysates from BGCAPP and PCAPP. As discussed below, the current market survey undertaken by Noblis had similar findings.

Market Survey

Noblis considered several factors when generating the list of TSDF candidates for the survey—foremost of which was the experience and capacity of the facility to handle the volume of hydrolysates produced by BGCAPP and PCAPP. Noblis contacted TSDFs via telephone and/or email. A questionnaire and the hazardous waste profiles were provided to each candidate company. Noblis explained the purpose of the survey to representatives of the facilities and explained the need for rough-order-of-magnitude cost estimates for the disposal service. It was also noted that the price should reflect different components such as transportation, pretreatment/disposal, surcharges, and ancillary expenses (e.g., outreach, legal, treaty). Noblis was explicit in its communication that this was not a formal request for price quote, and that no commitment was implied when responding to the survey. Finally, Noblis made commitments with the TSDFs that all information provided would be kept completely confidential.

The price per gallon for shipping and disposing of the ACWA hydrolysates is shown in Table 2-3 for the TSDFs that provided pricing information. Of major note is that the price varies widely by technology. However, individual TSDF disposal prices were the same (or very near the same) per gallon regardless of the hydrolysate (GB, VX, or warhead/energetics). All the TSDFs emphasized that the hydrolysates did not pose any major technical challenges for their disposal technology. The hazardous waste profiles compiled by Noblis were comprehensive, and based on questions from the TSDFs it appears that the facilities reviewed them adequately before pricing. Only one biotreatment TSDF responded, and they were only willing to consider the (PCAPP) mustard hydrolysate. As noted in Table 2-3, there was a wide variance in disposal prices for the incineration technology.

Table 2-3. Market Survey – ACWA Hydrolysate TSDF Disposal Market Price by Technology

	Current Year (CY08$) Market Price per Gallon			
Cost Element	**Deep-Well Injection**	**Biotreatment (Mustard Only)**	**Incineration**	
Transportation	$2	$2	$2	$2
Disposal	$1	$10	$15	$40
Total Price	**$3**	**$12**	**$17**	**$42**

Other associated costs, however, were not clearly defined by these facilities. For example, transportation costs, which include shipping and various required surcharges (such as demurrage, recovery fee, taxes, container cleaning) were provided piecemeal, thus Noblis developed a composite $2 price per gallon, conservatively based on the information provided. Ancillary costs (e.g., permitting, outreach), although requested, were not always provided in the responses. However, based on those who provided this information, ancillary costs are likely to be a component of overall disposal costs, but are expected to be a very small fraction of the total cost per gallon.

Some observations made by Noblis during the market survey include:

- **Technologies:** No new technologies have been introduced by the TSDFs applicable to disposal of the ACWA hydrolysates—deep-well injection, biotreatment, and incineration remain the base technologies.
- **Availability:** TSDFs are available, capable, and some are willing to accept the ACWA hydrolysates; however, the availability of TSDFs has been erratic and is expected to remain so in the future.
- **Price:** Compared to previous disposal prices (actual and quoted) related to Army liquid secondary wastes, deep-well injection remains in line with previous prices. Some incineration prices are much less while biotreatment and other incineration prices are much higher than previously observed.

Of the factors discussed above, availability and willingness pose the most uncertainty for treating and disposing of the ACWA hydrolysates at an offsite, commercial TSDF. This is primarily because the hydrolysates will not be produced for another 6 or more years. In general, the availability of TSDFs to dispose of hydrolysates is not in question—it is Noblis' position that some type of hazardous waste facility will be available when needed for the ACWA hydrolysates. However, whether all the technology options cited above will still be available is less certain. Similarly, the willingness of a particular TSDF may also change—some may decide not to accept the waste, while others may agree to accept it

Future Availability

TSDF commercial permanence is uncertain for various reasons. TSDFs have gone bankrupt and/or have been bought out by competitors—some have closed, some remain open. Some TSDFs previously open for commercial waste disposal are no longer accepting wastes from third parties. Regulatory laws change, as does their favor in the political arena. There may be more uncertainty with the future availability of deep-well injection or biotreatment than incineration, simply because there were fewer TSDF candidates with these technologies. However, Noblis could not identify any factors that would preclude any of these technologies as TSDF candidates for the ACWA hydrolysates. While there is no guarantee that a particular TSDF will be available when needed in 6 to 12 years for ACWA hydrolysates, it is Noblis' judgment that some suitable type of TSDF technology will be available.

TSDF Willingness

Intense stakeholder opposition can inhibit the willingness of a TSDF to accept a waste for disposal. As was observed during Noblis' market survey, some TSDFs are reluctant (or declined) to get involved with a market survey for chemical agent hydrolysate disposal, let alone actually consider accepting the waste. Their reservations are based on previous opposition, primarily CMA's experience of trying to dispose of the VX hydrolysate from the Newport Chemical Agent Disposal Facility (NECDF). TSDFs that understand the implications that come with accepting the ACWA hydrolysates are likely to provide more realistic cost estimates. Those used for the Noblis assessment seemed well aware of the issues.

3 Stakeholder Perspectives

As part of this study, Noblis considered input from a variety of stakeholders in Colorado and Kentucky. In December 2007, Noblis conducted a series of interviews with more than 40 stakeholders representing approximately 25 organizations (see Appendix A). In addition, all stakeholder comments discussed previously with Noblis in 2006[1] were also considered and incorporated into this current study. In cases where specific stakeholders expressed different views in 2006 and 2007, the more recent comments were given appropriately greater weight. Stakeholder views can influence the PM ACWA program in three ways: political, regulatory, and litigious.

These discussions were intended primarily to assess the impacts of stakeholder views on cost and schedule; the purpose was not to determine the degree to which the local community supports onsite or offsite treatment. Therefore, these discussions may not reflect an accurate picture of overall community sentiment. In general, there is no consensus of opinion among the stakeholders. Stakeholders' perspectives are driven by a broad range of underlying factors (e.g., regulatory requirements, jobs, expeditious destruction of stockpile, transportation risk). While many stakeholders accept offsite disposal of hydrolysate, some opposition does exist. The discussion in this section focuses on stakeholders concerns.

Noblis' interviews with elected officials at various levels suggest that there could be political opposition to offsite treatment and disposal of hydrolysates. Congressional staff members from both Colorado and Kentucky communicated opposition to offsite disposal of hydrolysates. In early 2008, similar bills were introduced by Sen. Kenneth Salazar of Colorado and by Rep. John Salazar of Colorado, cosponsored by Rep. Udall of Colorado and Rep. Chandler of Kentucky, to prohibit the transport of hydrolysate from PCAPP or BGCAPP to an offsite location for treatment, storage, or disposal. In addition, key Madison County, KY, officials, including the County Judge-Executive, are opposed to offsite treatment of the hydrolysate produced at BGCAPP. The Madison County government has considerable influence at the State level, and opposition by county officials has the potential to lead to changes in State laws or regulations, which could effectively mandate onsite treatment of hydrolysate. The impact of such legislative changes is difficult to predict, and so is not covered in the cost and schedule analysis of this report. Nevertheless, it should be considered qualitatively in any decision on the offsite disposal of ACWA hydrolysates.

In addition, Kentucky law requires that the Madison County Judge-Executive certify that the infrastructure improvements identified in the Emergency Response Plan be complete and that the Community Liaison position is filled before BGCAPP can begin operations. All critical shortcomings in the Emergency Response Plan must be resolved before operations begin. Although such local issues have the potential to cause schedule delays, that potential is judged less significant and the delays shorter than those associated with the regulatory issues.

---

[1] Noblis (formerly Mitretek Systems), *Analysis of Off-Site Treatment of Hydrolysates from Chemical Agent-Destruction Pilot Plants*, Mitretek Technical Report (MTR 2006-22), December 2006.

Many stakeholders would accept the offsite treatment and disposal of ACWA hydrolysates, but some opposition is inevitable. The most likely ways in which stakeholder opposition can directly impact the schedules and costs involve litigation of the Certificate of Designation (CD) for PCAPP and the RCRA permitting process for BGCAPP. Another potential way for opposed community members to impact the schedule is through litigation in Federal court under environmental laws. However, Federal courts are less likely to issue injunctions, thus limiting the schedule impact of such litigation. In addition, it seems likely that any injunction would at most prohibit the shipment of hydrolysate from PCAPP or BGCAPP to a TSDF, as was the case during hearings associated with shipments of hydrolysate from the NECDF. For purposes of the schedule and cost analyses, the uncertainty due to environmental litigation is assumed less than the uncertainty associated with the CD litigation and RCRA permitting issues discussed above.

For the community members who were opposed to offsite disposal of ACWA hydrolysates, a common theme was their perception that onsite hydrolysate treatment, although not free from technical risk, was under the control of PM ACWA and state regulators, and was relatively immune to outside pressure. In contrast, they viewed offsite hydrolysate disposal as subject to pressure from communities through which hydrolysate would be transported or the community in which it would be treated, thus allowing these outside communities to slow or stop the process. This leads to a rather unusual position that can be described as "I want to treat it in my backyard," in contrast to the clichéd "not in my backyard." Specific major stakeholder concerns include waning public trust, at least in some quarters. This loss of trust is, in part, the result of actions outside of PM ACWA, *e.g.*, groundwater contamination at PCD that is a legacy of conventional munition operations conducted years ago and the treatment of whistleblower cases, some very recent at BGAD. Nevertheless, this loss of trust impacts PM ACWA because many stakeholders make little, if any, distinction between different organizations within the DoD.

The potential loss of jobs from pursuing offsite hydrolysate disposal remains a concern, particularly at PCAPP where the memory of losing about one-third of the local jobs in 1982 remains with business and political leaders. Stakeholders expressed considerable misunderstanding and confusion about the various project schedules that have been put forward since 2006. Some stakeholders were also concerned about the effect of the shifting political landscape.

In their conversations, many (although by no means all) stakeholders suggested that more public education and outreach are needed if the offsite hydrolysate disposal option is selected. These stakeholders want to know more about ACWA hydrolysates: What is it? How toxic is it? They also wanted an understandable analysis of the risks posed by hydrolysate transportation. Some stakeholders perceive that offsite hydrolysate disposal would increase the transportation safety risk, although their assessment of the magnitude of the impact appears to differ. (Note: some of the factors for such an analysis are covered in Section 5.2 of this report.)

4 Schedule and Cost Impacts

This section presents the impacts on BGCAPP and PCAPP life cycle schedules and costs for a decision to treat and dispose of hydrolysates at an offsite, commercial TSDF. Noblis assessed the impacts on life cycle schedules and costs for both the APB and the proposed Acceleration Assessment cases.

Caution must be taken ***not*** to directly compare results between the APB and proposed Accelerated Assessment cases because of the differences in designs, funding, and assessment methodologies.

4.1 Acquisition Program Baseline

The currently approved stockpile destruction schedules maintain the ACWA program on its current track under the April 2007 Acquisition Program Baseline (APB) and the Fiscal Year 2009 (FY09) President's Budget. Based on the APB schedules to meet funding guidance, complete stockpile destruction is slated for Kentucky in 2023 and for Colorado in 2020. One of the most notable features of the schedules is the plan for operations on a 4-day on and 4-day off destruction operations schedule.

4.1.1 Analytical Approach for the APB Cases

Noblis used a top-down approach to estimate the impacts on life cycle schedules and costs from disposing of hydrolysates offsite. The sooner the decision is made, the more potential savings may be realized; especially if procurement of long-lead items associated with the onsite hydrolysate treatment systems can be avoided. The basic approach to the cost analysis is to accelerate schedule by allocating funds (limited by funding guidance) to activities from future years. For the offsite disposal option, the funds not spent for the hydrolysate treatment systems (e.g., SPB or BTA) are used to accelerate work in other areas. For example, assuming an offsite decision is made in early FY09, the FY09 cost savings for the SPB or BTA are used to accelerate work on other parts of the plant. Some work originally planned in FY10 may also be performed in FY09 as long as FY09 funding guidance is not exceeded. This is illustrated in Figure 4-1.

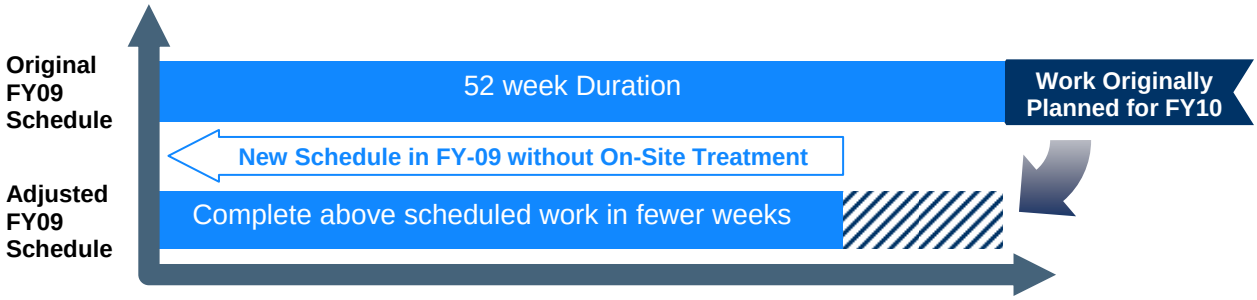


Figure 4-1. Use of Cost Savings to Shorten APB-Based Schedules

Treating and disposing of hydrolysates offsite affects life cycle costs in many ways, as shown in Table 4-1. These adjustments formed the basis for assessing the overall impacts on life cycle costs at BGCAPP and PCAPP. The costs of treating and disposing of hydrolysates offsite are based on results from the TSDF market survey (see Section 2). TSDF disposal prices ranged from $3/gallon for deep-well injection, to $17-$42/gallon for incineration (all including $2/gallon transportation cost).

Table 4-1. Main Cost Adjustments Due to Offsite Disposal of ACWA Hydrolysates

Phase/Item	Adjustments
Design	Some redesign work will be necessary to remove the hydrolysate treatment systems (SCWO and BTA) from the designs
Construction	Eliminated materials, labor, and equipment costs for SCWO and BTA; added cost of truck loading pad for waste shipment; reduced cost related to the hydrolysate storage tanks as fewer tanks will be needed for the offsite disposal option; added salvage value for equipment purchased but not used
Systemization	Reduced cost to reflect the reduction in number of staff needed during systemization because of absence of post-treatment systems
Operations	Reduced labor cost to reflect the net reduction in number of staff and reduced other direct costs; increased costs for hydrolysate transportation and disposal
Closure	Reduced closure costs if post-treatment facilities (e.g., SCWO, biotreatment, water recovery, etc.) not built, or if built but not used; used savings to accelerate closure
Project Services	Adjusted cost to reflect the reduced number of staff required if there were no hydrolysate systems onsite
Site Program Management & Support	Applies only to BGCAPP—reduced power and water usage in the absence of SCWO

4.1.2 APB Results for BGCAPP

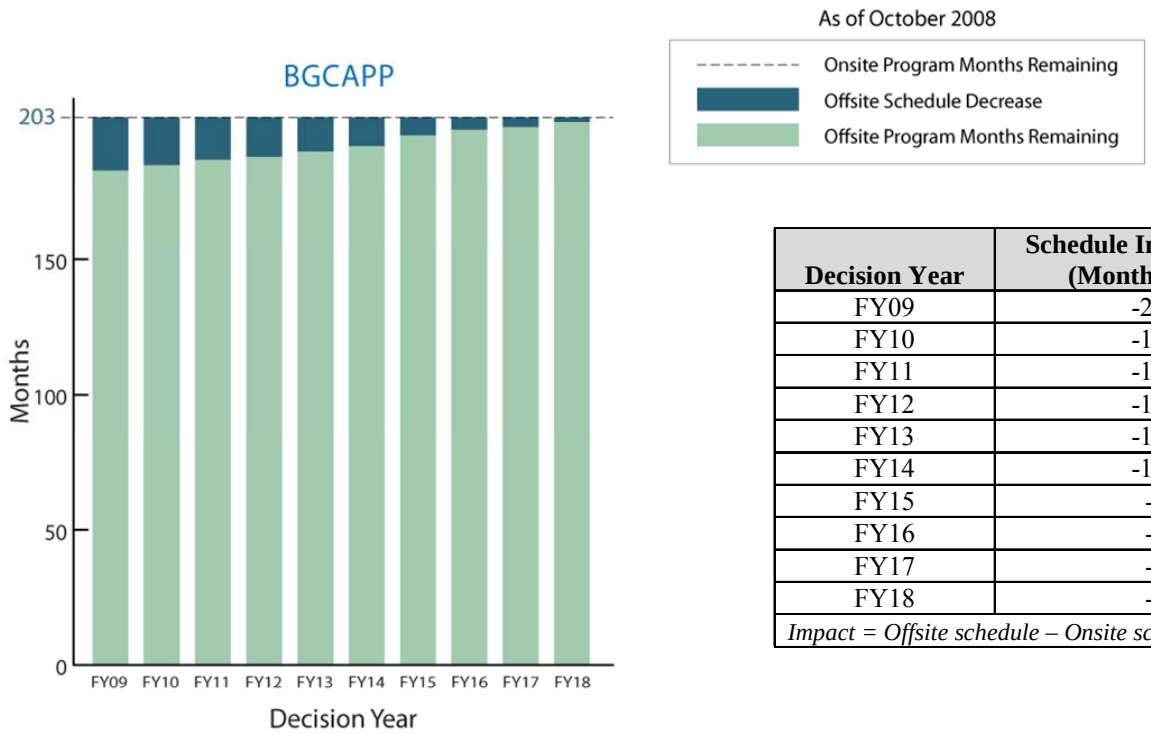
In conducting the analysis, Noblis used the APB-based design, schedules, and costs developed in early 2007. For BGCAPP, those included the following features:

- Facility designed and built for onsite treatment of hydrolysates using three SCWO reactors
- An operating schedule of 4-days on and 4-days off (operating 50% of the time over the long term), with the hydrolysate treatment systems operated continuously 7 days per week, 24 hours per day

Cost and schedule analyses were performed for decision years FY09 through FY18 (the year that operations start). Beyond FY18 there is little potential benefit expected at BGCAPP. If a decision to treat offsite is made in FY09, the resulting reduction in overall project duration is about 20 months. The change in BGCAPP schedule reflected by treating the hydrolysate offsite

is largely due to acceleration of planned work using funds that would have been otherwise intended for SCWO. The corresponding maximum cost savings are about $320 million (M) for a FY09 decision.[1]

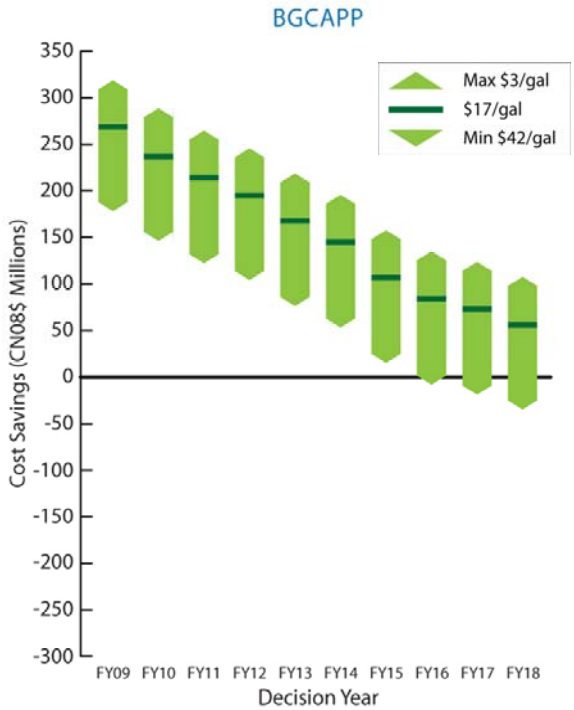
Figure 4-2 and Figure 4-3, respectively, indicate that there is a potential for schedule and cost savings relative to the APB onsite treatment option for offsite disposal decisions made in FY09 through FY15. Decisions made after FY15 may yield no cost savings if the higher disposal price for incineration must be paid. In general, the magnitude of cost savings diminishes over time because SCWO investments become less and less recoverable. Correspondingly, the ability to accelerate schedule also diminishes because of fewer funds available to reallocate.



Decision Year	Schedule Impact (Months)
FY09	-20
FY10	-18
FY11	-16
FY12	-15
FY13	-13
FY14	-11
FY15	-7
FY16	-5
FY17	-4
FY18	-2
Impact = Offsite schedule – Onsite schedule	

Figure 4-2. Offsite Impacts on APB-Based Schedule at BGCAPP

[1] *This finding contrasts with the 2006 Noblis study, which indicated little potential cost savings. The 2006 analysis was based on experience at NECDF where much higher TSDF disposal prices were paid to incinerate the hydrolysate.*



Decision Year	Cost Savings (CN08$ Millions)		
	Deep-Well Injection	Incineration	
	$3/gallon	$17/gallon	$42/gallon
FY09	320	270	180
FY10	290	240	150
FY11	270	210	120
FY12	250	200	100
FY13	220	170	80
FY14	200	150	50
FY15	160	110	20
FY16	140	80	-10
FY17	120	70	-20
FY18	110	60	-40

NOTE: Values rounded to the nearest 10 million. Positive value indicates cost savings; negative value indicates a cost increase.

Figure 4-3. Offsite Impacts on APB-Based Life Cycle Costs at BGCAPP

4.1.3 APB Results for PCAPP

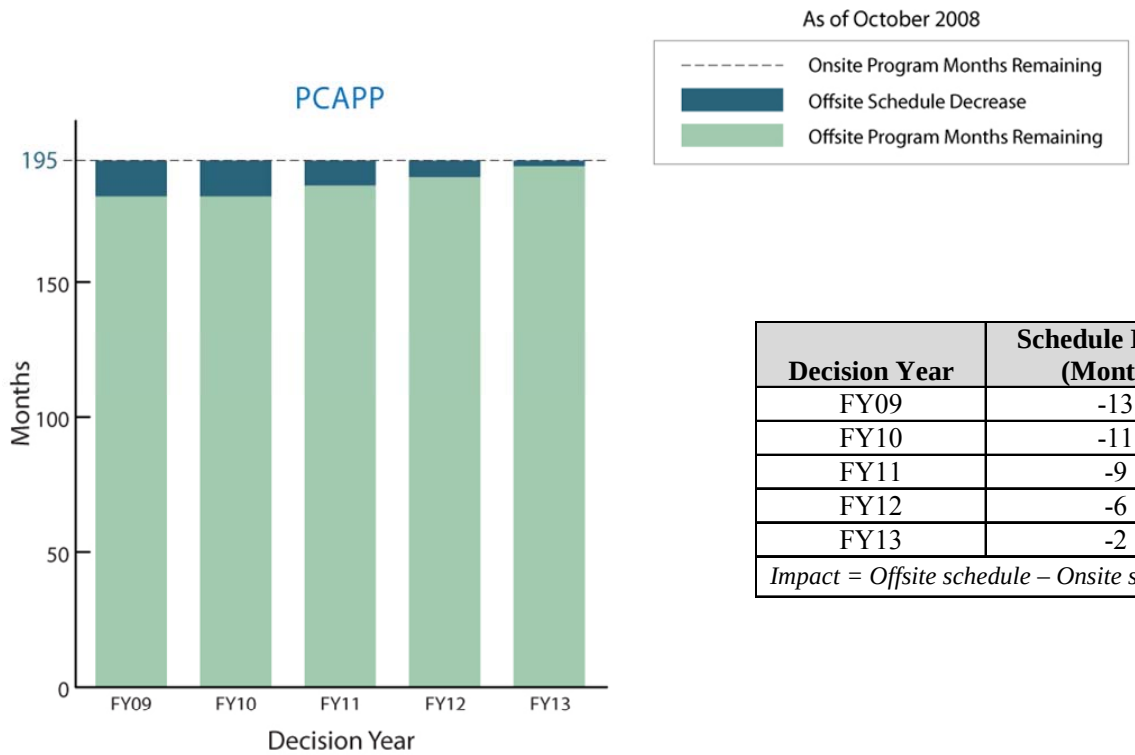
In conducting the analysis, Noblis used the APB-based design, schedules, and costs developed in early 2007. For PCAPP, those included the following features:

- Facility designed and built for onsite treatment of hydrolysates using biotreatment (12 immobilized cell bioreactors [ICBs]).
- An operating schedule of 4-days on and 4-days off (operating 50% of the time over the long term), with the hydrolysate treatment systems operated continuously 7 days per week, 24 hours per day

Cost and schedule analyses were performed for decision years FY09 through FY13, after which there are minimal potential schedule and cost savings. If an offsite disposal decision is made in FY09, the resulting reduction in overall project duration is about 13 months. The change in PCAPP schedule is largely due to acceleration of planned work using funds that would have been otherwise expended on the BTA. The corresponding maximum cost savings for an offsite decision in FY09 is about $190M.[1]

[1] *This finding contrasts with the 2006 Noblis study, which indicated little potential cost savings. The 2006 analysis was based on experience at NECDF where much higher TSDF disposal prices were paid to incinerate the hydrolysate.*

Figure 4-4 and Figure 4-5, respectively, show the potential for schedule and cost savings relative to the APB onsite treatment option for offsite decisions made in FY09 through FY13. Regardless of disposal technology, the magnitude of the cost savings diminishes over time because BTA investments become less and less recoverable as an offsite decision is delayed. Correspondingly, the ability to accelerate schedule also diminishes because of fewer funds available to reallocate. As shown in Figure 4-5, the potential for cost savings depends on the decision year and the TSDF disposal price.



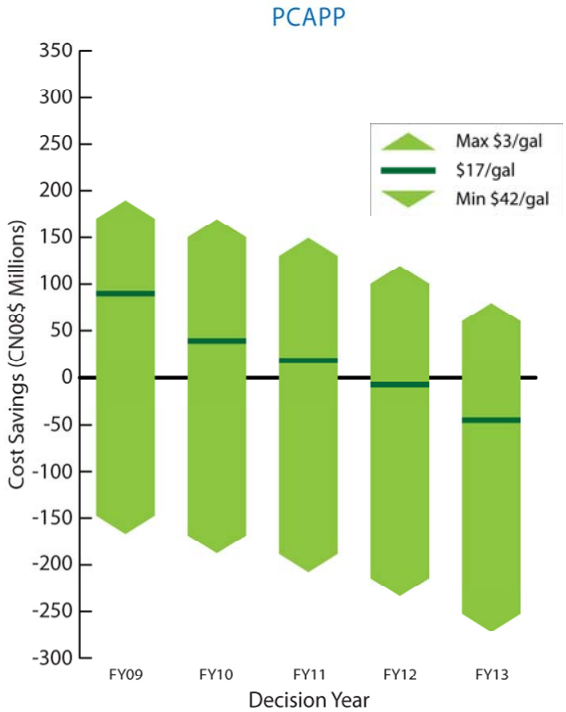
Decision Year	Schedule Impact (Months)
FY09	-13
FY10	-11
FY11	-9
FY12	-6
FY13	-2
Impact = Offsite schedule – Onsite schedule	

Figure 4-4. Offsite Impacts on APB-Based Schedule at PCAPP

4.2 Proposed Acceleration Assessment

In light of the protracted APB schedules due to funding constraints, the DoD directed PM ACWA to identify and assess options for destroying the remaining chemical weapons stockpile by the deadline set by the Chemical Weapons Convention (CWC). Specific requirements under Section 8119 of the Department of Defense Appropriations Act, 2008, Public Law (P.L.) 110-116 call for:

> *"DOD to complete work on the destruction of the U.S. stockpile of lethal chemical agents and munitions, including those stored at Blue Grass Army Depot, Kentucky, and Pueblo Chemical Depot, Colorado, by the deadline established by the Chemical Weapons Convention, and in no circumstances later than December 30, 2017."*



Decision Year	Cost Savings (CN08$ Millions)		
	Deep-Well Injection	Incineration	
	$3/gallon	$17/gallon	$42/gallon
FY09	200	60	-170
FY10	180	40	-190
FY11	150	20	-210
FY12	120	-10	-230
FY13	80	-50	-280

NOTE: Values rounded to the nearest 10 million. Positive value indicates cost savings; negative value indicates a cost increase.

Note: biotreatment is not shown, but at $12/gallon it would provide savings somewhat better than with $17/gallon incineration.

Figure 4-5. Offsite Impacts on APB-Based Life Cycle Costs at PCAPP

In response, PM ACWA is examining options to accelerate the BGCAPP and PCAPP destruction schedules to achieve stockpile destruction as close to 2017 as possible. As a result, PM ACWA is developing a proposed Acceleration Assessment of the BGCAPP and PCAPP schedules and costs to best reflect the schedule requirements under P.L. 110-116. The proposed Acceleration Assessment differs from the APB in several respects:

- New funding profile
- Increase construction staff
- Start systemization earlier
- Increase destruction operations from 4-days on/4-days off to continuous 24 hours a day, 7 days a week
- Use of an Explosive Destruction Technology (EDT) for mustard projectiles at BGCAPP
- Double PCAPP Biotreatment System (e.g., 24 biotreaters rather than 12)

4.2.1 Analytical Approach for the Accelerated Assessment Cases

To analyze the effect on schedule from offsite disposal of hydrolysates, Noblis determined expected changes to the proposed Acceleration Assessment schedule for each major phase (construction, systemization, operations, and closure). Decision years were assumed to be as early as FY09 and as late as the first year of operations, when switching to offsite hydrolysate disposal is not expected to provide as much benefit.

Potential schedule changes were identified and grouped as:

- *Technical*: Includes potential facility, activity, and processing changes; engineering judgment was used along with an examination of main risk factors.
- *Regulatory*: Includes unlikely, but possible, potential delays associated with permitting and other regulatory requirements (based on engineering judgment and stakeholder inputs).

Changes can shorten or lengthen a phase; however, no attempt was made to further accelerate existing activities in a phase if SPB or BTA activities were deleted, because schedule is assumed to be already accelerated as much as possible. Similar to the APB analysis, cost adjustments depend on the year of an offsite disposal decision; main adjustments to the Accelerated Assessment life cycle costs were shown previously in Table 4-1.

4.2.2 Acceleration Assessment Results for BGCAPP[1]

The SPB is a major processing building, second only in size to the Munitions Demilitarization Building/Control and Support Building (MDB/CSB) for BGCAPP. The SCWO technology that will be used for BGCAPP is considered to be mature, but with known technical risks for a first-of-a-kind process with extreme operating conditions.

Although construction of the SPB involves significant activities, BGCAPP construction of the MDB finishes about 1 year later. As a result, Noblis believes that removing the SPB (offsite disposal option) would not decrease the overall construction schedule. It is expected that SCWO can be systemized during SPB construction and after its completion. Thus, there would be no direct reduction in the BGCAPP systemization schedule. However, the overall facility will be less complex, and integrating the entire facility would be a little easier if there were no SPB to systemize and integrate.

The operations phase includes MDB, EDT, and SPB operations that are interrelated because when the MDB processes GB munitions and then VX munitions, the EDT and SPB must process the same types of munition components and agent hydrolysate. Therefore, schedule changes due to removing the SPB will not have a large effect on total operations duration.

Noblis believes that the duration of operations for the VX processing campaign would be slightly longer if the hydrolysate is disposed of by an offsite TSDF. This is due to the additional VX neutralization time that may be required to meet expected VX agent destruction level, EA2192 concentration, and flammability criteria for shipment offsite to a commercial TSDF.

---

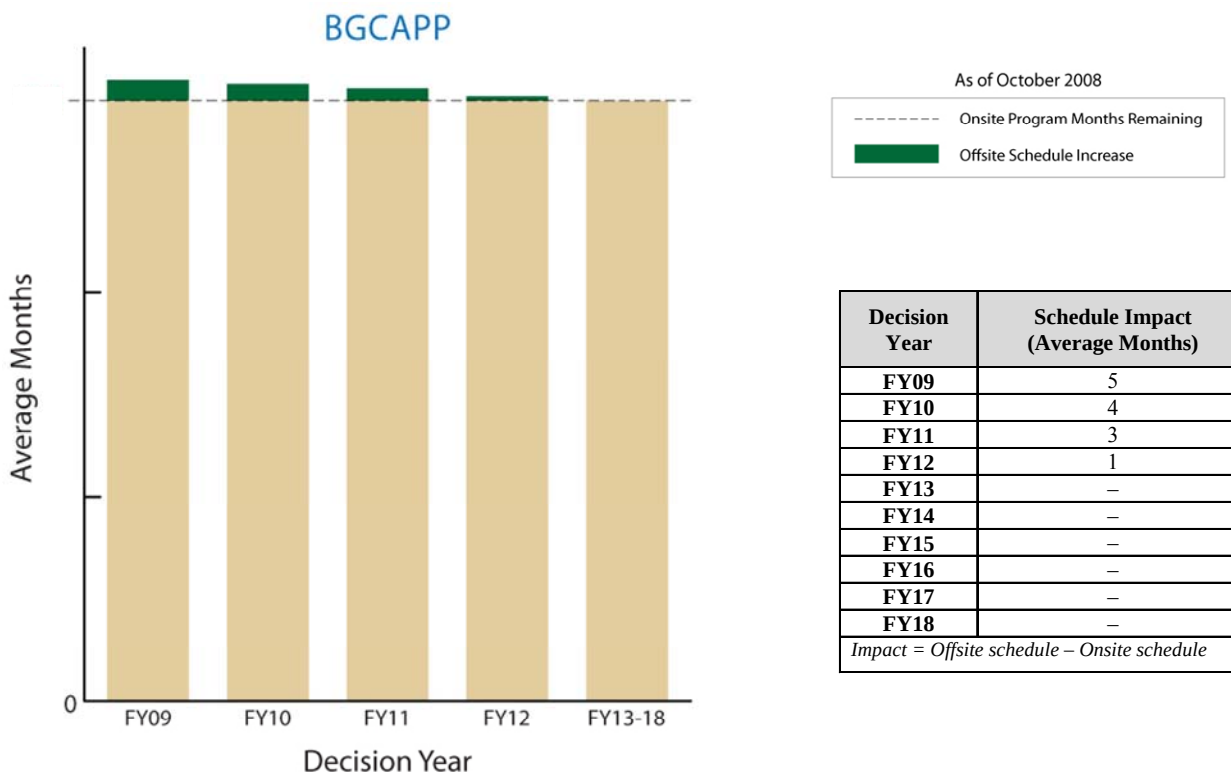
[1] *It should be noted that the life cycle schedule and costs for this option include redesign of the Explosive Containment Room (ECR). The increases in schedule and costs of this redesign are not included in the APB analysis.*

For closure, the uncontaminated SPB is much easier to decommission and can occur in parallel with MDB significant closure decontamination activities. Deleting the SPB would have minimal effect on closure activities and would not reduce the closure duration.

As discussed in Section 3, stakeholder opposition to offsite disposal of ACWA hydrolysates could cause potential schedule delays. For purposes of this analysis, Noblis assumed that there is a small chance that BGCAPP could lose its Research Development and Demonstration (RD&D) permit if SCWO were no longer used. This could delay construction up to several years in an unlikely worst case. It should be noted that there is a much higher probability that there would be no need to convert the RD&D permit or that there would be no delay to the schedule.

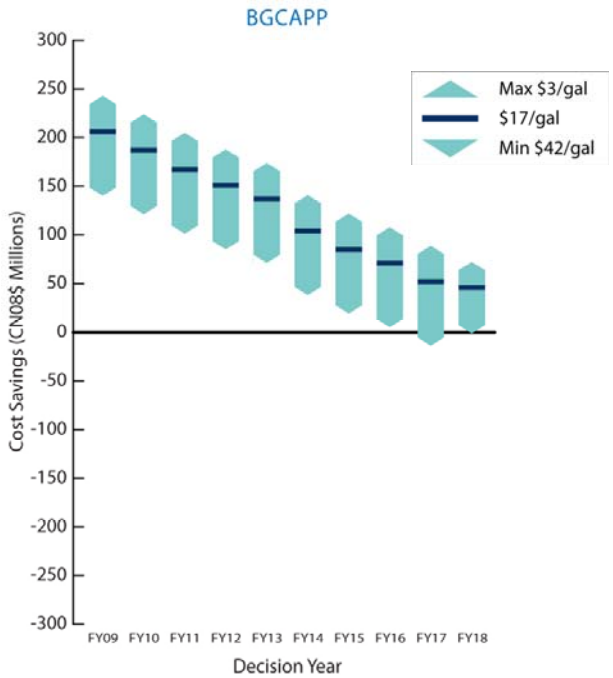
For operations, it was assumed that there would most likely be no regulatory delay and that for a small percent of the time, there would be a small delay (a couple of months) because of an assumed extended public comment period for converting the construction permit to an operating permit.

Figure 4-6 and Figure 4-7, respectively, show the potential schedule and cost impacts relative to the proposed Accelerated Assessment onsite treatment option. For an offsite disposal decision made between FY09 and FY12, there is a slight increase in BGCAPP schedule relative to the Acceleration Assessment schedule mainly due to the small possibility of BGCAPP losing its RD&D permit. For all decision years after FY13, there is essentially no schedule change.



Decision Year	Schedule Impact (Average Months)
FY09	5
FY10	4
FY11	3
FY12	1
FY13	–
FY14	–
FY15	–
FY16	–
FY17	–
FY18	–
Impact = Offsite schedule – Onsite schedule	

Figure 4-6. Offsite Impacts on Acceleration Assessment Schedule at BGCAPP



Decision Year	Cost Savings (CN08$ Millions)		
	Deep-Well Injection	Incineration	
	$3/gallon	$17/gallon	$42/gallon
FY09	240	210	140
FY10	220	190	120
FY11	210	170	100
FY12	190	150	90
FY13	170	140	70
FY14	140	100	40
FY15	120	90	20
FY16	110	70	10
FY17	90	50	-10
FY18	70	50	0

NOTE: Values rounded to the nearest 10 million. Positive value indicates cost savings; negative value indicates a cost increase.

Figure 4-7. Offsite Impacts on Acceleration Assessment Life Cycle Costs at BGCAPP

As shown in Figure 4-7, even with the small schedule increases in some early decision years, cost savings are possible at the TSDF prices identified by the market survey. However, if such a decision is delayed, the magnitude of the cost savings diminishes because SCWO investments become less and less recoverable.

4.2.3 Acceleration Assessment Results for PCAPP

The BTA is a third major processing area at PCAPP, after the Enhanced Reconfiguration Building (ERB) and Agent Processing Building (APB). The ICB technology is considered mature with known technical risks.

Construction of the BTA involves a significant footprint; however, PCAPP construction complexity is dominated by the main processing buildings, the ERB and the APB. Removal of the BTA systems from the critical path would save up to about 5 months of construction time and could also reduce complexity. In addition, Noblis believes that systemization cannot start earlier even if construction is shorter because the main systemization activities relate to the ERB and APB, which are retained with an offsite hydrolysate disposal decision. Noblis believes that BTA systemization activities are not on the critical path; however, without the BTA, the facility will be less complex and integrating the entire facility would be a little easier if there were no BTA to systemize and integrate.

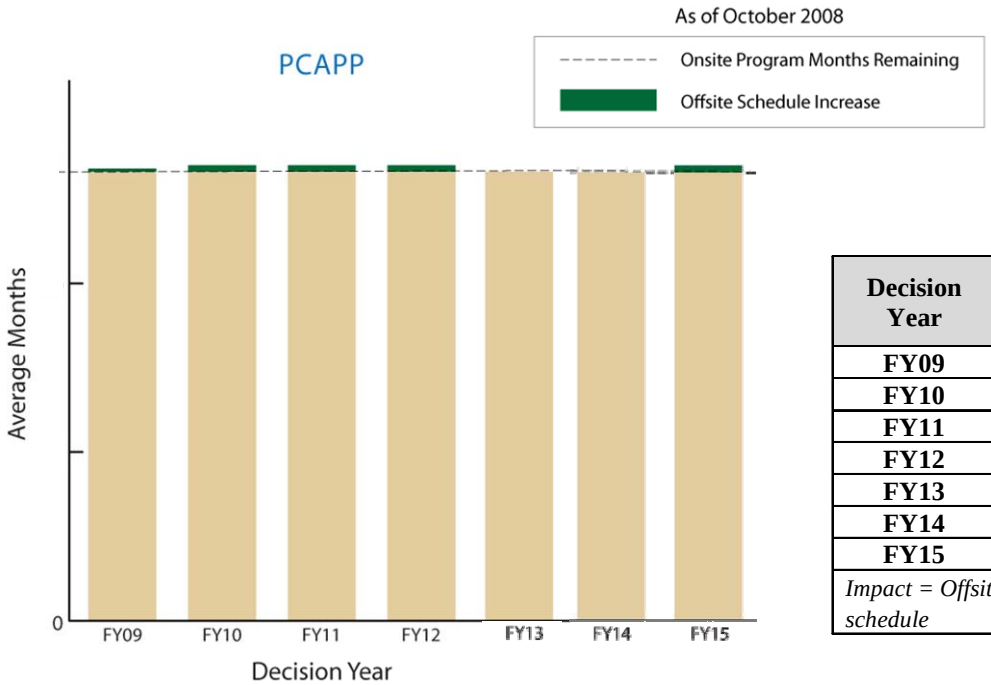
During operations, biotreatment of the hydrolysate is not the rate limiting process, and the BTA has spare systems and large buffering capacity to preclude it from delaying upstream ERB/APB operations. Therefore, treating and disposing of hydrolysate offsite and deleting the BTA would not decrease the operations schedule. Closure and demolition of the uncontaminated

BTA is much easier and can occur in parallel with the APB (and ERB) significant closure decontamination activities. Deleting the BTA would have minimal effect on closure activities and would not reduce the closure schedule duration.

As discussed in Section 3, stakeholder opposition to offsite disposal of ACWA hydrolysates could cause schedule delays. For purposes of this analysis, Noblis assumed that there is a small chance that litigation of the CD would result in an injunction, thereby delaying construction at PCAPP. An injunction could delay Stage 3 construction by an average of about 6 months if the decision to dispose of hydrolysate offsite were made during construction. It should be noted that there is a much higher probability of no litigation or no delay to the schedule.

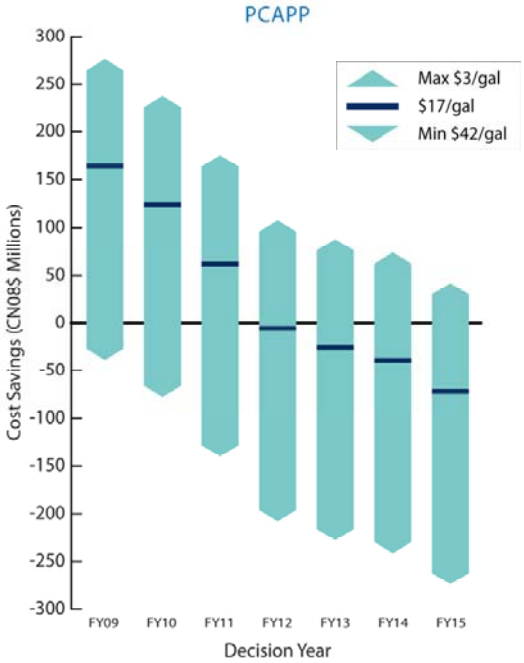
For offsite disposal decisions before operations begin (i.e., prior to FY15), Noblis assumed that there will most likely be no delay; however, there could be a small operations delay (average of about 2 months) due to an extended public comment period for converting the construction permit to an operating permit. For decision years starting in FY15 when operations are underway, litigation of the CD modification could result in a potentially longer delay. Noblis assumed that there would most likely be no delay; and a small chance that operations would be delayed by an average of about 6 months.

The net effects of potential schedule changes for the different phases were combined to determine schedule impacts. Figure 4-8 and Figure 4-9, respectively, show the potential schedule and cost impacts relative to the proposed Accelerated Assessment onsite treatment option. For a decision made up through FY12, there are negligible impacts on the PCAPP schedule relative to the Accelerated Assessment schedule. Decision years FY13 and FY14 essentially involve no schedule change for offsite disposal. As shown in Figure 4-9, the potential for cost savings depends on the decision year and the TSDF disposal price. In general, as an offsite decision is delayed, the magnitude of any cost savings diminishes because BTA investments become less and less recoverable.



Decision Year	Schedule Impact (Average Months)
FY09	1
FY10	2
FY11	2
FY12	2
FY13	–
FY14	–
FY15	2
Impact = Offsite schedule – Onsite schedule	

Figure 4-8. Offsite Impacts on Acceleration Assessment Schedule at PCAPP



Decision Year	Cost Savings (CN08$ Millions)		
	Deep-Well Injection	Incineration	
	$3/gallon	$17/gallon	$42/gallon
FY09	280	160	-40
FY10	240	120	-80
FY11	180	60	-140
FY12	110	-10	-210
FY13	90	-30	-230
FY14	70	-40	-240
FY15	40	-70	-270
NOTE: Values rounded to the nearest 10 million. Positive value indicates cost savings; negative value indicates a cost increase.			

Note: Biotreatment is not shown, but at $12/gallon it would provide savings somewhat better than with $17/gallon incineration.

Figure 4-9. Offsite Impacts on Acceleration Assessment Life Cycle Costs at PCAPP

4.3 Sensitivity of Cost Savings to Disposal Prices

As the decision to treat and dispose of hydrolysates offsite is delayed, the magnitude of the cost savings diminishes because costs are generally sunk and thereby become less recoverable. As noted in Section 4.1 and Section 4.2, cost savings will also be less if higher priced TSDF technologies are used. In addition to analyzing the sensitivity of cost savings to existing TSDF market prices, Noblis also performed breakeven analyses to determine the TSDF disposal price at which the LCCE with onsite hydrolysate treatment equals the LCCE with offsite hydrolysate disposal. Results of this analysis are shown for each potential decision year in Table 4-2 for the APB-based case and in Table 4-3 for the proposed Acceleration Assessment case.

Table 4-2. Breakeven Disposal Prices by Decision Year—APB Cases

Decision Year	Price/Gallon (CN08$)	
	BGCAPP	PCAPP
FY09	$90	$20
FY10	$80	$20
FY11	$80	$20
FY12	$70	$20
FY13	$60	$10
FY14	$60	--
FY15	$50	--
FY16	$40	--
FY17	$40	--
NOTE: All values rounded to the nearest ten dollars. Dashes indicate decision year not applicable.		

Table 4-3. Breakeven Disposal Prices by Decision Year—Acceleration Assessment Cases

Decision Year	Price/Gallon (CN08$)	
	BGCAPP	PCAPP
FY09	$100	$40
FY10	$90	$30
FY11	$80	$30
FY12	$70	$20
FY13	$70	$10
FY14	$60	$10
FY15	$50	$10
FY16	$40	--
FY17	$40	--
FY18	$40	--
NOTE: All values rounded to the nearest ten dollars. Dashes indicate decision year not applicable.		

Based on the APB case, the breakeven analysis shows that offsite disposal of hydrolysates at BGCAPP is cost effective if the TSDF price is less than about $90/gallon. This estimate is based on a decision made in FY09. The breakeven price becomes lower as the decision for offsite disposal is delayed. For PCAPP, the corresponding breakeven TSDF disposal price is about $20/gallon for a decision in FY09.

For the Acceleration Assessment case, the breakeven analysis shows that offsite disposal is cost effective at BGCAPP if the TSDF price is less than about $100/gallon. This estimate is based on a decision made in FY09. The breakeven price becomes lower as the decision for offsite disposal is delayed. For PCAPP, the breakeven TSDF disposal price is about $40/gallon for a decision in FY09.

5 Safety Impacts

This section contains a discussion of stockpile storage risk and presents a preliminary evaluation of local community risk from hazardous material shipments.

5.1 Stockpile Storage Risk

Public safety risk from munitions stored at various Army depots can be described in terms of the expected stockpile storage duration. Each hydrolysate disposal alternative and decision year has its own schedule and its corresponding stockpile storage duration. The stockpile storage duration depends primarily on the program duration. However, the stockpile storage duration is calculated differently than the program schedule durations in Section 4; stockpile storage duration depends on the beginning and end dates of agent (rather than hydrolysate) disposal operations. During agent operations, the size of the stored stockpile and the risk decrease from their maxima to zero. The full-stockpile "equivalent" risk period was determined in this analysis to end at the midpoint of agent operations, rather than at the beginning or end of agent operations.

5.1.1 Blue Grass Army Depot

The public safety risk from munitions storage at BGAD is considered to result primarily from the potential for a large earthquake or a strong lightning strike on storage magazines with 155-mm rockets that contain the nerve agents GB and VX. BGAD takes measures to keep the risk as low as possible, but the risk cannot be entirely eliminated until all munitions at BGAD are destroyed.

Based on the APB case, the expected onsite equivalent stockpile storage duration would be decreased by a decision to dispose of hydrolysate offsite. The savings in expected storage duration result from reductions in scheduled construction and systemization durations, and do not indicate the relatively small effects of potential regulatory delays. The resulting effects on storage duration by decision year for the APB case are illustrated in Figure 5-1. The maximum estimated decrease in storage duration is ~14% of the time from now until the end of onsite MDB operations (which would occur in about 142 months).

Based on the much shorter proposed Accelerated Assessment case (resulting in a shorter period of exposure to stockpile risk), the expected onsite equivalent stockpile storage duration would be increased slightly in early decision years by a decision to dispose of hydrolysate offsite. The increases in expected storage duration result primarily from the small potential for regulatory delays. The results by decision year for the Accelerated Assessment schedule are shown in Figure 5-2. The maximum estimated increase in storage duration is less than 6 months, which is considered to be minor.

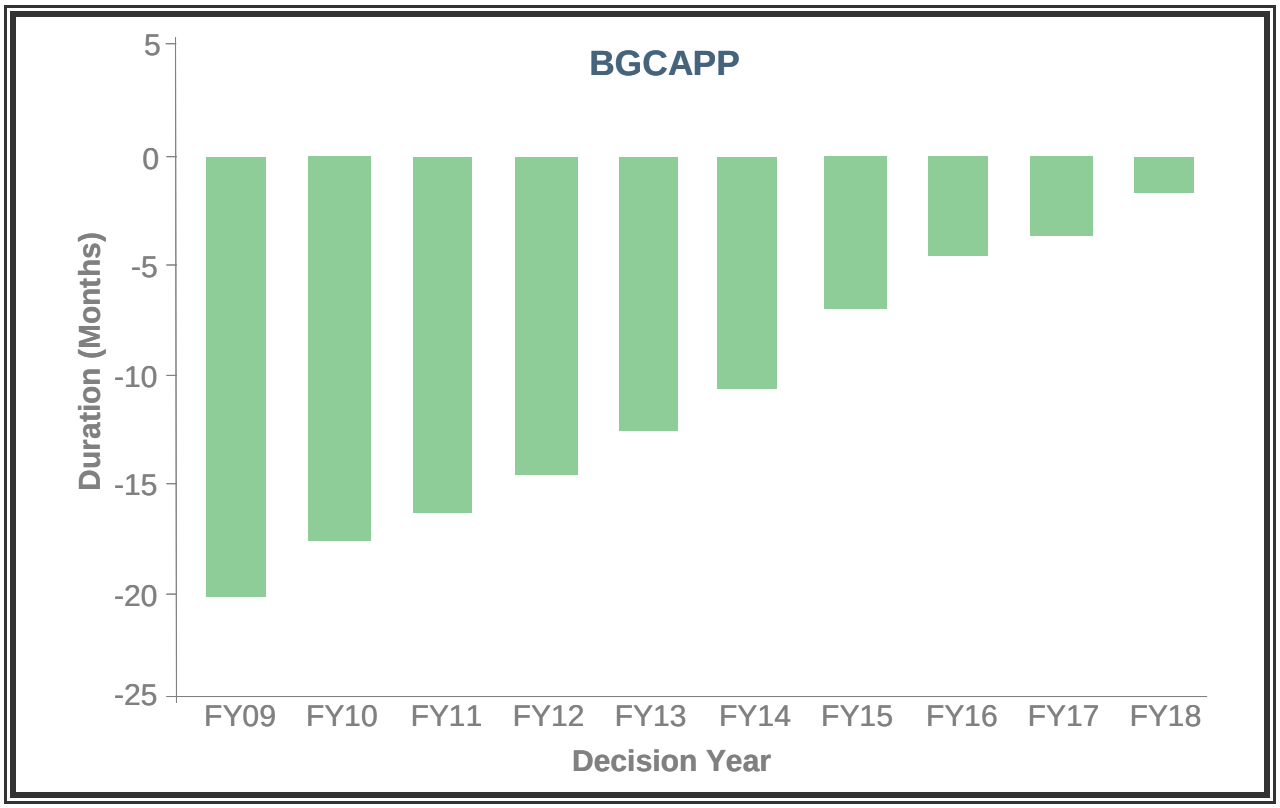


Figure 5-1. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (APB-Based Schedule)

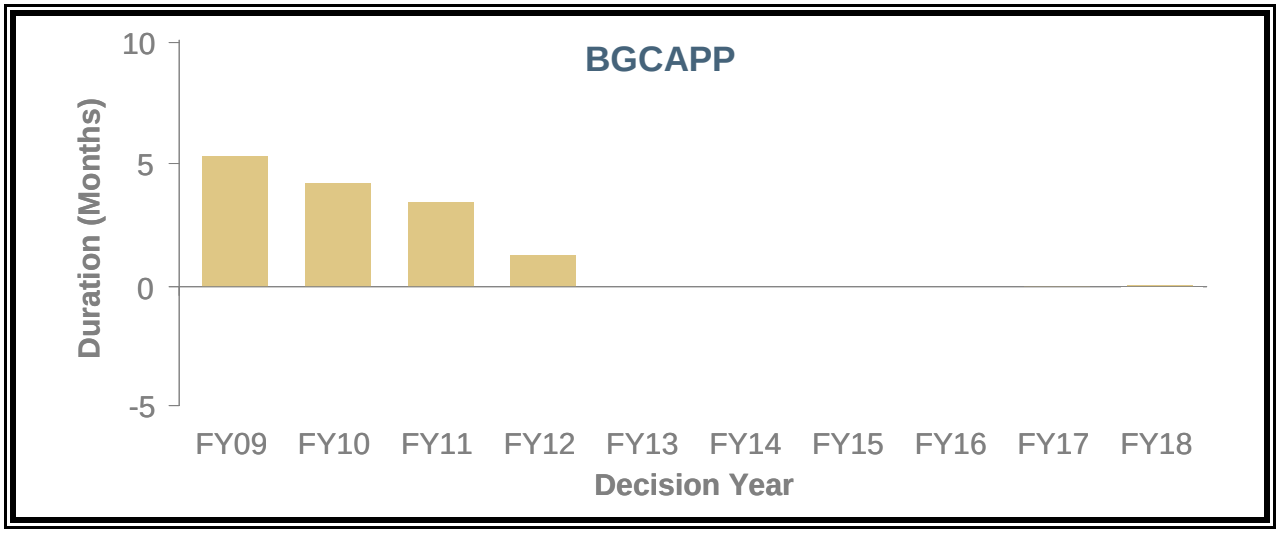


Figure 5-2. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (Accelerated Assessment Schedule)

5.1.2 Pueblo Chemical Depot

The public safety risk from munitions storage at PCD is considered to result primarily from the potential for an aircraft crash on a storage magazine with projectiles that contain mustard agent. PCD takes measures to keep the risk as low as possible, but the risk cannot be entirely eliminated until all munitions at PCD are destroyed.

Based on the APB case, the expected onsite equivalent stockpile storage duration would be decreased by a decision to dispose of hydrolysate offsite. The savings in expected storage time result from reductions in scheduled construction and systemization, and do not indicate the relatively small effects of potential regulatory delays. The resulting effects on storage duration by decision year for the APB case are shown in Figure 5-3. The maximum estimated decrease in storage duration is ~10% of the time from now until the end of onsite MDB operations (which would occur in about 125 months).

Based on the much shorter Accelerated Assessment case (resulting in a shorter period of exposure to the stockpile risk), the expected onsite equivalent stockpile storage duration would be increased very slightly by a decision to dispose of hydrolysate offsite. The increases in expected storage duration result primarily from the small potential for regulatory delays. The results by decision year for the Accelerated Assessment schedule are presented in Figure 5-4. The maximum estimated increase in storage duration is less than 2 months, which is considered to be insignificant.

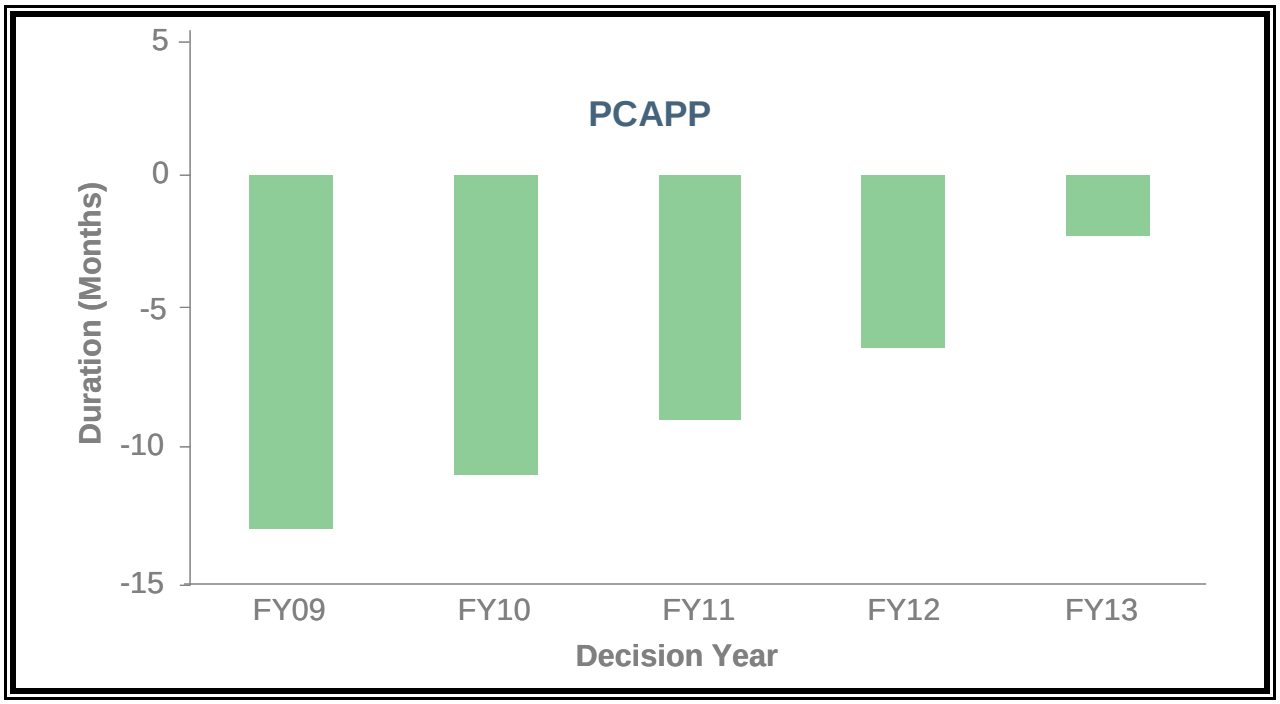


Figure 5-3. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (APB-Based Schedule)

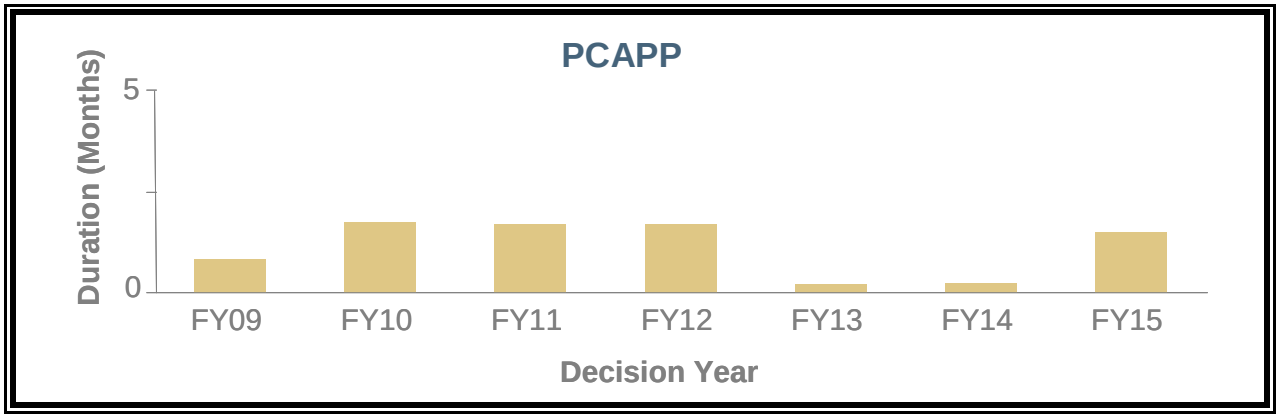


Figure 5-4. Effect of Offsite Disposal on Equivalent Expected Stockpile Storage Duration (Accelerated Assessment Schedule)

5.2 Preliminary Evaluation of Shipping Hazards

Chemical shipments associated with the ACWA sites will be done safely in accordance with the applicable U.S. Department of Transportation (DOT) regulations. However, when considering shipment of wastes from a site, it is often easy to take routine, commercial chemical shipping operations for granted, regardless of the quantity. In this preliminary comparative transportation hazard evaluation, a holistic approach has been taken for the entire life cycle of the project. Chemical shipments into the destruction facilities, as well as waste shipments from these facilities, were considered for both onsite treatment and offsite disposal of hydrolysates. In this section, Noblis presents a preliminary evaluation that considers the volume of materials shipped and the relative hazards of those materials.

The first step of the preliminary evaluation required development of estimated volumes (converted to nominal truckloads) for chemical substances shipped into and out of BGCAPP and PCAPP. Designs based on the APB case were used because all process streams related to the proposed Acceleration Assessment case have not been defined. If volumes for a substance change between the onsite and offsite disposal alternatives, Noblis identified hazards for each substance. Qualitative hazard ratings were assigned to each substance based on those hazards, as well as National Fire Protection Association (NFPA) ratings for Health, Flammability, Instability/Reactivity, and special precautions. Consideration was given to three perspectives: Environmental, Emergency Responders, and the Public. Table 5-1 provides examples illustrating how the relative hazard ratings were applied. Detailed evaluations and shipment volumes for each of the substances covered are given in Appendix B. Finally, the chemical substances were "binned" in the five relative hazard categories on the basis of their relative hazard rankings; shipment volumes in each category were summed to provide a qualitative profile of the hazards for each alternative.

Table 5-1. Qualitative Ratings of Shipment Hazards

	Relative Hazard Rating	Example	Example Drivers
Higher	Very High	35% Hydrochloric Acid	Local inhalation hazard; potential for plume migration >1 mile
	High	50% Sodium Hydroxide (Caustic)	Skin contact hazard with burns after short contact
	Medium	VX Hydrolysate	pH 13.5 skin contact hazard with burns after several hours
	Low	Brine Solution	Mild skin irritant; possible vegetation kill
Lower	Very Low	10% Dibasic Ammonium Phosphate	Mild eye irritant; very limited environmental effects

5.2.1 BGCAPP Preliminary Evaluation

Figure 5-5 presents a comparison of the number of truckloads for each "hazard level" shipped inbound and outbound from BGCAPP for the onsite and offsite disposal alternatives. The overall amount of truck traffic due to chemical or waste shipments decreases roughly 48% if hydrolysate is disposed offsite. An estimated 19,500 truck trips will be required to transport chemicals to and wastes from the site if hydrolysate is treated onsite in the SCWO, whereas an estimated 10,100 truck trips will be required to transport chemicals to and wastes from the site if hydrolysate is disposed offsite at a commercial TSDF.

This preliminary evaluation suggests that a decision to treat hydrolysate offsite would result in a decrease of 182 truckloads of very high hazard shipments, a decrease of 26 truckloads of high hazard shipments, an increase of 548 truckloads of medium hazard shipments, and a decrease of approximately 5,000 low or very low hazard shipments. Based on the preliminary findings, it appears that offsite disposal of hydrolysates from BGCAPP could potentially lower the risk to first responders, the environment, and the general public posed by transportation of hazardous substances into and out of the site. There is also a significant reduction in the overall volume of shipments, which reduces the potential for involvement in traffic accidents. A decision would merit a formal Transportation Impact Assessment (TIA) that considers the comparative impacts of onsite treatment and offsite disposal. A TIA would examine quantitatively the hazards posed by each material and the volumes shipped, and could be used to determine quantitatively whether the onsite alternative or the offsite alternative poses less risk. Further, as a result of this preliminary evaluation, it is Noblis' opinion that changes in the BGCAPP design for the proposed Acceleration Assessment case are likely to show similar reductions in hazards or risks by offsite hydrolysate disposal.

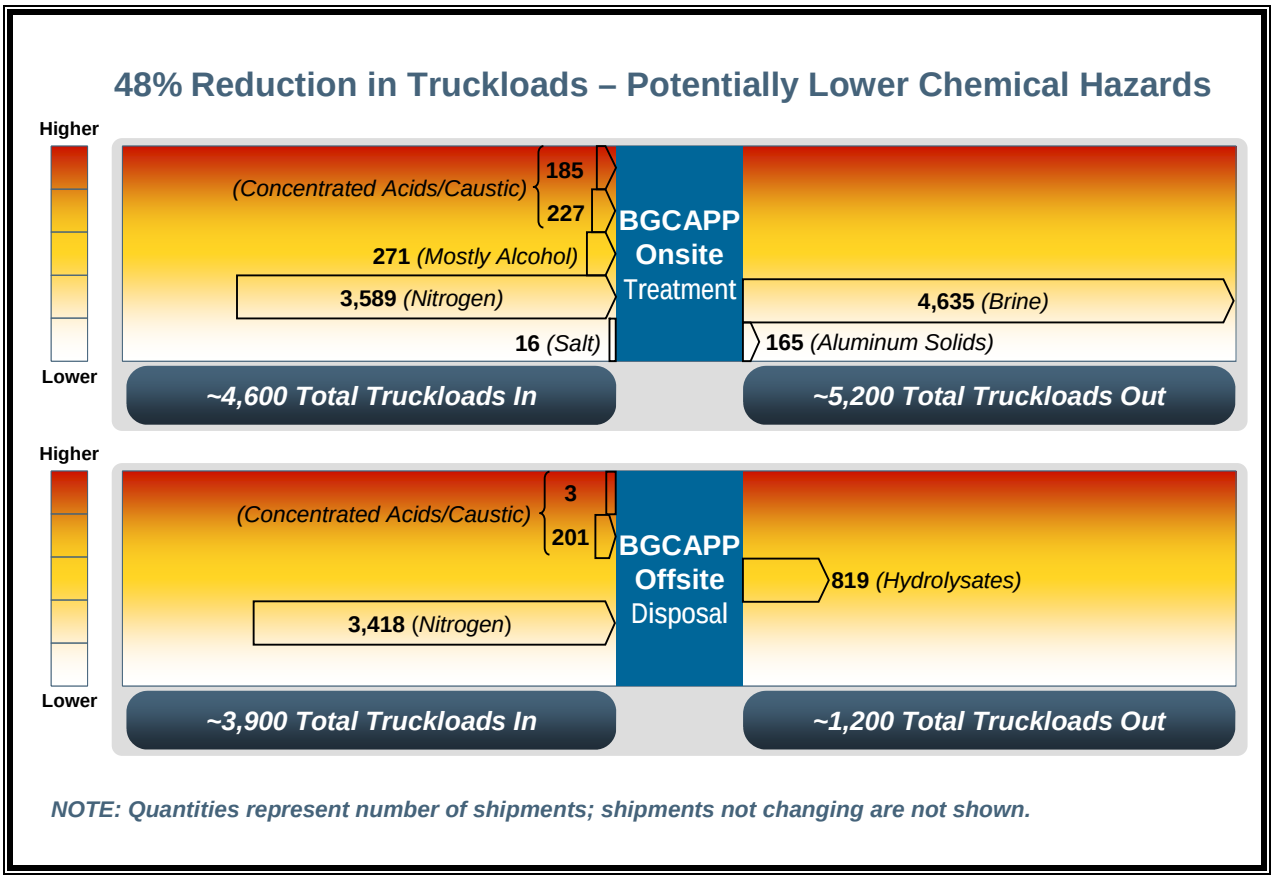


Figure 5-5. BGCAPP Shipments of Hazardous Materials

5.2.2 PCAPP Preliminary Evaluation

Figure 5-6 presents a comparison of the number of truckloads for each "hazard level" shipped inbound and outbound from PCAPP for the onsite and offsite treatment alternatives. The overall amount of truck traffic due to chemical or waste shipments decreases roughly 19% if hydrolysate is treated and disposed offsite. An estimated 15,900 truck trips will be required to transport chemicals to and wastes from the site if hydrolysate is treated onsite in the Biotreatment Area, whereas an estimated 12,900 truck trips will be required to transport chemicals to, and wastes from, the site if hydrolysate were treated offsite at a commercial TSDF.

This preliminary evaluation suggests that a decision to treat and dispose of ACWA hydrolysates offsite would result in a decrease of 817 truckloads of high hazard shipments, an increase of 1,765 truckloads of medium hazard shipments, and a decrease of over 2,400 low or very low hazard shipments. Based on these preliminary findings, it appears that offsite disposal of hydrolysates from PCAPP could moderately lower the risk to first responders, the environment, and the general public posed by transportation of hazardous materials into and out of the site. This merits a formal TIA that considers quantitatively the comparative impacts of onsite treatment and offsite disposal. It is expected that the truck shipments would be very similar for the Acceleration Assessment case, thus resulting in a similar finding.

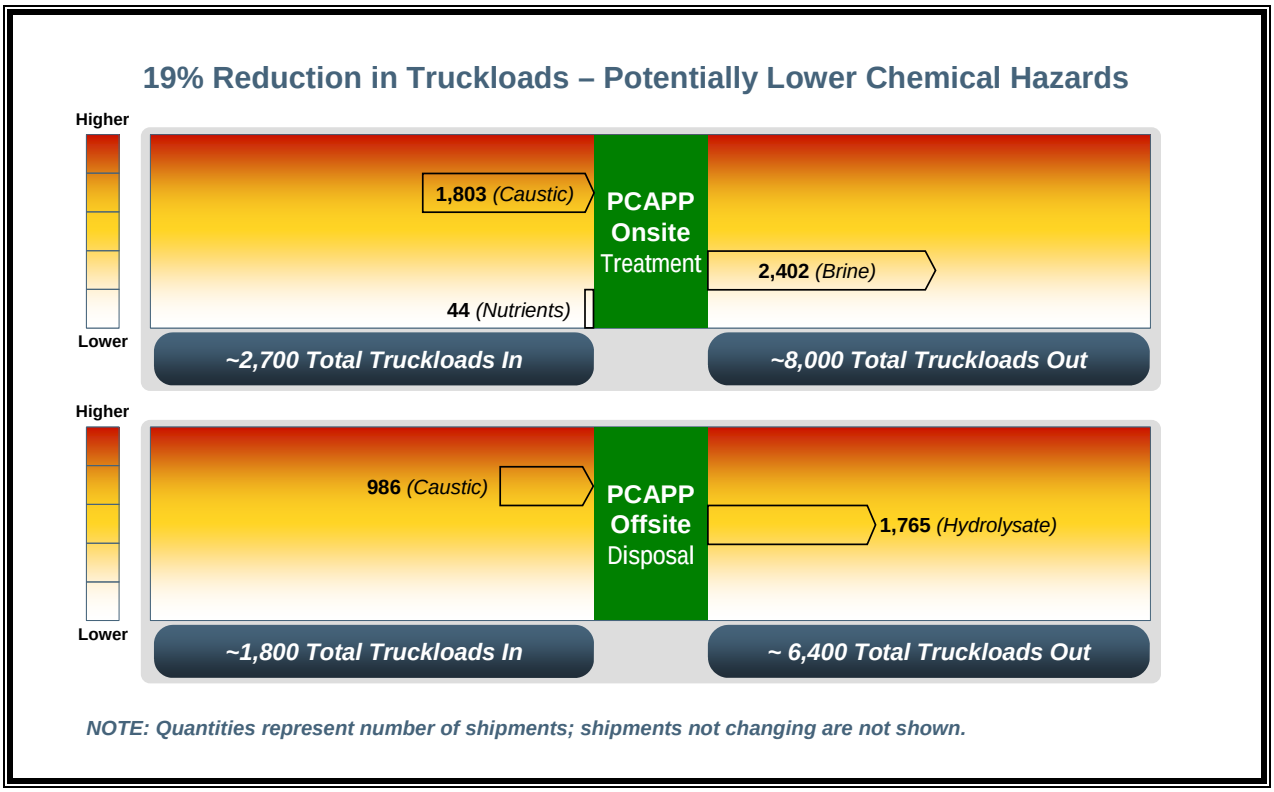


Figure 5-6. PCAPP Shipments of Hazardous Materials

6 Summary of Findings

Noblis identified the following major findings from its analysis.

- Offsite disposal of ACWA hydrolysates reduces BGCAPP and PCAPP equipment, facilities, and labor, as well as the overall project and process complexity.
- Offsite disposal could result in cost savings at both BGCAPP and PCAPP. The magnitude of the cost savings depends on when the decision is made (the sooner the better) and the offsite disposal technology used.
- The impacts on schedule from offsite disposal of hydrolysates vary from small decreases to very small increases.
- Facilities are currently available for disposal of the hydrolysates, with deep-well injection the most economical. Although future availability of deep-well injection is not certain, some type of TSDF will be available.
- Offsite hydrolysate disposal can decrease the total number of truck shipments into/out of each facility. Additionally, local community risks of hazardous material shipments could potentially be reduced.
- Many stakeholders would accept offsite disposal, but some opposition is inevitable, regardless of TSDF location or choice of offsite disposal technology.

Appendix A Stakeholder Perspectives

In December 2007, Noblis conducted a series of interviews with stakeholders in Colorado and Kentucky. This appendix provides a summary of those views. Section A.1 provides an overall summary of the views that emerged from those interviews and how they affect the uncertainty of this analysis. The next two sections provide detailed summaries of the discussions at individual sessions. All stakeholder comments discussed in Appendix A of the 2006 analysis (Noblis 2006) were also considered for purposes of this report, and are incorporated by reference. In cases where specific stakeholders expressed different views in 2006 and 2007, the more recent comments were given appropriately greater weight.

A.1 Overarching Issues

Stakeholder opposition to offsite hydrolysate treatment remains a major hurdle. Among the community members who were opposed to offsite hydrolysate treatment, a common theme was their perception that onsite hydrolysate treatment, although not free from technical risk, was under the control of PM ACWA and state regulators, and was relatively immune to outside pressure. In contrast, they viewed offsite hydrolysate treatment as subject to pressure from communities through which hydrolysate would be transported or the community in which it would be treated, thus allowing these outside communities to slow or stop the process. This leads to a rather unusual position that can be described as "I want to treat it in my backyard," in contrast to the clichéd "not in my backyard." One important factor is that opposition to offsite hydrolysate treatment in Kentucky includes key local government officials, which contributes to significant political uncertainty for BGCAPP. In addition, Congressional staff members communicated opposition to offsite disposal of hydrolysate by Representatives and Senators from both Colorado and Kentucky. On 14 February 2008, Sen. Kenneth Salazar of Colorado introduced a bill (S. 2656) to prohibit the transport of hydrolysate from PCAPP or BGCAPP to an off-site location for treatment, storage, or disposal. On 10 March 2008, Rep. John Salazar of Colorado introduced a similar bill (H.R.5574), cosponsored by Rep. Udall of Colorado and Rep. Chandler of Kentucky. Both bills were referred to committee.

Specific major stakeholder concerns include waning public trust, at least in some quarters. This loss of trust is, in part, the result of actions outside of Program Manager for Assembled Chemical Weapons Alternatives (PM ACWA), *e.g.*, groundwater contamination at (PCD) that is a legacy of conventional munition operations conducted years ago and the treatment of whistleblower cases, some very recent, at BGAD. Nevertheless, this loss of trust impacts PM ACWA because many stakeholders make little if any distinction between different organizations within the DoD.

The potential loss of jobs in the event of offsite hydrolysate treatment remains a concern. This was a particular concern at the Pueblo Chemical Agent-Disposal Pilot Plant (PCAPP), where the memory of losing 32% of the local jobs in 1982 remains with business and political leaders. Stakeholders expressed considerable misunderstanding and confusion about the various schedules, and many questioned the relevance of this study because it does not use the 2017 deadline mandated by Congress. Some stakeholders were also concerned about the effect of the shifting political landscape.

In their conversations, many (although by no means all) stakeholders suggested that more public education and outreach are needed if the offsite hydrolysate treatment option is selected. These stakeholders want to know more about what hydrolysate is, the toxicity of hydrolysate, and an understandable analysis of the risks posed by its transportation. In addition, this outreach must address the credibility of decisions based on risk analysis and operations plans prepared before the location of the Treatment, Storage, and Disposal Facility (TSDF) is determined. A common sentiment was "how can you decide if it's safe to select this option if you don't even know where it's going?"

A.2 Summary of Meetings with Colorado Stakeholders

The following sections summarize interviews that Noblis conducted with various PCAPP stakeholders in Colorado on 4-6 December 2007.

A.2.1 Discussion with Colorado Department of Public Health and Environment

The following sections summarize interviews that Noblis conducted with various PCAPP stakeholders in Colorado on 4-6 December 2007.

In response to a question regarding the final destination of the hydrolysate for treatment, DuPont in New Jersey (which processed the mustard hydrolysate from Aberdeen) and Veolia in Texas (which is processing the VX hydrolysate from Newport) were mentioned as possible candidates. It was noted that once a decision to treat hydrolysate offsite is made, the Army will issue a performance-based request for proposal to which a number of bidders will respond, and a bidder will subsequently be selected.

A question was raised regarding the impact of the North American Free Trade Agreement (NAFTA) on the transportation of hydrolysate where a low-cost transporter may use under par vehicles and drivers. It was noted that usually the selected TSDF will use its own transportation contractor because it has every incentive to minimize the possibility of a traffic accident or spill. In addition, PM ACWA always uses the best-value approach under the Federal Acquisition Regulations (FAR) to select contractors. This acquisition approach allows the government to pay a premium for a better approach or higher safety and certification requirements instead of selecting the lowest cost bidder.

Regarding changes in the political landscape, the attendees indicated that the new Colorado Governor may have a different perspective. It was also indicated that the Executive Director of CDPHE has been contacted by the Governor's office (in response to local citizens' concern over the possibility of offsite shipment and treatment of the hydrolysate). As a result, the Director wants an assessment performed of the risk associated with the transport of the hydrolysate within the State of Colorado. The CDPHE representative suggested that they would first determine what is in the waste (i.e., characterize the hydrolysate), and although not a regulatory requirement, a worst-case, deterministic, and bounding analysis of a hydrolysate spill would be performed to determine the impact on the environment. To make the analysis realistic, general consensus was that that such an analysis should focus on a "plausible worst-case scenario" and not necessarily on the worst-case scenario, which would unrealistically consider multiple, conservative

assumptions (e.g., quantity of spill, location of spill, environmental condition such as temperature, soil type).

CDPHE attendees pointed out the public perception issue associated with the transport of hydrolysate. Although there may be no impact on the schedule for issuing a Stage III permit if the biotreatment area (BTA) was replaced by a truck loading station (for shipment of hydrolysate), there could be delays in actually going through the permitting process. Although the hydrolysate should not contain any mustard agent, it is still a hazardous waste based on the level of hazardous waste constituents that may be present in it. Management, including shipment of any hazardous waste, poses some risk.

Since the hydrolysate transportation study for the Newport Chemical Agent Disposal Facility (NECDF) would be directly relevant to PCAPP, the regulators expressed interest in obtaining a copy of it. Subsequent to the meeting, Noblis provided the electronic link to the Centers for Disease Control and Prevention (CDC) VX hydrolysate study to PCAPP. In response to a request by Noblis, CMA subsequently provided a copy of Noblis' *Newport VX Hydrolysate Transportation Study* to PCAPP.

Waste minimization guidelines do not require the DoD to treat the hydrolysate waste onsite. However, they do recommend that hazardous waste management facilities should continually look for ways to minimize the volume and toxicity of wastes generated and shipped offsite for disposal at their facility.

Water conservation is a concern, and it has been estimated that about 17 acre feet of water (≈5.54 million gallons) will be lost should the hydrolysate be sent offsite and not reprocessed onsite. However, it became evident that this amount of water is relatively small from an agricultural perspective.

CDPHE suggested that the cost of public outreach and public relationship to reach out to the communities along the shipment route should also be considered in Noblis' analysis. In addition, the analysis should consider the increasing cost of transportation.

Usually, the duration for receiving and addressing public comments on an environmental permit is about 45 days. Given the nature of this particular issue at PCAPP, a 90-day review period would be more likely (45 days would be the 50 percentile of probability distribution and 90 days would be the 90th percentile). One case that occurred almost 20 years ago took about 180 days. The regulators indicated that they would address only pertinent comments.

The potential to further treat the hydrolysate before it is shipped for offsite disposal was discussed. It was noted that a possible option is to treat it such that it meets the Land Disposal Restriction (LDR) codes. This is not a Resource Conservation and Recovery Act (RCRA) permit condition, but it would be good to consider.

PCAPP LDR regulations govern the ultimate disposal of wastes that are generated in treating the mustard agent, regardless of where they may eventually be disposed of. The mustard agent at Pueblo is characteristic for several organic and metal waste toxicity codes in addition to carrying

the waste military munitions listing. The hydrolysate that is generated from the neutralization reaction appears to carry some of the organic toxicity waste codes as well as several underlying hazardous waste (HW) constituents. If the hydrolysate could be rendered free of hazardous constituents (to the universal treatment standards for the characteristic organics and underlying HW constituents and TDG [thiodiglycol]), options for its ultimate disposal may be enhanced. Caustic digestion/destruction of the remaining organics, including TDG, in the reactor vessel should be considered along with chemical flocculation and immobilization of any remaining HW constituents that may remain in the hydrolysate. Hazardous waste that is rendered non-hazardous through treatment by destroying or immobilizing the hazardous waste constituents contained in it may cease to be a hazardous waste and may be considered for delisting. Disposal of non-hazardous solid waste (RCRA Subtitle D) do not involve the risks or concerns that are typically associated with hazardous wastes.

Colorado does not require the performance of a transportation risk study. In general, it was noted that the Colorado State Patrol (State Police) has the primary responsibility for responding to a spill. The Colorado DOT (CDOT) does not regulate transportation of hazardous materials and does not issue a permit. A representative of the Colorado Department of Transportation's (CDOT's) Permits and Routes office, indicated that she was attending the meeting because her boss' concern over the use of special containers to transport the hydrolysate. Noblis noted that typical tanker trucks with 4,000-5,000 gallon capacity may be used similar to what the Aberdeen Chemical Disposal Facility (ABCDF) used. Once a decision to transport hydrolysate is made, CDOT would be interested in receiving information about: (1) the transportation routes, (2) the number of trucks on the road annually, and (3) the timing of the shipment (day time and specific hours). It was noted that trucking companies receive safety ratings by the states.

In response to follow-up questions from Noblis, e-mailed subsequently to the stakeholder meetings, a CDPHE representative indicated that:

"If biotreatment units were permitted for PCAPP and a decision was made to not use them and ship the hydrolysate offsite, the permit would still need to be modified to eliminate the bio-treatment units and to add the hazardous waste transfer/loading area. The fact that the bio-treatment unit(s) might already be constructed does not change the requirement to modify the permit. That is, the permit would need to be modified to reflect how waste from the facility will actually be managed prior to managing that waste.

Transfer or loading/unloading areas are typically permitted as ancillary equipment to tanks. Modifications to hazardous waste permits are described under 6 CCR 1007-3, Part 100.63[5]. In particular, Appendix I to Part 100 specifies classification of permit modifications. For those permit modifications not explicitly described in Appendix I, the Division will assess the classification of the modification according to 6 CCR 1007-3, Part 100.63(d), *Other Modifications*.

---

[5] Colorado Solid and Hazardous Waste Commission Regulations 6 CCR 1007.3, Part 100.63, Permit Modification At The Request Of The Permittee, Appendix I, Classification of Permit Modification

Permit modifications in Colorado are classified at the time they are submitted based on the specific units/processes/operating requirements needing to be changed. Based on the scenario described by Noblis, the CDPHE representative thought that a Class 2 permit modification would be appropriate (6 CCR 1007-3, Part 100.63, Appendix I, G.2 or 4 - Modification of a tank system without increasing its capacity or modification of a tank management practice respectively). Class 2 modifications to the permit require a mandatory 60-day public comment period and public meeting. CCR Section 100.63(b) also requires that the CDPHE responds to any comments received during the comment period before approving, denying, or re-classifying the modification request.

A.2.2 Discussion with Pueblo, CO, Emergency Management, Local Government, and Business Representatives

This discussion primarily focused on the interviewees' views on transporting and shipping hydrolysate offsite and what concerns, if any, they may have should a decision be made to go with offsite disposal. The general consensus was that, from an emergency management standpoint, the hydrolysate is much more "benign" than other hazardous wastes being transported and passing through Colorado highways everyday. They did not see any safety problem. They were more interested in getting the agent destruction completed and did not understand why there was so much opposition from a few very vocal individuals against the offsite disposal of the hydrolysate. They were indeed concerned about the political ramifications and were convinced that a decision to ship the hydrolysate will prompt a lawsuit from those opposed to offsite shipment. When asked by Noblis how PM ACWA could address their concerns, they offered the following suggestions:

- Communicate to the community the standards used for selecting a waste transporter—this will help ease their concerns on the safety of transporting the hydrolysate.
- There is a need for a coordinated effort between the three major law enforcement agencies (Pueblo emergency response team, rural fire department, and city fire department) to enable a good/effective response to an accident. Consider developing a seamless response plan along the transportation route (one participant questioned the practicality of this suggestion as existing response requirements are so diverse and the priorities may be inconsistent); an impact fee to support a seamless response program could be used. Also, consider staggering the shifts to minimize traffic during shift turnover.
- Use of a tanker or container that does not attract attention will be better so as not to inadvertently alarm people in the communities along the transportation route.
- Develop an operations plan for the transport of the hydrolysate and give the law enforcement groups an opportunity to review and provide inputs. The plan should include contingencies regarding the shipment of hydrolysate to ensure safety, e.g., don't ship when the weather is bad. These contingencies could be part of a "common sense" operational plan.
- In 1982, there were significant job losses (16,000 of 50,000 jobs) as a steel company and the Pueblo Depot cut back on their activities. Jobs are still important, but not as important as they were 20 years ago.

- Use the Pueblo Safety and Health Council as a venue to communicate the safety of transporting the hydrolysate. The Council's members can help explain/inform the issue to their friends/neighbors.
- Use experience gained from the Aberdeen shipment of hydrolysate to New Jersey to ensure transportation safety.
- Educate the public on transportation safety and the economics of transporting offsite.
- Use the media to help spread the "word"—showcase meetings with law enforcement and business representatives.
- Once a decision is made to treat the hydrolysate offsite, consider briefing the Pueblo Safety Council whenever they meet.

Additional issues discussed were the following:

The Colorado State Patrol will be the first responders should an accident occur while waste is being transported in state. A State Patrol representative indicated that there are already designated routes for hazardous material transport (a map of these routes in Colorado was provided subsequently to Noblis). He asked if the waste shipment will be placarded. A Chemical Stockpile Emergency Preparedness Program (CSEPP) representative responded that, if the pH is less than 12.5, it may not be placarded; however, if there are heavy metals, it could be placarded on that basis. The State Patrol indicated that placarding may be useful even if not required because it will help them if they have to respond to an accident involving the hydrolysate shipment.

One participant expressed frustration over so much concern about hydrolysate transport when no one seems to be concerned about the more hazardous chemicals (e.g., concentrated sodium hydroxide) that will be trucked to the plant and will be used for the hydrolysis of agent.

Someone asked about rail transport. Noblis responded that the safest means of transporting the hydrolysate will be determined in a transportation risk assessment.

When asked by Noblis how the results of the Noblis study should be presented, one interviewee suggested that "plain language" be used.

A.2.3 Discussion with PCAPP Legal Support

Noblis asked PCAPP Legal Support about the Pueblo County Certificate of Designation (CD) process. PCAPP Legal Support described the process, noting that the Depot had taken the approach of obtaining State permits first, and then following up with the County. The CD would be awarded after a hearing in front of the County Commissioners. Any appeal would have to show that the Board's decision was arbitrary and capricious.

If hydrolysate were to be treated offsite, PCAPP would go before a formal hearing of the board with an application to modify the CD. PCAPP would put any results of studies describing cost savings, transportation risk studies, and other relevant documents into the administrative record to support the request. These documents should be provided to the County Director of Planning and Development, as early as possible but no less than approximately 60 days before

the formal hearing date. PCAPP Legal Support noted that PCAPP has always provided even more time to the County Director of Planning and Development, even though 60 days is sufficient for normal modifications, to allow the County Director of Planning and Development to complete his process and present his summary to the Board. The County Director of Planning and Development would disseminate the documents within the County staff, including emergency responders, and request their comments. He would also compile the responses into an executive summary, which typically would be presented to the Commissioners at a Thursday working session prior to a Tuesday hearing.

Subsequent to the stakeholder meetings, the PCAPP Legal Support representative provided the following additional details regarding modifications to the CD. For normal, uncontroversial modifications to the Certificate of Designation, the Board has 10 days from receipt of a modification notice to review and either approve the modification or request additional information. They stated that PCAPP always provides an advanced, informal modification packet to the Director of Planning and Development for Pueblo County, which allows him sufficient time to disseminate the documents within the County. This informal arrangement is done so that they the '10-day clock is not triggered. Once the County Director of Planning and Development has obtained input from other County departments, he submits his executive summary to the Board and the 10-day clock begins. However, PCAPP does not expect the Board's decision until after the Board's regularly scheduled meeting. For their past modifications, the Board has always provided its response (approvals thus far) at the next, regularly scheduled Board meeting when it has received the County Director of Planning and Development's executive summary.

However, the PCAPP Legal Support representative noted that:

> *"Requesting a modification that would allow offsite shipment and treatment of hydrolysate would not be a normal, uncontroversial, modification. In such a situation, under the County's CD regulations such a modification request would, without doubt, be considered a Class C modification. A Class C modification is treated the same as an initial CD application. Under such a scenario, the County has 120 days from receipt of a Class C modification to inform PCAPP of any deficiencies or issue a Certificate of Completeness. Upon the issuance of the Certificate of Completeness, the Board has an additional 180 days to approve or disapprove the modification request. PCAPP could, and would, request an expedited review. The Board would hold a formal Hearing on the modification request. At the hearing, PCAPP and Bechtel representatives would provide testimony and documentary support for the modification request. Members of the public would have the opportunity to support or oppose the modification request."*

The PCAPP Legal Support representative went on to state that:

> *"The Board's decision on the CD would have to be appealed within 30 days of the hearing. If an injunction were requested, an additional 30 days would be required to get expedited scheduling, and a further 60 days (total of 90 days) to submit arguments and briefs; a judge's decision on an injunction typically follows within 2 weeks."*

PCAPP Legal Support also clarified that:

> *"Assuming the Board of Commissioners approves the modification request (this would be likely in that PCAPP would have already obtained the State's (CDPHE) approval) any appeal would go to Colorado District Court. The standard of review is whether or not there is any competent evidence to support the decision of the Commissioners. In essence, the Court would have to find that the Commissioners were arbitrary and capricious in their approval. Obviously, the Army/DoD could seek to have the case removed to Federal district court. However, because this is an extremely difficult standard of review to overcome, the Army/DoD would likely allow the State process to continue."*

The PCAPP Legal Support representative indicated that a judge would likely be reluctant to overturn the decision of the elected board unless there is a showing that the decision is arbitrary and capricious. He noted that Federal courts are less likely to agree to injunctions, and that if the Army decides to insert itself into the suit as a party, the suit could be moved to a Federal court. PCAPP Legal Support indicated that this is typically accomplished in similar cases (a suit between two parties resulting in an injunction against the Federal government) without much difficulty.

Finally, the PCAPP Legal Support representative indicated that based on the current schedule, if a decision to treat hydrolysate offsite were made within the next year, litigation could be resolved without affecting the start of operations. In other words, "assuming the modification request is filed in a timely manner by PCAPP, there should be little, in any, disruption or delay in the construction process."

A.2.4 Discussion with Avondale, CO Residents

The Avondale residents wanted to know where the hydrolysate was going. Noblis explained that the selection of a hazardous waste facility to treat and dispose of the hydrolysate will undergo a competitive bid process, which will be performance based. Hence, the lowest bidder would not necessarily be selected.

One resident had experience with the transportation of hazardous materials and is aware that shipment of hazardous materials is very well regulated. Hence, he did not express concern that the shipment could not be done safely. He thought Level C Personnel Protective Equipment (PPE) would suffice for responding to a truck accident.

They mentioned that transportation of hazardous materials is subject to the requirements in a transportation safety plan, which usually limits the driving hours to 6AM–4PM, identifies the multiple routes that can be taken, uses a convoy of two trucks, etc.

They wanted to know how much it will cost to ship by truck or rail. While no cost data was provided, Noblis explained that the question of shipping by truck or rail will be addressed as part of a transportation risk assessment.

The residents were in agreement that it is time to get rid of the munitions, "just get it done." They are not opposed to offsite disposal. However, they warned about lawsuits by the Sierra Club and other opponents.

They had no additional concerns regarding transporting the hydrolysate. They believe the transporters (and truck drivers) are well qualified to handle and transport hazardous waste—they have to meet training and licensing requirements. They suggested that it would be important to get the goals and procedures of the hazardous waste transporters into the public domain.

They believe that chemicals going to the plant (PCAPP) will be more dangerous than the hydrolysate coming out of the plant.

They highlighted the importance of informing the community, in particular emphasizing the training and certification requirements for drivers, etc. They also suggested sending out flyers to inform the residents.

While not related to the issue of offsite hydrolysate treatment, the residents expressed their frustration with the CSEPP announcement system which, because of echoing, is very hard to understand. They proposed the use of a standard signaling system, perhaps followed by verbal announcement.

A.2.5 Discussion with a Pueblo Resident

The Pueblo resident felt that, if all things were equal, the hydrolysate should be treated onsite. However, since all things are not equal, it is worthwhile to discuss the issue of shipping and treating the hydrolysate offsite, if there are cost savings. His main concern is the potential for litigation and what a delay, incurred as a result of litigation, would do to the cost savings. In the past he has been skeptical about the Army's ability to be involved in a litigation that will not result in delaying munition destruction. However, the Newport experience has shown that this will not be a big concern. Hence, if litigation will not slow down the project, he would be in favor of offsite shipment—just get the agent destruction done and over with.

The resident highlighted some of the difficulties in finding trained and qualified people to do the job. He believes that the loss of a few jobs because the hydrolysate will not be treated onsite is not an economic issue. The community is not very much concerned about such an economic loss because, at present, the economy is pretty good. People who come to the Citizens Advisory Commission (CAC) meetings have pretty much the same agenda (i.e., they generally oppose offsite disposal). The "real" community is not that concerned about offsite disposal of hydrolysate; the vocal group who opposes this option does not really represent the community. As long as the Army can show that the offsite shipment/treatment option is safe, the community will not be opposed to it. In this regard, if a decision is made for offsite disposal, the "message" has to be delivered effectively. Some ways of doing this are as follows:

- Get the support of the business leaders who are in touch with the local communities. (Note: In the past, when the Army wanted to set up a forum with the business community, the opposition group foiled the idea because they did not want the Army

meeting with business leaders without their being there.) In order to address any concerns with jobs that would not be created if the hydrolysate is treated offsite, let the communities know that jobs will ramp up early; also highlight some of the recent construction efforts that have benefited the community (i.e., the new access road to the industrial complex).

- Develop an educational program—provide assurance on the safety of transporting the hydrolysate. Also, educational and public outreach activities should ramp up as soon as a decision is made.
- Meet with Chief Executive Officers (CEOs) from the Airport Industrial Park and get their support—assure them of the transportation safety. The Rotary and the Pueblo Economic Development Corporation are other means of connecting with the business community.
- Once a decision is made, be ready with the information to allay public concerns and ensure that the action can be successfully implemented.
- Get media support—talk with the *Pueblo Chieftain* editorial board about helping educate the public.
- Sen. Allard could be a strong ally, although he is leaving office in a year, as could Sen. and Rep. Salazar. Meet with their staffs in Washington, DC; they may have a better perspective than the local staff in Pueblo who appear to be leaning towards the position of the vocal minority opposing offsite shipment.

A.2.6 Discussion with Local Staff of Colorado Elected Officials

The local staff representatives of elected officials would like to move forward with the destruction of the stockpile of agent at PCAPP and support efforts to expedite the schedule. They also recognize that there is some local opposition to the offsite shipment of the hydrolysate. There was a concern regarding the likelihood of any cost savings. Specifically, the local representatives recalled a statement made by Mr. Mike Parker, former Director of CMA, in mid-2006 that there would not be any cost savings from the offsite disposal of hydrolysate unless a decision was made by February 2008. Noblis indicated that Mr. Parker's statement was based on the 2006 LCCE and schedule, and reflected the schedule for the procurement of long-lead items for the biotreatment area. The current schedule, which is subject to an annual cap, has delayed the procurement of these items by several years. Noblis also indicated that its analysis would consider the sunk cost of construction and equipment procurement for the onsite treatment of hydrolysate as well as the cost associated with the offsite disposal of hydrolysate.

The impact of the decision to treat hydrolysate offsite on jobs is very important. In the late 1980s, there was a significant economic downturn and approximately 16,000 jobs were lost in the Pueblo, Colorado, area. Since then, there has been a lot of emphasis on creating local jobs. The economy has recently improved, and the current unemployment rate is approximately 4%.

There was general consensus that contingencies should be identified to ensure the safe transportation of the hydrolysate (e.g., not shipping during blizzard conditions). There was extensive discussion concerning the potential destination site for the hydrolysate. The Noblis report should indicate what disposal alternatives were considered in the analysis, how the costs for disposal were determined, and describe the contracting procedures for determining the hazardous waste disposal subcontractor. It was recommended that Noblis' analysis consider the

uncertainty stemming from a possible temporary closure of the disposal site. Addressing the safety issue at a level similar to that of Newport would be useful.

One staffer indicated that the local community is not paying much attention to the hydrolysate issue and is not generally concerned. However, there is a small, vocal group of people who have always been against the offsite shipment of hydrolysates for a variety of reasons, and they will continue their opposition. She emphasized the importance of due diligence in conducting this effort. She also suggested that PCAPP provide information on specific examples of facilities that are currently treating agent hydrolysate (or could treat the hydrolysate from PCAPP) to make the issue more tangible to the community. In summary, she indicated that the Senator's first and foremost concern is meeting the deadline set (2017) in the latest legislation for disposal of the US stockpile. If this study can help meet the deadline, he might not object to offsite shipment.

Another staffer expressed his concern regarding any potential delays in the destruction of agent caused by the performance of this study. Noblis indicated that its analysis is being conducted in parallel with the construction of PCAPP and will not impact the current construction schedule. In summary, the staffer indicated that the Senator wants the stockpile destroyed as quickly as possible.

Another staffer indicated that he receives several phone calls from constituents whenever there is an article in the *Pueblo Chieftain*, the local newspaper, regarding the offsite disposal of hydrolysate. He also mentioned that the recent expansion of the scope of testing and activities at the Army's Pinon Canyon project has resulted in a loss of trust between the local communities and the Army. In response to receiving the draft notes from the meeting, the staffer stressed that the Senator is opposed to offsite destruction because he has strong concerns that litigation and permitting difficulties will result in cost-growth and delays to weapons destruction. The staffer added that these concerns were reinforced by the findings of two studies (Lean Six Sigma and Mitretek) that were completed in early 2007. The Lean Six Sigma study estimated a 59-month delay from offsite destruction, given that local communities are opposed to offsite destruction. The current study is both redundant and unnecessary; we already know that offsite destruction is more expensive and will cause delays to weapons destruction. Besides, the plant design already provides for on-onsite destruction of hydrolysate.

Another staffer indicated that the issue of offsite disposal of hydrolysate had been evaluated in the past. Specifically, she recalled that, in a public opinion survey conducted for PM ACWA by the Keystone Institute several years ago, most participants voted against offsite shipment. She is concerned that this new effort may prove to be of little value considering local opposition.

A.2.7 Discussion with CAC Members

The CAC wanted to incorporate the comments from the 2006 comments into the record. Although there is no formal record for the project, Noblis agreed that the 2006 comments would be considered in this analysis and incorporated by reference into the project report.

The public debate would be served if the transportation risk document for Pueblo hydrolysate were redone. The CAC noted that highway conditions have changed since the original assessment. A very important issue for our consideration is that any incident involving a hydrolysate tanker, even one that does not result in injury or fatality, would likely halt the program for an extended period for investigations, etc.

Information dissemination in the event of an incident needs to be planned and discussed with the public. A recent incident at a local Ashland plant and the panic that ensued was described.

The public debate needs to address the question of planning and analyzing transportation safety before the destination of the waste is known.

Environmental justice concerns were raised, and the approach used for implementing hydrolysate transport at the Newport site was described as a failure.

The CAC also raised the ethical issue of unnecessarily imposing risks on otherwise uninvolved bystanders.

Issues related to risk were discussed. The CAC noted that there were conflicting signals sent by messages intended to reassure the public about the low level of risk associated with the mustard and the message concerning the risk benefits of accelerating destruction by treating hydrolysate offsite. CAC members are convinced that the risk of transporting hydrolysate offsite—no matter how low—are greater than the risk of treating it onsite.

The CAC noted that the funding caps during operations, which are part of the base assumptions of our study, are inadvisable because of the issue of weekly startup and shutdown of process units.

The CAC mentioned that there is a significant body of local opinion that the risk the community has lived with for 50 years justifies an opportunity to gain jobs and local spending from the destruction of the chemical munitions.

The CAC indicated that there is a significant likelihood that, if a decision is made to transport hydrolysate offsite, legislation prohibiting that option will follow "within a week." This is based on conversations with Sen. Salazar's Washington staff.

Local elected officials will likely be pressured if they approve an amendment to the CD allowing offsite transportation.

The CAC suggested that it will be important to explain the constraints on Noblis' study very prominently so that the application of our results is not misperceived.

A.3 Summary of Meetings with Kentucky Stakeholders

The following sections summarize interviews that Noblis conducted with various Blue Grass Chemical Agent-Destruction Pilot Plant (BGCAPP) stakeholders in Kentucky on 12-14 December 2007.

A.3.1 Discussion with Kentucky Regulators

Discussion with Kentucky Department of Environmental Protection (KDEP) staff focused primarily on the RCRA permit for BGCAPP. They indicated that their position on the permit (as provided to Noblis in 2006) has not changed. That is, if the Supercritical Water Oxidation (SCWO) is deleted from the design, PM ACWA would need to provide a strong justification for why the Research, Development, and Demonstration (RD&D) permit is still valid. If the modified justification is rejected by KDEP, this will stop plant construction until a RCRA Part B permit is issued.

They also noted that, regardless of whether or not PM ACWA pursues the offsite disposal of hydrolysate, it may be a good idea to start, in advance of filing a modification request for the RD&D permit, the RCRA Part B application as soon as the design is finalized.[6] They are willing to consider a "phased" Part B approach where a permit can be issued for parts of the facility (e.g., per building). For example, a Part B permit for the Munitions Demilitarization Building (MDB) can be issued as long as the 99.9999% (six 9's) agent destruction during hydrolysis is met.

When asked how long it will take for KDEP to approve a Part B permit application and issue a permit, their response was that several factors can contribute to the timeline, including the following:

- Extent to which KDEP receives information on the final design prior to filing an application
- Completeness of the application
- Review of application—dependent on information provided in the application
- Public Notice (including public meeting)—this typically takes 45 days
- Response to Public Comments—typically 60 days
- Issuance of permit—usually 30 days

Considering other constraints (e.g., staffing) and past experience, the most optimistic schedule for issuing a Part B permit for the MDB would be 1 year from the time the application is filed. However, based on their experience in issuing a RCRA Part B permit, this could take up to 3 years.

KDEP staff also indicated that they have limited staff and there are priorities that compete for the time they devote to BGCAPP, such as the SCWO for BGAD and the permit to treat the GB

---

[6] *In October 2008, PM ACWA indicated to Noblis that they have already begun an accelerated application process.*

ton containers by the Blue Grass Chemical Activity (BGCA). Apparently, two of the five positions for permitting analysts have been eliminated. Ralph Collins made this an action item for him to determine how PM ACWA can talk to the Governor's office concerning KDEP staffing since PM ACWA is providing funds to KDEP and the money is not being spent because of a hiring freeze.

When asked if they would be required to review the transportation safety plan and waste characterization of the hydrolysate, similar to what the Indiana Department of Environmental Management did for the Newport hydrolysate, KDEP responded that they have no such regulatory requirement, but would be interested in receiving similar information and can perform such a review if asked. Their concern is the nature of the waste before it leaves the facility.

A.3.2 Discussion with Kentucky Citizens' Advisory Commission and Chemical Destruction Community Advisory Board Members

This section covers the information provided by the Kentucky Citizens' Advisory Commission (CAC) and Chemical Destruction Community Advisory Board (CAC/CDCAB) members, both in the interview conducted with Noblis and in subsequent communications.

The CAC/CDCAB discussion points included the following:

- The CAC and the CDCAB have gone on record more than once to recommend that all agent and energetic hydrolysate generated at BGCAPP be treated onsite via the secondary treatment process identified in the 2003 Record of Decision, which is SCWO. The Department of Defense, ACWA, and others need to move forward to implement the approved program within the timeframe provided by Congress.
- Whether the Noblis analysis assumes no other possible budget besides the 2006 LCCE that was the basis for the 2007 Program Baseline. Noblis explained that this was the basis for its analysis.
- There was considerable discussion concerning whether putting forward preliminary estimates would result in press reports that would be prejudicial. A subsequent teleconference with PM ACWA provided guidance that such figures not be shared with members of the public before they had been briefed to PM ACWA.
- Any data presented as part of the Noblis study, including the Government's LCCE, must be reviewed independently by someone trusted by the community to give it credibility in any decision.
- The CDCAB provided a list of 18 issues that had been separately provided to PM ACWA. One member indicated that the list reflected the shared concerns of his CDCAB Co-Chair, the Madison County Judge-Executive.
- The CAC/CDCAB members predicted that any decision to treat the hydrolysate offsite would open a huge controversy in the community. They noted that many in the community feel as if onsite hydrolysate treatment was included "in the agreement" when BGCAPP initially gained community acceptance, and that offsite disposal of the hydrolysate would be viewed as reneging on the previous agreement. There will be no time to build a new consensus and this will delay, rather than accelerate, the program. The Army already has numerous public trust issues, an example of which was provided

by the 12 December editorial in the *Lexington Herald-Leader* on the recent leaking ton container at the Blue Grass Army Depot (BGAD).

- The loss of jobs was expressed as an important issue to the CAC and to the Judge-Executive. Better data on the numbers involved, as well as on the potential for re-use of the SCWO facility and re-employment of SCWO workers, would be helpful to this component of the debate.
- It was noted that Kentucky legislation had been changed as a result of citizen input to allow BGCAPP to start, and that legislation could be changed again as a result of such input.
- It was observed that citizens are tired of the issue, so getting them to understand new twists will be difficult.
- One member recommended that the Noblis study be performed after the new LCCE for the 2017 deadline has been developed, as there is uncertainty related to comparing the 2007 Program Baseline estimates with the FY08 Defense Appropriations Act directing the DoD to complete agent destruction by December 2017.

One member expressed concern that DoD intends to study this issue until it gets the answer it wants. The continuous restudy of options and reframing of timelines (first speed it up, then slow it down), a result of political and budgetary maneuvering, have worn down citizens who are attempting to stay informed of the process and ensure disposal occurs in a safe and efficient manner.

The member also indicated that there are four key factors in the decision: safety, social justice, schedule, and cost. All of these are related. Both public safety and cost considerations are impacted by schedule. A schedule has been approved by Congress and funding commitments for the foreseeable future. As established by prior studies, both schedule and cost would be negatively affected by offsite disposal. Delays due to litigation and permitting changes are both expected if offsite disposal is pursued.

The member also stated that: "Citizens of this community have repeatedly expressed a commitment to social justice. From the very beginning of the process to identify a safe way to destroy these weapons, local citizens sought not only a way to protect their own community but to respect the rights of other communities. The Chemical Weapons Working Group (CWWG) arose from the agreement reached among the various weapons sites that they would not pursue a solution that shifted harm to another community. Shipping hydrolysates offsite for disposal violates the spirit of that agreement by exposing many other communities along the transportation corridor, not to mention the receiving community, to unnecessary danger."

Finally, the member suggested that the community had lost confidence in the Army and DoD because of what some considered the underhanded way they went about shipping VX from Newport to Port Arthur, TX (Veolia) without gaining prior approval of the receiving community.

A.3.3 Discussions with Elected Officials and Their Representatives

Discussions with the elected officials and their representatives focused on public sentiment and constituent perceptions and expectations regarding the onsite or offsite disposal of hydrolysate.

Noblis indicated that any cost savings from the offsite disposal of hydrolysate would be used to expedite the schedule for the destruction of agent, which would, in turn, reduce the stockpile storage risk. One official questioned the Army's sincerity regarding the stockpile risk reduction and asked why safety risk was not a concern when the Army prolonged the schedule. He indicated that every time the issue of transporting hydrolysate and changes in the schedule come up, the public's confidence in the Army is undermined. He also noted that the issue of stockpile acceleration is only an issue because of the DoD's actions to constrain funding, which caused years of delay for which the offsite disposal of hydrolysate can only partially compensate. He noted that this ignores what Senators and Congressmen are saying.

Another official highlighted the importance of community safety, which should be counter balanced by the potential for base closure and loss of jobs. It is understood that the hydrolysate is an industrial waste, not a lethal substance. As far as the community is concerned, cost savings are the least important element. The schedule for the neutralization of agent at BGCAPP has been drawn out to pay for other DoD activities (i.e., the Iraq war). One way to address the issue of jobs would be for DoD to include the depot in the protected list of bases to ensure that it will not be added to the list of closed bases in the future. This could address the community's concern regarding the jobs that would not be created if the hydrolysate is shipped offsite for treatment. There is also a heightened concern on the part of the business leaders in the technical community that some of the most highly qualified people will be taken to run the SCWO at the detriment of other high tech jobs in the area.

Another official indicated that, to the extent possible, local processing of hydrolysate in Kentucky should be considered in order to keep jobs in the state. The possibility of building a treatment facility in Kentucky was also discussed. However, the counter argument was that the construction of a new facility would invite the transfer of waste from other states into Kentucky. Since, at this time, DoD has not made a decision to transport the hydrolysate, it would be difficult to determine if there are existing waste treatment facilities in Kentucky that would be able to process the hydrolysate.

It was also noted that a new Citizen's Advisory Committee had been formed to look into creating new jobs at the depot. Currently, the depot is being retrofit for armor plating of vehicles sent to Iraq. Any decisions regarding the offsite disposal of hydrolysate should be at the intersection of public safety, long-term survival of jobs, and depot mission. Public distrust has been exacerbated by what the Government wants to do with the long-term mission of the depot and its impact on jobs.

A.3.4 Discussion with Madison County Residents and Civic Organization Representatives

The interviewees wanted to know the following:

- The local risk associated with the hydrolysate, the transportation route, where the hydrolysate is going, and the impact of the waste on the receiving communities
- The cost of keeping the hydrolysate treatment onsite and the risk associated with the possibility that a TSDF may not be able to receive the hydrolysate
- If there is a facility capable of treating and disposing of the hydrolysate in Kentucky
- The importance of educating the local communities was stressed.

One individual expressed his trust of the BGAD as he has lived in the area all his life. However, he did not want to be a guinea pig for the testing of a new technology. He would not mind if the munitions are taken out of Kentucky as long as they are taken to a proven facility.

Two residents were also interviewed for the 2006 Noblis (Mitretek) study. They basically said the same thing—they want the munitions moved to an incineration facility because they believe they could be destroyed faster there, and the citizens of Kentucky will not have to wait another 10 years to get the munitions and agent destroyed. They believe that the Army should be left alone to do its job. One resident cited the Army action on the leaking GB ton containers as a good example of how prompt action on the Army's part will lead to faster destruction of the GB ton containers.

A.3.5 Discussion with Local University and Business Representatives

There is insufficient information on the hydrolysate—no waste characterization data has been presented. There was some discussion on how risk information needs to be presented at different levels, e.g., handouts for the general public and CDC reports for college faculty.

Where the hydrolysate is going and the transportation route that will be used is not known.

Transporting waste is not good because of added risk. The issue of the potential impact to the environment in the event of a spill (e.g., surface water contamination) was also discussed.

Any action that leads to lots of publicity is not good for their institutions and could impact recruitment.

Educate the people in the community about the hydrolysate because of the "fear of the unknown." There is at least some public perception that hazardous materials already are leaving the site because people have seen construction and new highways; education is needed to overcome that perception.

A well-organized, vocal group against the offsite disposal of hydrolysate can control the information disseminated to the community. Hence, it is very important that accurate information be provided to the public. The more information provided the better.

They acknowledged that a great deal of work needs to be done to develop the information needed to educate the public about the issue, and it should be provided before a decision is made to ship the hydrolysate offsite. They also acknowledged that if the SCWO brings high-technology jobs to the area, the people in the community would welcome that and support the building of the SCWO at BGCAPP.

A.3.6 Discussion with Emergency Management Representatives

The Madison County Emergency Management Agency Director categorically stated his opposition to the offsite disposal of hydrolysate for the following reasons:

- There are many "unknowns"—such as where the hydrolysate is going; after a decision is made to treat offsite, it will be several years before the hydrolysate is actually shipped to a commercial facility; and there are no definitive numbers as to the number of trucks per day and how many gallons of hydrolysate will be shipped on a daily basis.
- Lawsuits arising from a decision to ship offsite will cause more delays in the destruction of the stockpile.
- Although the amount of waste generated by operation of a SCWO facility would be close to that for hydrolysate (which is in liquid, diluted form), he is more comfortable with shipping solid wastes from the plant (e.g., SCWO byproducts) than millions of gallons of caustic liquid waste.
- The emergency response team is not equipped to handle a large volume of spills.
- Hydrolysate is not officially listed in the Emergency Response Guide (ERG). They do not have equipment in Madison County to deal with a hydrolysate spill during transport. He thought Level-A HAZMAT PPE would be required to respond to a hydrolysate spill. He also expressed concerns that the Newport hydrolysate may not be at the six 9's level by the time it reaches Texas, where the offsite disposal facility is located.
- They have had 26 truck accidents per year in Madison County, mostly involving tankers carrying small quantities of hazardous materials (150–200 gallons). However, one recent spill of 4,000 gallons of emulsified sulfur was significant, and the response team was not equipped to handle such a large volume of spill.
- The Army already made an agreement with the community about using the SCWO to treat the hydrolysate; consideration of offsite disposal amounts to the Army reneging on that agreement.
- The recent experience with the transportation of depleted uranium hexafluoride from Oak Ridge has proven that no matter what type of administrative controls are put in place for the transportation of HAZMAT (e.g., truck to stay on designated routes, not stopping in rest areas), the drivers may not follow them.
- The rhetoric about saving money and accelerating destruction does not make sense. The DoD diverted funds for other uses; now they want people to believe they are for saving money by doing away with the SCWO.
- Munitions have been stored for 70 years—focus on getting rid of them. Consideration of offsite shipment is seen as another attempt to further delay the destruction of these munitions.

- Providing information that can be trusted would help; however, trust in the Army (due to leaking GB ton containers, cover up allegations, and the whistle-blower case) is as low as it has ever been.

The Madison County Emergency Management Agency Director indicated that the County Judge-Executive shares his views. He also said that they will fight for a RCRA Part B permit if the SCWO is removed from the plant design.

The main interest of the Kentucky State Police representative was in the training of personnel, i.e., State Police Officers, for emergency response to accidents involving hydrolysate (during transport) in the districts within the transportation route. Specifically, he identified two activities that would have to take place if hydrolysate were to be shipped: (1) training of the State Troopers at each post area, and (2) identifying the specific transportation routes (e.g., I-70, I-64). In general, the State Police representative could not see any major impediment to the transportation of hydrolysate especially if the hydrolysate is a less dangerous material than depleted uranium hexafluoride, which was recently transported in KY.

Appendix B Supporting Documentation for Preliminary Evaluation of Shipping Hazards

This appendix contains the detailed information that supports the preliminary evaluation of shipping hazards, as presented in Section 6.2.

B.1 Evaluation Approach

This section describes the analytical approach used to compare the relative shipping hazards associated with onsite treatment and offsite disposal of ACWA hydrolysates.

B.1.1 Chemical and Waste Shipment Data

Noblis collected information from previous life cycle cost estimates and the ACWA site designs (e.g., mass and material balances, process information, etc.) and adjusted them to compile estimates of chemical and waste shipments for BGCAPP and PCAPP. It should be noted that the available data was not all inclusive, but the missing data identified either represents shipments that do not change or that decrease with offsite hydrolysate disposal, resulting in somewhat more conservative estimates. Basically, there are many different types of shipments associated with onsite treatment of hydrolysates, and one additional type associated with offsite disposal of hydrolysate—ACWA hydrolysates from the destruction facilities to the TSDF(s).

Design information is not available for the processes proposed to achieve the accelerated schedule (impacts BGCAPP, not PCAPP). Therefore, this evaluation only addresses the current site process designs compared to the conceptual offsite hydrolysate disposal process. This was to limit the uncertainty with the numbers for offsite shipments, not both onsite and offsite.

To the extent the data was available, Noblis also tried to account for shipments associated with each life-cycle phase of the sites, including any hazardous material shipments resulting from offsite testing (e.g., FOAK or shop testing), that would be eliminated if that equipment was no longer used for offsite disposal. Additionally, truckloads of equipment and other materials needed for fabrication and construction of the facilities eliminated by offsite hydrolysate disposal are not known.

In every case, the chemicals specific to the changes resulting for offsite hydrolysate disposal are available. However, in some cases, data for other chemicals or wastes were available for one site and not the other, even though both sites should use those chemicals or produce a similar waste. The site-inconsistent data related to offsite testing, anti-scale/anti-corrosion chemicals used for the boiler systems, nitrogen, lab gases, closure wastes, and office waste (rubbish). Typically, more information was available for BGCAPP than for PCAPP. In these cases, Noblis used its engineering judgment to ensure consistency or, at the very least, include the chemical or waste in the list for completeness.

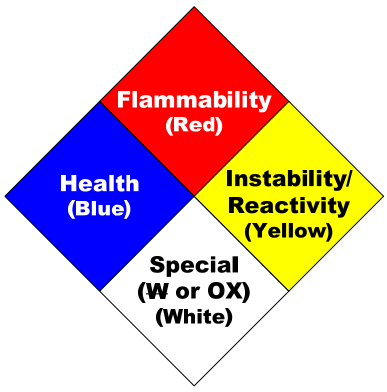
B.1.2 Data Precision

It should be noted that this is a preliminary evaluation using available data to show general trends and comparisons. As such, precise accuracy is not required. For example, small changes in the number of truckloads have little change on the comparative percentages. To illustrate, an inaccuracy of 50 truckloads of the most hazardous chemicals at BGCAPP would only equate to about 1% of the total for these chemicals, and only 0.5% of the total truck shipments. In addition, some of the small-volume chemicals will not necessarily be shipped in full truckloads (e.g., totes); again, this is not expected to significantly affect the overall conclusions of this preliminary evaluation.

Although these numbers could be refined as mass and material balances are developed for the new design, they appear sufficient for this preliminary evaluation. As will be shown below, the uncertainty is unlikely to change the overall findings of this evaluation (i.e., that relative transportation risk could potentially be reduced with offsite hydrolysate disposal). Additionally, the process simulation models for each site could be used to more accurately identify the quantities for both the onsite case and, by shutting down some portions of the model, the offsite hydrolysate disposal conceptual design. The BGCAPP model could also be used to simulate the accelerated schedule conceptual design, but would likely require additional work.

B.1.3 Transportation Hazard Identification

Transportation hazards for each chemical and, to the extent available, waste were identified and placed in tables, along with ratings under the National Fire Protection Association (NFPA) Standard 704, "Standard System for the Identification of the Hazards of Materials for Emergency Response". This standard addresses "the health, flammability, instability, and related hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies". This information is presented in a placard (the hazard "diamond") that is placed on transporting vehicle and is used to provide quick hazard information for emergency responders. Higher hazards are assigned higher numbers in the NFPA standard.



NFPA Hazards Rating "Diamond" Placard

B.1.4 Relative Hazard Perspectives

Not all truckloads are equal—perspectives are an important consideration. Noblis examined some of the transportation hazards resulting from a catastrophic release (due to an accident or spill) from three perspectives: Environmental, First-Responder (*e.g.*, police, fire, HAZMAT, and other emergency responders), and the Public. Noblis used its best, impartial judgment to assign a rating to each of these perceived risks—the ratings are both qualitative and relative. Ratings were assigned only to those materials where the number of shipments changes significantly between the two options. For a comparative study, factors that do not change (or change very little) are not discriminators. Additionally, long-term environmental risks are a much more complex issue and cannot be assessed at this time. These must be evaluated as part of a formal Transportation

Risk Assessment, which would be conducted once actual shipment routes are being considered. Finally, this evaluation does not include risks attributable to continued exposure of workers at the sites (CAPP or TSDF).

- **Environmental:**
  "Is it going to hurt the flora or fauna/human health?"
  This perspective is related to the immediate hazard to the environment associated from a catastrophic release of the material. From an environmental perspective, primary concerns relate to the likely impacts of the materials on the environment. For example, from a release pathway standpoint, liquids generally present a higher hazard than do solids due to their ability to flow. In the sections that follow, the potential impact of each material is briefly summarized and a qualitative rating is assigned to each material based on the relative short-term environmental impact.

  - **First-Responder:**
  "Is this going to be dangerous/difficult to clean up and how fast does it spread?"
  This perspective is related to the hazard to the first-responders associated with a catastrophic release of the shipment. From first-responders' perspectives, primary concerns would typically relate to the NFPA 704 factors: Health, Flammability, Instability/Reactivity, and special precautions. For example, generally speaking, gases and volatile liquids are expected to represent more of a threat to first-responders than less volatile liquids, which are expected to represent more of a threat than non-volatile solids (depending on the reactivity). In addition, the level of personal protective equipment (PPE), such as clothing and masks, was also considered. In the sections that follow, the potential hazard posed by each material is briefly summarized and a qualitative rating is assigned based on its relative health effects, flammability, reactivity, and stability.

- **Public:**
  "Is that truck going to hit me or will a release cause a dangerous cloud and require evacuation?"
  This perspective is related to the risk to the local, general public associated with a catastrophic release of the shipment. The general public's concerns include the potential for dangerous releases to the air that could pose health risks or the inconvenience of evacuation. In the sections that follow, the potential hazard posed by each material is briefly summarized and a qualitative rating is assigned based on its relative health effects and the potential for the hazard to spread beyond the immediate site of the spill. Another major concern is related to the overall number of trucks, as that equates to the probability of involvement in an accident. The total volume of shipments is considered for each of the sites.

Finally, an overall relative hazard rating is assigned to each material based on the aggregate evaluation of the three perspectives discussed above. It should be stressed that these hazard ratings are relative within this study; in absolute terms, large volumes of even the highest hazard substances covered in this study are routinely shipped safely. When spills of these very high hazard materials occur, emergency responders train in standard hazardous materials response measures to effectively address the hazards. The materials rated as "very high" hazards in this

study are considerably less hazardous than some materials that are routinely transported in U.S. highways.

B.2 BGCAPP Preliminary Evaluation

The BGCAPP comparative transportation data for materials that would be shipped in different quantities in the two alternatives, NFPA hazard ratings, and the qualitative "relative hazard" factors, provided in Table B-1, are based on the APB design. At this time, Noblis could not account for the various process flow changes caused by the BGCAPP design for the proposed Acceleration Assessment, which moves the entire mustard campaign from the MDB/SPB to an EDT facility that is yet to be defined. The implications of these changes to the

Table B-1. BGCAPP Shipments for Onsite and Offsite Treatment Alternatives

		Truckloads		NFPA 704 Hazard Diamond Rating				
Substance	Primary Usage/ Source	Onsite	Offsite	Health	Flamm-ability	Instability/ Reactivity	Special	Overall Relative Hazard
Acid, sulfuric, 93%	APS/AFS	88	3	3	0	2	COR, W	Very high
Acid, hydrochloric, 35%	APS/AFS	97		3	0	0	COR	Very high
Acid, phosphoric, 75%	APS/AFS	18		3	0	0	COR	High
Caustic, sodium hydroxide, 50%	ANS	209	201	3	0	1	COR	High
Isopropyl Alcohol, 70%	SCWO	262		1	3	0		Medium
GB Hydrolysate Surrogate	SCWO	9		2	0	0		Medium
Salt	Plant-wide	16	8	1	0	1		Very low
Nitrogen	Plant-wide	3,589	3,418	3	0	0	SA	Low
Aluminum Filter Cake	APS/AFS	165		1	0	0		Very low
Brine Solution	WRS	4,635		0	0	0		Low
Hydrolysate, Agent, GB	ANS		205	3	0	1	COR	Medium
Hydrolysate, Agent, VX	ANS		40	3	2	1	COR	Medium
Hydrolysate, Warhead, GB & VX	ENS		430	3	0	1	COR	Medium
Hydrolysate, Agent, HD	ANS		53	2	0	0		Medium
Hydrolysate, Energetics, HD	ENS		91	3	0	1		Medium

process flow ins and outs are too wide-spread to predict their effect on the existing mass and material balances. Significant systems that would be reduced, eliminated, and/or rerouted include, at a minimum, the EBH, ENS, OTE, MWS, MPT, SCWO, and WRS. Systems that are added include the EDT unit and its offgas treatment system (wet scrubber with aqueous sodium hydroxide for acid gases), plus its onsite process destination of the flows (e.g., brines to SCWO/WRS), if any. However, it should be noted that the liquid effluent of the EDT facility is likely to be primarily a brine solution from its offgas treatment system, with primarily ash and scrap metal as its solid effluent. Additionally, plant utilities (e.g., steam, hot and cold water, etc.) and the chemicals associated with these systems are assumed to be unchanged between onsite treatment and offsite disposal. This section presents a preliminary evaluation of the hazards posed by each of these substances based on the three perspectives outlined earlier, along with a qualitative overall relative hazard descriptor. These overall descriptors will be combined with the estimated shipment volumes to provide a preliminary basis for comparing the hazards posed by the onsite and off-site treatment alternatives.

Sulfuric Acid

Ninety-three percent sulfuric acid is used in the APS/AFS; an estimated 88 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas an estimated 3 truckloads will be shipped to the site if hydrolysate is treated offsite at a commercial TSDF. Sulfuric acid is considered a Priority 1 substance under the Agency for Toxic Substances and Disease Registry's Hazardous Substances Emergency Events Surveillance (HSEES) system. Acute releases of Priority 1 Substances are likely to result in public health actions such as an evacuation, and are more likely than other releases to involve injuries. This material is primarily a contact hazard; concentrated sulfuric acid is strongly corrosive and can cause severe burns to skin, eyes, or the respiratory tract. Reactivity of concentrated sulfuric acid with metals leads to generation of hydrogen and reactivity with some organic materials such as acetone or alcohols can lead to fires or explosions. Mixing with water can be dangerous because of the high heat of mixing which can cause violent spattering. Sulfuric acid can also react with environmental materials such as limestone. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 93% sulfuric acid are as follows:

- The severely caustic nature of sulfuric acid and its unusual reactivity with water and metals present a very high hazard to first responders or to members of the public at the scene of a spill.
- The strongly acidic and reactive nature of sulfuric acid presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a high hazard to the public at large because if sulfuric acid mixes with water, violent spattering can cause some of the material to become airborne as droplets, presenting a limited threat to those downwind of the spill site.

Overall, shipments of 93% sulfuric acid present a very high hazard.

Hydrochloric Acid

A 35% solution of hydrochloric acid is used in the APS/AFS; an estimated 97 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas none will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. Hydrochloric acid is considered a Priority 1 substance under the HSEES system. This material poses both an inhalational hazard and a contact hazard. A spill of 35% hydrochloric acid will offgas hydrogen chloride, which has a 1-hour Short-term Public Emergency Guidance Level (SPEGL) of 1 ppm, or 1.5 mg/m^3. Hydrogen chloride has an immediately danger to life or health (IDLH) concentration of 50 ppm, or 75 mg/m^3. Models suggest that a 500 gallon spill of 35% hydrochloric acid when the temperature is 85°F could generate IDLH concentrations of hydrogen chloride up to several hundred yards downwind, and could reach the SPEGL up to 1.5 miles downwind. 35% hydrochloric acid is also corrosive to skin and the eyes, producing severe burns.

Reactivity of 35% hydrochloric acid with metals leads to generation of hydrogen. Hydrochloric acid can also react with environmental materials such as limestone. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 35% hydrochloric acid are as follows:

- The contact hazard and local inhalation hazard presents a very high hazard to first responders or to members of the public at the scene of a spill.
- The strongly acidic and reactive nature of 35% hydrochloric acid presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a very high hazard to the public at large because the airborne threat can migrate significant distances downwind from the spill site.

Overall, shipments of 35% hydrochloric acid present a very high hazard.

Phosphoric Acid

Phosphoric acid is used in the APS/AFS; an estimated 18 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas none of this material will be required if hydrolysate is treated off-site at a commercial TSDF. This material is primarily a skin contact hazard, although it can also present a minor inhalation hazard if a mist is generated. Phosphoric acid is a strong acid, which can react with some metals to generate hydrogen, which can in turn present an explosive hazard under some circumstances. Phosphoric acid has no significant systemic effect, and the chance of pulmonary effects from mist or spray inhalation is said to be remote. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping phosphoric acid are as follows:

- The skin contact hazard presents a high hazard to first responders or to members of the public at the scene of a spill.
- The corrosiveness presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.

- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site except in some specific and improbable scenarios.

Overall, shipments of phosphoric acid present a high hazard.

Sodium Hydroxide

A 50% aqueous solution of sodium hydroxide is used in the ANS; an estimated 209 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas an estimated 201 truckloads will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. This material is primarily a skin contact hazard; causing irritation or severe burns vey quickly. A mist formed from the solution can also present an inhalation hazard. The reactivity of this substance with some metals (notably aluminum) generates hydrogen, which can present an explosive hazard under some circumstances. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 50% aqueous sodium hydroxide are as follows:

- The skin contact hazard presents a high hazard to first responders or to members of the public at the scene of a spill.
- The corrosiveness presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site except in some specific and improbable scenarios.

Overall, shipments of 50% aqueous sodium hydroxide present a high hazard.

Isopropyl Alcohol

Seventy percent isopropyl alcohol is used in the SCWO; an estimated 262 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas none will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. This material is primarily a flammability hazard. Isopropyl alcohol also poses a minor inhalational hazard; models suggest that a 500 gallon spill of 70% isopropyl alcohol when the temperature is 85° F could generate IDLH concentrations of 2,000 ppm isopropyl alcohol within 25 yards downwind of the spill and concentrations exceeding the 1-hour emergency exposure guidance level of 400 ppm 72 yards downwind. Isopropanol has been identified as a metabolic product of aerobic microorganisms, anaerobic microorganisms, fungi, and yeast, and is typically present in the environment. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 70% isopropyl alcohol are as follows:

- The flammability presents a high hazard to first responders or to members of the public at the scene of a spill.
- The solvent properties of isopropyl alcohol present a medium hazard to the environment at the point of a spill. However, isopropyl alcohol has been identified as a metabolic product of aerobic microorganisms, anaerobic microorganisms, fungi, and yeast, and is

readily biodegraded. Therefore, it is expected to pose a much lower hazard as the material is diluted in more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of 70% isopropyl alcohol present a medium hazard.

GB Hydrolysate Surrogate

GB hydrolysate surrogate is used in the SCWO; an estimated 9 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas none will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. This material is expected to have a pH of roughly 13.5, making it corrosive and a contact hazard. At this pH, the hazard is somewhat less than for concentrated sodium hydroxide solutions; irritation may not develop for several hours. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping GB hydrolysate surrogate are as follows:

- The contact hazard presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The elevated pH presents a medium hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of GB hydrolysate surrogate present a medium hazard.

Salt

Salt is used plant-wide typically for water softening; an estimated 16 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas an estimated 8 truckloads will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. This material is primarily a minor contact hazard; solid salt causes contact dermatitis and the dust can be irritating if inhaled. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping salt are as follows:

- The contact hazard presents a very low hazard to first responders or to members of the public at the scene of a spill.
- The potential for killing vegetation contacted by the salt presents a low hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a very low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of salt present a very low hazard.

Nitrogen

Nitrogen is used plant-wide; an estimated 3,589 truckloads will be shipped to the site if hydrolysate is treated onsite in the SCWO whereas an estimated 3,418 truckloads will be shipped to the site if hydrolysate is treated off-site at a commercial TSDF. This material is primarily a contact hazard because it would most likely be shipped in liquid form. Liquid nitrogen is a cryogenic material, and the extreme cold can burn exposed skin surfaces. In some circumstances where the material is spilled into a confined space, the boil-off can drive out oxygen in the space, creating an asphyxiation hazard. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping liquid nitrogen are as follows:

- The contact and asphyxiation hazards present a medium hazard to first responders or to members of the public at the scene of a spill.
- Liquid nitrogen presents a very low hazard to the environment at the point of a spill.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of nitrogen present a low hazard.

Aluminum Filter Cake

Aluminum filter cake is produced in the APS/AFS; an estimated 165 truckloads will be shipped from the site if hydrolysate is treated onsite in the SCWO whereas none will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. This material is primarily an inert solid composed of alumina and adsorbed water. The solid material can cause mild skin irritation, and can irritate the nose and lungs if dust is inhaled. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping aluminum filter cake are as follows:

- The potential for irritation presents a low hazard to first responders or to members of the public at the scene of a spill.
- The filter cake presents a low hazard to the environment at the point of a spill.
- This material presents a very low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of aluminum filter cake present a very low hazard.

Brine

Brine solution is produced in the WRS; an estimated 4,635 truckloads will be shipped from the site if hydrolysate is treated onsite in the SCWO whereas none will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. The brine solution is primarily composed of water, sodium chloride, sodium phosphate, and sodium sulfate salts; solutions of these salts typically present a minor threat of dermatitis. The brine solution could migrate through the environment, killing some vegetation along the way. Based on a combination of these hazards

and the expected NFPA ratings, a preliminary evaluation of the hazards of shipping brine residue are as follows:

- The contact hazard presents a very low hazard to first responders or to members of the public at the scene of a spill.
- Vegetation kill presents a low hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a very low hazard to the public at large because the threat is expected to remain local to the spill site except in some specific and improbable scenarios.

Overall, shipments of brine solution present a low hazard.

GB Hydrolysate

GB hydrolysate is produced in the ANS; none will be shipped from the site if hydrolysate is treated onsite in the SCWO whereas an estimated 205 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. This material is expected to have a pH of roughly 13.5, making it corrosive and a contact hazard. At this pH, the hazard is somewhat less than for concentrated sodium hydroxide solutions; irritation may not develop for several hours. The fluoride content of the hydrolysate does not pose a significant hazard from dermal contact. The residual GB concentration will be subject to a release criterion for shipment; it is expected that the criterion will be developed to ensure that no significant toxicity due to GB will result from skin contact. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping GB hydrolysate are as follows:

- The contact hazard presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The elevated pH presents a medium hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of GB hydrolysate present a medium hazard.

VX Hydrolysate

VX hydrolysate is produced in the ANS; none will be shipped from the site if hydrolysate is treated onsite in the SCWO whereas an estimated 40 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. This material is expected to have a pH of roughly 13.5, making it corrosive and a contact hazard. At this pH, the hazard is somewhat less than for concentrated sodium hydroxide solutions; irritation may not develop for several hours. An organic thiol presents a minor inhalational hazard in the immediate vicinity of the spill; downwind evacuation may be required due to the foul odor of the thiol for approximately 100

yd. There are expected to be several release criteria to mitigate hazards due to residual cholinesterase inhibitors and flammability. It is expected that lots of VX hydrolysate will not be released with flashpoints above 141º F. The residual VX and EA2192 concentrations will be subject to release criteria for shipment; it is expected that the criteria will be developed to ensure that no significant toxicity due to VX will result from skin contact. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping VX hydrolysate are as follows:

- The contact hazard presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The elevated pH presents a medium hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of VX hydrolysate present a medium hazard.

Rocket Warhead Hydrolysate

GB and VX rocket warhead hydrolysate is produced in the ENS; none will be shipped from the site if hydrolysate is treated onsite in the SCWO whereas an estimated 430 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. This material is expected to have a pH of roughly 13.5, making it corrosive and a contact hazard. At this pH, the hazard is somewhat less than for concentrated sodium hydroxide solutions; irritation may not develop for several hours. There may be some hazard due to the products of Comp B destruction, although none are known at this time. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping rocket warhead hydrolysate are as follows:

- The contact hazard presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The elevated pH presents a medium hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of rocket warhead hydrolysate present a medium hazard.

Mustard Hydrolysate

Mustard hydrolysate is produced in the ANS; none will be shipped if hydrolysate is treated onsite in the SCWO whereas an estimated 53 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. Mustard hydrolysate contains primarily water, thiodiglycol, and sodium chloride, and is adjusted with sodium hydroxide to pH 12.

Mustard hydrolysate is irritating to the skin and eyes because of the pH of the material, but should cause little injury to the skin (injury generally requires pH of 12.5 or greater). The systemic effects of thiodiglycol and sodium chloride via skin absorption or inhalation will be low. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping mustard hydrolysate are as follows:

- The skin and eye irritation potential presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The impurities in mustard hydrolysate and the pH level presents a low hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of mustard hydrolysate present a medium hazard. However, based on recent revisions to the design, mustard hydrolysate is no longer generated by the onsite process.

Projectile Energetics Hydrolysate

Mustard projectile energetics hydrolysate is produced in the ENS; none will be shipped if hydrolysate is treated onsite in the SCWO whereas an estimated 91 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. This material is expected to have a pH of roughly 13.5, making it corrosive and a contact hazard. At this pH, the hazard is somewhat less than for concentrated sodium hydroxide solutions; irritation may not develop for several hours. There may be some hazard due to the products from destruction of the energetics mustard rounds, although none are known at this time. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping mustard energetics hydrolysate are as follows:

- The contact hazard presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The elevated pH presents a medium hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of mustard energetics hydrolysate present a medium hazard. However, based on recent revisions to the design, mustard energetics hydrolysate is no longer generated by the onsite process.

B.3 PCAPP Preliminary Evaluation

The PCAPP comparative transportation data for materials that would be shipped in different quantities in the two alternatives, NFPA hazard ratings, and the qualitative “relative hazard” factors, provided in Table B-2, are based on the APB design. The PCAPP design does not

notably change in the proposed acceleration assessment. This section presents a preliminary evaluation of the hazards posed by each of these substances based on the hazard perspectives outlined earlier, along with a qualitative overall relative hazard descriptor. These overall descriptors will be combined with the estimated shipment volumes to provide a preliminary basis for comparing the hazards posed by the onsite and off-site treatment alternatives.

Table B-2. PCAPP Shipments for Onsite and Offsite Treatment Alternatives

		Truckloads		NFPA 704 Hazard Diamond Rating				Overall Relative Hazard
Substance	Primary Usage/ Source	Onsite	Offsite	Health	Flamm-ability	Instability/ Reactivity	Special	
Sodium Hydroxide (25%)	MDB/BTA	1,794	986	3	0	1	COR	High
Dibasic Ammonium Phosphate (DAP) (10%)	BTA	22		1	0	0		Very Low
Urea Solution (10%)	BTA	22		1	0	0		Very Low
Phosphoric Acid	BTA	9		3	0	0	COR	High
Hydrolysate, Mustard	ANS		1,765	2	0	0		Medium
Brine Residue	BRS	2,340		1	0	0		Very Low
Sludge	WRS	62		0	0	0		Low

Sodium Hydroxide

A 25% aqueous solution of sodium hydroxide is used in the MDB and in the BTA; an estimated 1,794 truckloads will be shipped to the site if hydrolysate is treated onsite in the BTA whereas an estimated 986 truckloads will be shipped to the site if hydrolysate is treated offsite at a commercial TSDF. This material is primarily a skin contact hazard; causing irritation or severe burns. A mist formed from the solution can also present an inhalation hazard. The reactivity of this substance with some metals (notably aluminum) generates hydrogen, which can present an explosive hazard under some circumstances. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 25% aqueous sodium hydroxide are as follows:

- The skin contact hazard presents a high hazard to first responders or to members of the public at the scene of a spill.
- The corrosiveness presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site except in some specific and improbable scenarios.

Overall, shipments of 25% aqueous sodium hydroxide present a high hazard.

Dibasic Ammonium Phosphate

A 10% solution of dibasic ammonium phosphate (DAP) is used in the BTA; an estimated 22 truckloads will be required if hydrolysate is treated onsite in the BTA whereas none of this material will be required if hydrolysate is treated off-site at a commercial TSDF. Skin contact with DAP solutions may cause mild irritation, although no harmful systemic effects have been reported. DAP solutions may cause mild irritation to the eyes. DAP solutions are stable, and act to fertilize plant growth in the environment. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 10% DAP are as follows:

- Mild skin or eye irritation presents a very low hazard to first responders or to members of the public at the scene of a spill.
- Fertilization by 10% DAP presents a low hazard to the environment; this effect can be harmful to the environment only if a spill were to enter a body of water where phosphate is a limiting nutrient.
- This material presents a very low hazard to the public at large because DAP is nonvolatile and will not migrate from the spill.

Overall, shipments of 10% DAP present a very low hazard.

Urea

A 10% solution of urea is used in the BTA; an estimated 22 truckloads will be shipped to the site if hydrolysate is treated onsite in the BTA whereas none of this material will be required if hydrolysate is treated off-site at a commercial TSDF. Skin contact with urea solutions may cause mild irritation, although no harmful systemic effects have been reported. Urea solutions may cause mild irritation to the eyes. Urea is ubiquitous in the environment and is relatively nonvolatile. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping 10% urea solution are as follows:

- Mild skin or eye irritation presents a very low hazard to first responders or to members of the public at the scene of a spill.
- A spill of 10% urea appears unlikely to pose more than very low hazard to the environment because the solution is relatively dilute and urea is already present in most environments.
- This material presents a very low hazard to the public at large because urea is relatively nonvolatile and will not migrate from the spill.

Overall, shipments of 10% urea present a very low hazard.

Phosphoric Acid

Phosphoric acid is used in the BTA; an estimated 9 truckloads will be shipped to the site if hydrolysate is treated onsite in the BTA whereas none of this material will be required if

hydrolysate is treated off-site at a commercial TSDF. This material is primarily a skin contact hazard, although it can also present a minor inhalation hazard if a mist is generated. Phosphoric acid is a strong acid, which can react with some metals to generate hydrogen, which can in turn present an explosive hazard under some circumstances. Phosphoric acid has no significant systemic effect, and the chance of pulmonary effects from mist or spray inhalation is said to be remote. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping phosphoric acid are as follows:

- The skin contact hazard presents a high hazard to first responders or to members of the public at the scene of a spill.
- The corrosiveness presents a high hazard to the environment at the point of a spill, although as the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site except in some specific and improbable scenarios.

Overall, shipments of phosphoric acid present a high hazard.

Mustard Hydrolysate

Mustard hydrolysate is produced in the ANS; none will be shipped if hydrolysate is treated onsite in the BTA whereas an estimated 1,765 truckloads will be shipped from the site if hydrolysate is treated off-site at a commercial TSDF. Mustard hydrolysate contains primarily water, thiodiglycol, and sodium chloride, and is adjusted with sodium hydroxide to pH 12. Mustard hydrolysate is irritating to the skin and eyes because of the pH of the material, but should cause little injury to the skin (injury generally requires pH of 12.5 or greater). The systemic effects of thiodiglycol and sodium chloride via skin absorption or inhalation will be low. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping mustard hydrolysate are as follows:

- The skin and eye irritation potential presents a medium hazard to first responders or to members of the public at the scene of a spill.
- The impurities in mustard hydrolysate and the pH level present a low hazard to the environment at the point of a spill. As the material moves through the environment, dilution will likely limit the hazard to more distant environments.
- This material presents a low hazard to the public at large because the threat is expected to remain local to the spill site.

Overall, shipments of mustard hydrolysate present a medium hazard.

Brine

Brine residue is produced in the BRS; an estimated 2,340 truckloads will be shipped from the site if hydrolysate is treated onsite in the BTA whereas none will be shipped if hydrolysate is treated off-site at a commercial TSDF. The brine residue is primarily composed of sodium chloride and sodium sulfate salts; these salts typically present a minor health hazard due to the

irritating nature of the solids to skin and inhalational irritation due to release of dust. Based on a combination of these hazards and the expected NFPA ratings, a preliminary evaluation of the hazards of shipping brine residue are as follows:

- Potential skin irritation and irritation of dust to unprotected nasal passages presents a low hazard to first responders or to members of the public at the scene of a spill.
- The brine residue presents a very low hazard to the environment at the point of a spill; vegetation in contact with the residue may die, but the solid brine residue is unlikely to migrate from the scene of a spill.
- This material presents a very low hazard to the public at large because the solid brine residue is unlikely to migrate from the scene of a spill.

Overall, shipments of brine residue present a very low hazard.

Sludge

Sludge is produced in the WRS; an estimated 62 truckloads will be shipped from the site if hydrolysate is treated onsite in the BTA whereas none will be shipped if hydrolysate is treated off-site at a commercial TSDF. Activated sludge is stable and nonflammable; sludge is considered nontoxic but can lead to nausea or diarrhea by ingestion or allergic dermatitis from contact. If spilled into a body of water, the sludge can consume oxygen and cause localized fish kills under some circumstances. Based on a combination of these hazards and the NFPA ratings, a preliminary evaluation of the hazards of shipping sludge are as follows:

- The potential for contact dermatitis presents a low hazard to first responders or to members of the public at the scene of a spill.
- The potential for fish kills in limited circumstances presents a low hazard to the environment at the point of a spill
- This material presents a very low hazard to the public at large because it is not mobile in the environment.

Overall, shipments of sludge present a low hazard.

List of Acronyms

ABCDF	Aberdeen Chemical Disposal Facility
ACWA	Assembled Chemical Weapons Alternatives
AFS	Aluminum Filtration System
ANS	Agent Neutralization System
APB	Acquisition Program Baseline
APB	Agent Processing Building
APS	Aluminum Precipitation System
ATSDR	Agency for Toxic Substances and Disease Registry
BCS	Bulk Chemical Storage
BFD	block flow diagram
BGAD	Blue Grass Army Depot
BGCA	Blue Grass Chemical Activity
BGCAPP	Blue Grass Chemical Agent-Destruction Pilot Plant
BRS	Brine Recovery System
BTA	Biotreatment Area
CAC	Citizens' Advisory Commission
CAPP	Chemical Agent Pilot Plant
CCR	Colorado Code of Regulations
CD	Certificate of Designation
CDC	Centers for Disease Control and Prevention
CDCAB	Chemical Destruction Community Advisory Board
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health and the Environment
CEO	Chief Executive Officer
CMA	Chemical Materials Agency
CN	Constant Year (dollars)
COR	Corrosive
CSB	Control and Support Building
CSEPP	Chemical Stockpile Emergency Preparedness Program
CWC	Chemical Weapons Convention
CWM	Chemical Warfare Materiel
CWWG	Chemical Weapons Working Group
DAP	dibasic ammonium phosphate
DoD	Department of Defense
DOT	U.S. Department of Transportation
EDT	Explosive Destruction Technology
ENS	Energetics Neutralization System
ERB	Explosives Recovery Building
ERG	Emergency Response Guide
FAR	Federal Acquisition Regulation
FOAK	first-of-a-kind
FY	Fiscal Year

GB	Sarin (nerve agent)
H	mustard agent; bis(2-chloroethyl) sulfide
HAZMAT	hazardous material
HD	mustard agent, distilled
HSA	Hydrolysate Storage Area
HSEES	Hazardous Substances Emergency Events Surveillance
HW	hazardous waste
ICB	immobilized cell bioreactor
IDLH	immediately danger to life or health
KDEP	Kentucky Department of Environmental Protection
LCCE	life cycle cost estimate
LDR	Land Disposal Restriction
M	million
MDB	Munitions Demilitarization Building
MWS	Munitions Washout System
NAFTA	North American Free Trade Agreement
NCRM	Non-contaminated Rocket Motor
NECDF	Newport Chemical Agent Disposal Facility
NFPA	National Fire Protection Association
O&M	operating and maintenance
OTE	Energetics Offgas Treatment System
OTS	Offgas Treatment System
PCAPP	Pueblo Chemical Agent-Destruction Pilot Plant
PCD	Pueblo Chemical Depot
PHS	Projectile Handling System
P.L.	Public Law
PM ACWA	Program Manager for Assembled Chemical Weapons Alternatives
PPE	Personnel Protective Equipment
PPM	parts per million
RCRA	Resource Conservation and Recovery Act
RD&D	Research, Development, and Demonstration
RHA	Residue Handling Area
SA	Simple Asphyxiant
SCWO	supercritical water oxidation
SPB	SCWO Processing Building
SPEGL	Short-term Public Emergency Guidance Level
TDG	thiodiglycol
TIA	Transportation Impact Assessment
TRRP	Technical Risk Reduction Program
TSDF	Treatment, Storage, and Disposal Facility
VX	nerve agent
W	Water (reactivity)
WRS	Water Recovery System