AUGUST TECHNICAL REPORT
AMERICAN CYANAMID SUPERFUND SITE

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August 15, 2017

On May 31, 2017 members of the Board of CRISIS and I attended a presentation by Pfizer and USEPA on the status and findings of the long investigation conducted with respect to the most challenging area to remediate on the entire American Cyanamid Superfund site, Impoundments 1 & 2. CRISIS had long requested this meeting as we were concerned with the slow rate of progress by Pfizer in determining how remediation of these impoundments could be conducted, and equally concerned as to their ability to assure a high level of protection to the community given the difficult nature of the wastes stored in the flood plain at the site.

Pfizer's presentation with an informative handout was titled "American Cyanamid Superfund Site Operable Unit 8 Focused Feasibility Study Technology Screening and Alternative Development".

The theme of this Technical Report is to provide the essence of that presentation, and to set the stage for a series of Technical Reports in the months to follow that better inform our members and friends about the ultimate choices that will have to be made by USEPA in addressing this key Area of Concern within the American Cyanamid site. This report focuses on the **technologies** considered, and how they are being narrowed down.

1. BACKGROUND

Why are Impoundments 1 & 2 "the most challenging area to remediate" among all areas of the American Cyanamid Site?

- They occupy a combined area of approximately 4 acres (195,000 square feet)
- They are situated in the flood plain of the Raritan River which has experienced significant flooding on a recurring frequency
- The waste content of "acid tar" is highly acidic and corrosive, with a pH below 2
- The estimated volume of acid tar is 54,500 cubic yards, (1.47 million cubic feet)
- The waste contains substantial amounts of Volatile Organic contaminants, including Benzene with over 6% of the total mass of the waste, (60,000 parts per million) exceeding all pertinent standards by at least 5 orders of magnitude
- Volatile Organic compounds present a vapor and air pollution threat when being stored, treated and/or transported
- The waste material stored in Impoundments 1 & 2 is not only chemically potent, but is physically difficult to handle, with some of it described as "viscous rubbery" (goo) and the rest "hard and crumbly"
- EPA labels this waste as a "Principal Threat Waste", which they define as a waste that is a "source material" capable of migrating to water or air. Principal Threat Wastes are considered by EPA to warrant treatment in preference to storage and containment

It should be noted that there were some superficial remedial measures taken at Impoundments 1 & 2 from the 1980's through 2004. In 2004 remediation was suspended due to unmanageable air emissions resulting from the treatment methods that had been instituted. It took another 8 years until a plan was developed to move forward – that plan has been enacted and in 2018 EPA is expected to issue a Record of Decision on Impoundments 1 & 2 that will determine the course of remedial action moving forward. All other Areas of Concern on the American Cyanamid site are proceeding with remediation on a schedule more satisfactory to CRISIS, and I have been reporting on some of these in my Technical Reports within the past few years.

2. PREVIOUS TECHNICAL REPORTS ON IMPOUNDMENTS 1 & 2

Since starting as Technical Advisor to CRISIS in November 2012, I have prepared a number of Technical Reports devoted partly or fully to the subject of Impoundments 1 & 2. These reports are available for viewing on the CRISIS website www.crisistoxicwatch.org. Issues covered in these prior reports include:

- Field Pilot Study: Nov. 2013, Dec. 2013, Feb. 2014, April 2014, July 2014
- Focused Feasibility Study: Sept. 2013, Nov. 2013
- Potential Remediation Alternatives: June 2016
- Key Steps in Remediation: Oct. 2016

Readers who may have questions regarding the history of remediation at Impoundments 1 & 2, or the potential future steps may contact me at iwhitman@whitmanco.com.

3. REMEDIATION OPTIONS FOR DIFFICULT HAZARDOUS WASTES

The concept that certain wastes are "hazardous" and not just "pollutants" is not all that old! Legally, "hazardous" wastes were first defined in 1976 in the federal Resource Conservation and Recovery Act, known as RCRA (it seems that all federal environmental legislation, and most of the regulations MUST have an acronym!). RCRA was designed to manage hazardous substances and wastes "from cradle to grave", and most substances now deemed to be hazardous are heavily regulated in one way or another. Under RCRA, substances were deemed to be "hazardous" if they are

- Toxic (injurious to human or the environment)
- Ignitable
- Corrosive
- Reactive

Upon discovery of sites in New Jersey and nationally that are significantly contaminated by hazardous substances (think Love Canal) legislation was developed to mandate the "cleanup" or remediation of such sites, specifically

- New Jersey Spill Act – 1976*
- Superfund (Comprehensive Environmental Response, Compensation and Liability Act) – 1980 (CERCLA)

Despite living in an age dominated by rapidly expanding technology, ridding contaminated sites of impacts created by the presence of hazardous wastes often involves measures that are not dominated by sophisticated technology. The basic options include:

- Containment – constructing containment mechanisms such that the hazardous wastes are made secure by preventing any migration or impacts from their presence.
- Excavation/transport – moving the wastes to locations that are more secure and less likely to impact external receptors (persons, places or things)
- Treatment/destruction – converting the "hazardous" substances or wastes in some way to render them "non-hazardous"

As indicated in Section 1.0 above, the fact that the wastes in Impoundments 1 & 2 are considered to be "Principal Threat Wastes" triggers USEPA's preference for treatment over and above measures of containment and/or removal and transport.

*New Jersey has been a national leader in remediating sites contaminated by hazardous wastes.

4. HAZARDOUS WASTE TREATMENT – IN GENERAL TERMS

Treatment of hazardous wastes may come in many forms, some of which are variations on well established waste treatment technologies, while others have been developed and extensively tested for specific applications to specific wastes. Research on effective hazardous waste treatment methods has expanded as waste materials have become more varied and resistant to common approaches. In general, technologies employed to treat hazardous wastes include:

- Biological methods. Using bacteria and other micro-organisms to break down organic waste substances into non hazardous components
- Destructive methods. Incineration at high temperatures can break waste materials down into their elemental components
- Chemical methods. In some cases, addition of selected chemicals can lead to chemical reactions that render the waste to become non hazardous
- Thermal methods. Heat introduced into certain wastes cause the hazardous components to volatilize, creating a vapor stream where hazardous components are much easier to capture and treat than the same substances in liquid or solid form
- Physical methods. Some wastes can be stabilized and solidified, reducing their ability to leach or otherwise be transported into the environment where harm can be done upon contact with them
- Combined treatment methods. There are cases where some hazardous wastes can be more effectively treated with a combination of technologies than by one single method or another
- In-situ or ex-situ. Some wastes can be treated effectively in place (in-situ) while others require special equipment or technologies such that they must be moved out of place to be effectively treated

In many cases, studies and investigations of waste characteristics need to be conducted in order to determine which technologies may be suited to a given waste treatment challenge. Laboratory scale, bench scale and field pilot studies were conducted for the wastes stored in Impoundments 1 & 2 in order to develop specific treatment alternatives that could be considered to be feasible for those wastes. While much was known about the chemical composition of the Impoundment 1 & 2 wastes, the very size of the impoundments and the strange physical properties of the wastes suggested that conventional treatment methods may have to be significantly modified, or may not be useful at all.

5. PRE-2012 TECHNOLOGY SCREENING FOR IMPOUNDMENTS 1 & 2

At a November 2012 meeting with CRISIS, Pfizer reviewed the efforts made post-2004 on technologies to remediate Impoundments 1 & 2. Their efforts were described in the following terms:

- "One technology may not address the complex physical and chemical characteristics of impoundment materials – hence a combination of treatment technologies may be needed'
- Technologies "not studied previously" were identified; In-Situ Thermal Treatment, and In-Situ Stabilization and Solidification.
- Laboratory treatability studies were commissioned to determine the effectiveness of each technology individually and combined
- As a result of those studies a larger range of remedial alternatives can be developed to consider the "best" results of each individual technology

In January – February 2012 laboratory studies were conducted for both Thermal Treatment and Stabilization and Solidification. As reported at that time by Pfizer, the results of those studies were encouraging, and supported continued evaluation of the two individual technologies AND of the combined technologies. The 2012 study conclusions supported the proposal to conduct *field pilot scale testing* in situ of the individual and combined technologies, but noted "*significant implementation and technical challenges for pilot and full scale treatment remain".*

6. 2014 FIELD PILOT STUDIES

As noted in Section 2.0, the field pilot studies were described in detail in several earlier CRISIS Technical Reports. Three 7 foot diameter cylindrical caissons were built in Impoundment 2 that were used as test cells for each treatment technology and for the combined technologies. The equipment required was massive in scale, and technologically complex. The entire testing period was approximately 5 months, and was interrupted by a significant Raritan River flood event that occurred on May 1, 2014. On May 31, 2017, in its meeting with CRISIS, Pfizer reported the results of the pilot studies as follows:

In-Situ Thermal Treatment

- Over 90% of the Volatile Organic Compound(VOC) mass (primarily Benzene) was removed
- Leaching of contaminants was significantly (90%) reduced
- However, strong acidity remained following treatment
- Explosion potential from the process requires complex safety controls
- There is a high risk of vapor release
- Flooding during treatment could be catastrophic

In-Situ Stabilization and Solidification

- Over 25% of the VOC mass was removed
- Leaching and hydraulic conductivity were significantly reduced
- Compressive strength of the treated waste was increased
- Using smaller cells would reduce the flood risk
- Vapor emission controls would be a challenge during treatment and waste removal
- This is a proven technology

As a result of the 2014 field pilot study, Pfizer and EPA determined that the field studies of the two (2) technologies were useful for developing alternatives (a key component in the Superfund decision making process) for the remediation of Impoundments 1 & 2, but that these studies raised questions that need to be further addressed by additional studies and testing. The questions raised included:

- What other technologies/approaches may be feasible?
- Regarding the existing upland on-site landfill (located at Area 8 of the American Cyanamid site) is the containment protective liner material compatible with the leachate generated from the treated wastes?

Given these questions, additional technology screening and bench studies were conducted in 2015 – 2016.

7. TECHNOLOGY SCREENING AND BENCH STUDIES

Following the completion of the field pilot studies of remediation technologies considered for Impoundments 1 & 2, three additional studies were carried out in order to refine the potentially viable technologies:

- Steam Enhancement: Laboratory testing of In-Situ Stabilization and Solidification was conducted with the introduction of steam into the body of waste material during the stabilization treatment process. Adding steam led to reduced benzene concentrations, added compressive strength, and reduced acidity; three attributes that improved upon the outcome of the original treatment method tested.
- Mechanical Dewatering: It was found that a process of mechanically dewatering the wastes in Impoundments 1 & 2 in lieu of treatment would render the material suitable for transportation to another location where final treatment can take place. The dewatering concept could be implemented with the intent of shipping the wastes off site to a cement kiln, where at very high temperatures the material, with substantial BTU energy value, can possibly be destroyed and rendered non-hazardous. Cement kilns (there are none present in New Jersey) are now used to treat and capture the energy value of other organic wastes.
- Liner Compatibility Testing: The secure hazardous waste landfill constructed at Area 8 of the American Cyanamid site is considered (under the federal RCRA program) to be a "Contaminated Area Management Unit" or CAMU. Tests were done to see if the Impoundment 1 & 2 wastes, once treated, would be compatible with the CAMU landfill liner. Testing done in 2015-2016 indicated that leachate from the treated waste would be compatible.

8. ALTERNATIVE TREATMENT TECHNOLOGIES FOR IMPOUNDMENTS 1 & 2

The Superfund decision making process requires that there be a "Focused Feasibility Study" to enumerate the plusses and minuses of remediation approaches considered, with EPA then taking all of the known factors under consideration to render a final "Record of Decision", or ROD. The ROD for major areas of the site *excluding* Impoundments 1 & 2 was rendered by EPA in 2012, and the remediation for those areas is either in advanced stages of planning and design, and in the case of the Site Wide Ground Water Extraction, Treatment and Injection System is presently under construction.

The Record of Decision for Impoundments 1 & 2 is expected to be issued by EPA in the second half of 2018, although EPA has said it *could* be sooner.

While we have not been provided with a list of alternative treatment measures being considered, the meeting of May 31, 2017 and subsequent discussions lead CRISIS to deduce that the following treatment options are likely to be on the list for consideration:

- In-Situ Stabilization and Solidification (ISS)*
- Thermally Enhanced ISS*
- Combined ISS and In-Situ Thermal Treatment**
- Dewatering/Thermal Destruction by Offsite Cement Kiln

Following is a brief description of each of the treatment technologies that CRISIS believes may be on the list of potential alternatives:

8.1 In-Situ Stabilization and Solidification(ISS)

- This method features the physical addition of chemical reagents to impoundment wastes
- Reagents are added by use of heavy construction equipment, and mechanically mixed
- The “cement” material added immobilizes chemical contaminants
- PH is increased, acidity is greatly neutralized
- Permeability (water infiltration) is reduced
- Compressive strength is increased
- In general – the material is less hazardous and much easier to handle

8.2 Thermally Enhanced ISS

- Steam is added as the chemical reagents are mixed (in the ISS process)
- Mass of VOCs removed during mixing increases

8.3 Combined ISS and In-Situ Thermal Treatment

- In addition to ISS, electrical heating of the waste mass occurs
- Vapors driven off by heat are collected and treated using high temperature thermal oxidation
- Air space must be made inert using Nitrogen
- Significant safety hazards and issues occur. Hydraulic conductivity and benzene leachability are decreased

8.4 Dewatering/ Thermal Destruction by Offsite Cement Kiln

- Mechanical dewatering is a standard technology that seems to work on the Impoundment 1 & 2 waste
- By dewatering, waste is easily and safely loaded into over the road trucks
- Process would generate 2-3 truckloads per day(not significant truck traffic)
- Material trucked to cement kiln, likely in mid-west, operating under full environmental permits
- Cement kiln would bring about high temperature destruction of waste
- Cement kiln residuals are managed under regulatory permits

While it is premature for CRISIS to formally comment on these alternative technologies, we continue to analyze them and to prepare to comment before a final decision is rendered. We do have serious concerns regarding some of the options, and those concerns (based on what we know now) are expressed as follows:

* In-Situ technologies are logical for wastes as difficult as those found in Impoundments 1 & 2. We are ultimately interested, however, in determining what EPA refers to as the “Final Endpoint” for the waste. *For example, if ISS or an*

enhanced ISS is selected, with the intent to secure the treated waste in place on the flood plain, CRISIS could see many objections to such a scheme. On the other hand, waste treated in-situ and then transported to an upland landfill as its final endpoint results in a less objectionable set of hazards and risks.

** Thermal treatment, while possibly the best method for removing hazardous contaminants from the waste, comes with a set of difficulties and risks that may outweigh the benefits from using this approach. Issues of concern with thermal treatment include the problems of scaling the treatment up to impoundments 2 acres in size, difficulties in capturing vapors, the impact of corrosion by the acid wastes, the threat of explosion, and the potential for catastrophic disruption by serious flooding.

9. MOVING FORWARD TOWARDS A DECISION

CRISIS intends to stay deeply involved for every step of the Feasibility Study/Decision Making Process until a ROD is issued for Impoundments 1 & 2. We are relying on Pfizer and EPA to keep us informed, and so long as they believe there is a concerned public in the Bridgewater community that is following this process, we believe that they will.

Technical Reports on Impoundments 1 & 2 will be written by me and distributed to the public by CRISIS. One Technical Report will explore the possible "Final Endpoints" for the treated waste, and how we assess the impacts of the potential endpoints. Another Technical Report will assess the Focused Feasibility Study if we are given access to it, and another will provide a summary of the final Record of Decision.

If you have any questions or comments, please contact CRISIS' Technical Advisor by e-mail at iwhitman@whitmanco.com.

For more background on the American Cyanamid site go to the CRISIS web site www.crisistoxicwatch.org., or seek out information on the USEPA web site.

If you are interested in playing an active role as this important remediation decision looms, contact CRISIS' Executive Director Ross Stander at tensor_metrix@yahoo.com.

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