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April 30, 2008

Via E-Mail and Regular Mail

Mr. Matt Mortefolio, P.E.
NYSDEC Project Coordinator
Bureau of Solid Waste & Corrective Action
Division of Solid and Hazardous Waste Materials
NEW YORK STATE DEPARTMENT OF
ENVIRONMENTAL CONSERVATION
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Albany, NY 12233-7255

Mr. Michael Infurna
USEPA Project Coordinator
Environmental Planning and Protection Division
UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY, Region II
290 Broadway – 20th Floor
New York, NY 10007-1866

Re: RCRA Section 3008(h) Administrative Order on Consent
Docket No. II-RCRA-90-3008(h)-0209
FMC Corporation, Middleport, NY Facility
EPA I.D. No. NYD002126845
Report on Investigative Work
Agencies' December 13, 2007 Letter

Dear Messrs. Mortefolio and Infurna:

By letter dated December 13, 2007, the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) (jointly, "Agencies") requested that FMC Corporation (FMC) perform additional investigative work and submit the resulting information relative to the following reports:

1. "Herbicidal Formulations of Enhanced Efficacy for Defoliation, Final Report, Contract DA18-064-AMC-366(A), January 21, 1965 to July 31, 1967", dated August 14, 1967, prepared by Dr. J.R. Willard, Niagara Chemical Division, FMC Corporation, and submitted to the U.S. Army Biological Laboratories, Fort Detrick, Maryland ("1967 DoD Report"); and
2. "The History of the US Department of Defense Programs for Testing, Evaluation, and Storage of Tactical Herbicides", dated December 2006 and prepared by Alvin L. Young, Ph.D. for the Office of the Under Secretary of Defense William Van Houten ("2006 DoD Report").

A meeting was held on February 14, 2008 among representatives (including senior management) of FMC, NYSDEC, New York State Department of Health (NYSDOH) and the USEPA to discuss the Agencies' December 13, 2007 directives for additional investigative work. In preparation for the February 14th meeting, FMC submitted preliminary results of its investigative activities by letter dated February 7, 2008. FMC is now providing the final results of the additional investigative work performed, as requested in the Agencies' December 13, 2007 letter. The report on this work is contained in Appendix A to this letter.



Based on the investigative activities conducted and described in Appendix A, FMC's findings and conclusions concerning the 1965-1967 research activities are as follows:

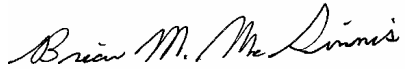
1. During the research study, FMC utilized **less than 12 gallons of total chemicals** in the laboratory, greenhouse and field tests over a period of 2 1/2 years (January 1965 to July 1967).
2. The 1965-1967 DoD laboratory, greenhouse and field activities were **performed under strict controls** (e.g., application to plants within enclosures, use of plant sentinels in the lab to identify any drifts), such that any significant releases to air, ground, water or sewer were improbable.
3. Field tests were conducted in the summers of 1965 and 1966. It is estimated that 0.92 gallons were directly applied in the field on plants within seven-foot square test plots. The chemical/herbicide formulations were applied within a seven-foot cubical enclosure. Based on information contained in the 1967 DoD Report, it is estimated that 73 plots (3,577 square feet or 0.08 acre) were tested over a two year period. It is estimated that on average approximately **0.2 teaspoon of total chemicals was applied to one square foot of the test area**. If the application rates and the number of replicates are taken into account, **the range of total chemical application in the field is estimated to be 0.05 to 0.26 teaspoon of chemicals per square foot** (based on 3-5 replicate applications at rates of 1-3 gallons per acre). For comparison purposes, based on the label of a currently available lawn treatment product that contains 2,4-D (i.e., Ortho Weed B Gon[®]), the application rate is calculated to be approximately 0.04 teaspoon of product per square foot of lawn per application (typically applied two times per year). Therefore, it is concluded that the amounts of test formulations/chemicals applied during the DoD research study are similar to the amounts used in currently available lawn treatment products.
4. Consistent with the procedures specified in FMC's 1988 Master Compound List document, the **chemicals used by FMC in the DoD research study should not be added to FMC Site-Specific Parameter List (SSPL)**, which was used in environmental investigations and studies conducted after 1988. The basis for this conclusion is that very minuscule amounts (less than 11 gallons total were used in the laboratory and approximately 1 gallon was used in a greenhouse and in the field), in a single research study, under very tight material controls. The chemicals were not used in the manufacturing or commercial formulation operations.
5. Soil sample data for 2,4-D and 2,4,5-T collected from the production/manufacturing areas of the Plant Site and from off-Site study areas did not identify any significant presence of 2,4-D and 2,4,5-T. Therefore, it can be concluded that **there is no FMC-related "Agent Orange" contamination in the Middleport study areas**.
6. FMC's R&D Facility in Middleport was constructed in 1964 and was considered to be a "State-of-the-Art" research facility for that time. The R&D activities were conducted by highly skilled and educated research personnel, who **utilized specialized procedures and methods with appropriate scientific and environmental controls**. The activities conducted in those facilities consisted of office/administrative related activities; testing in laboratories (equipped with appropriate ventilation and lab hoods filters); testing in greenhouses within constructed "floors" (typically soil/plants were contained in "tables" and not planted in the ground); small-quantity chemical storage in cabinets; and waste management in containers within two designated waste storage areas. Pilot testing or any production/manufacturing activities did not occur in or around the R&D Facility located at the southwest corner of the Plant Site. Further, based on our current knowledge and existing records, **no spills or releases to the environment occurred at FMC's R&D Facility** at the southwest corner of the Plant Site.

7. Based on the findings, further sampling and analysis for chemicals used in the DoD study are not warranted.

FMC believes that additional efforts to identify the test location(s) used during the studies is a waste of resources and will not yield any meaningful information. Sampling and analysis of the field test areas are not warranted based on the small quantities used in the field tests (an average of 0.2 teaspoon of chemicals per one square foot of test area), the controls (i.e., use of enclosures during application) used in the field study, and other reasons discussed above. The amounts of test formulations applied in the field are similar to the amounts used in currently available lawn treatment products that contain 2,4-D.

If there are any questions or if additional information is needed at this time, please contact me at (215) 299-6047 or at the above address.

Sincerely,



Brian M. McGinnis
Remediation Project Manager
(215) 299-6047

Attachment

pc: Without enclosures
J. Reidy, USEPA, NYC
E. Dassatti, NYSDEC, Albany
R. Phanuef, NYSDEC, Albany
D. David, NYSDEC, Buffalo
G. Litwin, NYSDOH, Troy
R. Fedigan, NYSDOH, Troy
Senator George Mazarz, Lockport
Assemblyman Mike Cole, West Seneca
Congressman Tom Reynolds, Williamsville

With enclosures
W. Mugdan, USEPA, NYC
D. Radtke, NYSDEC, Albany
G. Sutton, NYSDEC, Buffalo
M. Hinton, NYSDEC, Buffalo
J. Ridenour, NYSDOH, Troy
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D. Thompson, FMC
W. Lachell, Geomatrix
E. Rankin, P.E., ARCADIS
B. Arnold, Middleport Community Input Group
Mayor Julie Maedl, Village of Middleport
D. Seaman, Esq., Lockport Office
D. Watts, NJ Institute of Technology

APPENDIX A
Additional Investigative Information and Findings
In Response to the Agencies' December 13, 2007 Letter
RCRA Facility Investigation\Corrective Measures Study
FMC Corporation, Middleport, NY

By letter dated December 13, 2007, the New York State Department of Environmental Conservation (NYSDEC) and the United States Environmental Protection Agency (USEPA) (collectively, "the Agencies") requested that FMC Corporation (FMC) perform additional investigative work and submit the resulting information relative to the following reports:

1. "Herbicidal Formulations of Enhanced Efficacy for Defoliation, Final Report, Contract DA18-064-AMC-366(A), January 21, 1965 to July 31, 1967", dated August 14, 1967, prepared by Dr. J.R. Willard, Niagara Chemical Division, FMC Corporation, and submitted to the U.S. Army Biological Laboratories, Fort Detrick, Maryland ("1967 DoD Report"). The Agencies received a copy of the 1967 Report in mid 2005 and provided an electronic copy to FMC Corporation (FMC) at that time; and
2. "The History of the US Department of Defense Programs for Testing, Evaluation, and Storage of Tactical Herbicides", dated December 2006 and prepared by Alvin L. Young, Ph.D. for the Office of the Under Secretary of Defense William Van Houten ("2006 DoD Report").

Electronic copies of both reports as well as a list of some seventy chemicals ("2007 FMC-DoD Chemical List") were provided with the Agencies' December 13, 2007 letter.

The 1967 DoD Report summarized research conducted by FMC's Research and Development (R&D) facilities in Middleport from 1965 to 1967 on two U.S. Department of Defense (DoD) "tactical herbicides" (developed by the DoD for use in combat operations) and other commercially available herbicides. The two tactical herbicides used in the study were referenced as "MIL 1" and "MIL 3" in the 1967 DoD Report. MIL 1 consisted of a 50:50 mixture of the butyl esters of 2,4-D (2,4-dichlorophenoxyacetic acid) and 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and MIL 3 consisted of a 50:50 mixture of the isooctyl esters of 2,4-D and 2,4,5-T..

2,4-D is a widely used broad leaf herbicide and is found in many lawn care products and other weed control products. In North America, 2,4-D ranks the third-most widely used herbicide. It is the most widely used herbicide in the rest of the world. 2,4,5-T is a herbicide used to defoliate broad-leaved plants. It was developed in the late 1940s and was widely used until being phased out in the late 1970s. U.S. DoD developed a tactical herbicide consisting of a 50:50 mixture of the butyl esters of 2,4-D and 2,4,5-T commonly known as "Agent Orange" for use during the Vietnam War.

The 2007 FMC-DoD Chemical List, developed by the Agencies, contains a list of 75 chemical names that reportedly appear in the 1967 DoD Report and, according to the Agencies, do not specifically appear in FMC's "Master Compound List and Various Related Lists for

Environmental Studies, FMC-Middleport, NY”, dated December 19, 1988 (“1988 MCL Document” or “Master Compound List”) or on the Site-Specific Parameter List(s) (“SSPL”) developed from the Master Compound List.

The following presents FMC perform four investigative activities. In response to the Agencies’ request, FMC has expended a considerable effort to understand the role of its research laboratories in the 1965-1967 study. FMC reviewed the 1967 DoD Report, searched existing R&D records for that time period, reviewed laboratory notebooks that include reports pertaining to the 1965-1967 study, and interviewed retired and existing employees who may have been involved in the 1965-1967 study. Based on information contained in the 1967 DoD Report, it is estimated that less than 12 gallons of various chemicals and/or herbicide formulations containing 2,4-D, 2,4,5-T and other materials were used over the two year study period (1965-1967). Of those 12 gallons of chemicals, approximately 4.1 to 10.6 gallons were used in the tests/studies conducted in the laboratory, approximately 0.07 gallon combined was directly applied to plants in greenhouse enclosures, and approximately 0.92 gallon was directly applied to plants in the field test enclosures. An additional 14 gallons of various herbicide formulations were prepared and sent to the Fort Detrick Army laboratory in Maryland. The total handling of materials identified in the 1967 DoD Report was apparently less than ½ of a 55 gallon drum.

The following presents FMC’s findings for each of the four activities requested in the Agencies’ December 13, 2007 letter.

1.0 BACKGROUND INFORMATION

The Agencies’ December 13th letter implies that FMC intentionally omitted information or provided inaccurate information concerning the 1965-1967 research study conducted by FMC’s Middleport R&D facility during preparation of the 1988 MCL Document. FMC takes offense with and denies this implication. FMC utilized its best knowledge and the information available at that time in preparing the 1988 MCL Document. Most importantly, FMC identified the two main test components (2,4 D and 2,4,5-T) of the 1965-1967 DoD research in the 1988 MCL Document since the two herbicides had been historically purchased and repackaged by FMC in its Middleport production operations. As stated in the December 19, 1988 submittal of the MCL Document cited by the Agencies in their December 13, 2007 letter, FMC did not manufacture or formulate these compounds. 2,4 D and 2,4,5-T were also included on FMC’s Site-Specific Parameter List, which was used in various environmental studies at the Plant and in off-Site study areas.

The 1988 MCL Document attempted to identify all compounds historically produced and or handled at the FMC Middleport Plant site from the early 1920’s to 1988 (a period of more than 60 years). The written records on materials used and/or produced at the FMC Plant site during this time period were primarily from the 1970s and 1980s. The 1988 MCL Document was developed based on the knowledge of long-term employees and production records from the 1970s and 1980s. The focus was on production operations, and not R&D which was no longer conducted at Middleport. Any records that remained on R&D activities had been moved to FMC’s chemical R&D facility in Princeton, New Jersey in the early 1980s.

The FMC personnel involved in the preparation and review of the 1988 MCL Document were engaged in the manufacturing organization of FMC and did not have specific knowledge of R&D activities and projects, including the 1965-1967 DoD research. These persons were aware that the quantities of chemicals used in research activities were very small relative to the quantities used in the commercial manufacturing/formulating activities at the Middleport site. They were also aware that field and greenhouse testing of chemicals by the R&D group were performed under controlled conditions that would not result in any appreciable releases to the air, ground, water or sewer.

Rather than review each of the hundreds or perhaps thousands of research projects conducted over many decades to identify all possible chemicals used in the R&D activities, the group focused its efforts on identifying chemicals used in the manufacturing/formulating activities over an approximate 60 year period (from 1920's to 1988) at the Middleport site. FMC continues to believe any effort to further review its historic R&D activities would expend significant resources and time with little or no benefit with respect to FMC's ongoing environmental studies and remediation efforts. This perception is supported by the work done to investigate the materials used in the 1965-1967 DoD study, as reported below. Specifically, R&D studies, even those that included lab/greenhouse and field testing, (1) involved the use of very small quantities of materials (far below the quantity thresholds used for placement of compounds on the 1988 MCL on the SSPL(s)); (2) R&D work was performed under controlled conditions that would not have resulted in any appreciable releases (another of the criteria for determining what compounds should be included on the SSPL(s)); and (3) the "cost" in terms of time, dollars, project delays, and project uncertainty necessary to review the volume of information that may remain with respect to the entire universe of R&D projects far outweighs any potential "benefit" from possibly identifying some compound or chemical in addition to the hundreds that have been examined and that may warrant additional field sampling to complete the RFI. Further information regarding the development of the Master Compound List is summarized in Section 2.1 below.

2.0 INVESTIGATIVE ACTIVITY 1

As requested in the Agencies' December 13th letter, FMC has reviewed the 1967 DoD Report, the Agencies' 2007 FMC-DoD Chemical List (see Table 1), and FMC's 1988 MCL Document for the following purposes:

- To compare the chemicals listed in the Agencies' 2007 FMC-DoD Chemical List to chemicals identified in the 1967 DoD Report and in the 1988 Master Compound List contained in the 1988 MCL Document;
- To identify the types of chemicals discussed in the 1967 DoD Report;
- To summarize the amounts of chemicals reportedly used in the 1965-1967 DoD research project.

The results of the above review are discussed in Sections 2.1 through 2.5.

2.1 Background Information on the Development of the 1988 Master Compound List Document and the Site-Specific Parameter List

FMC first developed a list of chemicals used and/or produced historically in its manufacturing operations at the Middleport Plant for the purposes of its environmental site investigation program conducted during the years 1985-1987. That list was presented as Table 1.1 in the “Middleport Site Investigation Final Report”, dated May 1987 (“1987 SI Report”). As a result of discussions with the NYSDEC, FMC committed to review and refine the “Master List” (or “MCL”) of materials handled at the Middleport Plant and to develop a Site-Specific Parameter List (SSPL) for use in subsequent environmental investigations and studies. The revised Master List, the SSPL, related lists, and a description of how the document and associated lists were developed were presented in the 1988 MCL Document. The 1988 MCL Document consists of:

- i) a description of how the document and associated lists were developed, including comments from NYSDEC (and other agencies, including the New York State Department of Health (NYSDOH) and the Niagara County Health Department) on previous versions of the document and FMC’s responses to those comments;
- ii) the revised Master List or MCL (Table I), which consists of compounds used or produced at the Plant, estimated time periods of use, estimated annual use quantities, methods of material storage at the Plant (i.e., bulk or package), and the criteria used to exclude a compound from the SSPL, which was to be used for subsequent environmental studies;
- iii) a list of materials (Table II) that were included in the list presented in 1987 SI Report but excluded from the revised Table I - Master List;
- iv) a list of potential degradation products and impurities (Table III) that were associated with the chemicals on the Master List;
- v) a SSPL (Table IV) which consists of chemicals on the Master List that could be present in the plant environmental media and that could be analyzed for by a specific analytical method. The SSPL or a particular subset of the SSPL was intended to be used in subsequent environmental studies and monitoring activities for the Plant Site and for the off-Site investigation program then under discussion with NYSDEC;
- vi) a list of the test parameter and analytical methods for each compound on the SSPL (Table V); and
- vii) a description of specific rationale for deletion of certain compounds from the SSPL (Table VI).

The 1988 MCL Document was developed by an FMC Task Force (Task Force) consisting of current (in 1988) and former Plant production employees with knowledge of past plant practices dating back to the late 1940s and the 1950s. FMC Task Force personnel held or had held the following positions:

Production Manager
Plant Manager
Quality Assurance Manager
Production Foreman
General Foreman

Warehouse Supervisor
Production Laborer
Environmental Engineer
Shift Foreman
Lift Truck Driver

The Task Force identified materials that may have been stored at the warehouses and/or used in the manufacturing, formulation, and packaging of products at the Middleport Plant during the approximate time period from the mid-1920s through 1988, based on the best of their knowledge and on the plant production records (1971-1988) and plant formulation files (1950-1988) that were available at that time. There were no existing records for production and formulation prior to 1971 and 1950, respectively. The Task Force focused on identifying materials that were used and handled in the plant's pesticide manufacturing, formulations, and packaging operations, and did not attempt or purport to identify products and materials that may have been used by non-production departments (i.e., administrative departments, maintenance department, analytical laboratories, and research and development facilities at the Middleport Plant). Among other things, the quantities of materials that may have been used by non-production departments were and were understood to be significantly smaller than the quantities used by the production departments.

Personnel from FMC's R&D group in Princeton, New Jersey also reviewed and provided input in the development of the 1988 MCL Document, in particular as to identification of potential degradation products and impurities associated with the compounds on the MCL and identification of appropriate analytical methods. Further, the SSPL included compounds that were not included on the 1988 Master List, but were detected at significant levels and/or frequencies in environmental samples collected at and around the FMC Plant site.

FMC submitted the 1988 MCL Document to the NYSDEC by letter dated December 19, 1988. Based on a series of exchanges of correspondences between FMC and the NYSDEC, the SSPL was modified and approved for use by the NYSDEC by letters dated April 28, 1988, June 1, 1989, and June 28, 1989. The SSPL or a subset of the SSPL was subsequently used in the following programs: 1989 Central Surface Impoundment (CSI) closure, 1989-1992 RCRA Site Groundwater Quality Assessment Monitoring Program (SGQAMP), subsequent groundwater monitoring programs (e.g., Groundwater Monitoring Program), 1990-1993 Off-Site Investigation (OSI), and 1993-1997 RCRA Facility Investigation (RFI) field sampling and analysis activities.

2.2 Investigative Activity 1, Task A - Comparison of the Agencies' 2007 FMC-DoD Chemical List to the 1967 DoD Report and the 1988 MCL Document

The Agencies' 2007 FMC-DoD Chemical List (attached Table 1) was reviewed and each of the 75 chemicals listed was assigned a reference number in the order of its appearance. The 1967 DoD Report was reviewed to verify the Agencies' 2007 FMC-DoD Chemical List and the Agencies' 2007 FMC-DoD Chemical List was compared with the compounds listed the MCL in the 1988 MCL Document. The attached Table 2 presents the numbered list of the 75 chemicals identified in the Agencies' 2007 FMC-DoD List along with notes which summarize the verification and comparison findings.

Review and comparison of the 2007 FMC-DoD Chemical List to the 1967 DoD Report and the 1988 MCL Document indicate the following:

- i) Twelve of the 75 chemicals on the Agencies' 2007 FMC-DoD Chemical List are: (1) duplicate entries; (2) other names (synonyms) for chemicals already on the Agencies' 2007 FMC-DoD Chemical List; or (3) not identified in the 1967 DoD Report as having been used but rather discussed as background information only. These 12 chemicals are listed below, including their cross-reference numbers, and should be deleted from the 2007 FMC-DoD Chemical List:

#7 colloidal silica	#40 dioctylphthalate
#15 tordon 22K	#42 diquat
#18 Amitrol	#44 isobutyl 2,4,5-T
#24 methyl ethyl ketone	#47 Thixcin E
#32 cellosolve	#48 Thixcin R
#33 cab-o-sil	#51 polyhaloaliphatic acid

- ii) Six additional chemicals on the Agencies' 2007 FMC-DoD Chemical List are petroleum distillate products and have been included in the MCL as Isopar M, consistent with FMC's Response to Agency comment #1 raised at a May 25, 1988 meeting (Section 4.0 of the 1988 MCL Document). These six chemicals are listed below and should be deleted from the 2007 FMC-DoD Chemical List:

#13 No. 2 fuel oil	#60 Isopar H
#16 kerosene	#61 Isopar L
#59 Isopar E	#75 ultrasene

- iii) Seven additional chemicals are not included on the Agencies' 2007 FMC-DoD Chemical List or on the 1988 MCL, but were identified in the 1967 DoD Report. These seven chemicals are listed in attached Table 3.

- iv) There are ten other chemicals that are not included on the Agencies' 2007 FMC-DoD Chemical List, but that were identified in the 1967 DoD Report. These 10 chemicals (listed on Table) were included in the 1988 MCL3 and should not be added to the 2007 FMC-DoD Chemical List.

In accordance with the points above, the 2007 FMC-DoD Chemical List should consist of 64 chemicals that have been cited as being used in field and/or laboratory testing by FMC, as described in the 1967 DoD Report, and that are not included in the 1988 MCL.

2.3 Investigative Activity 1, Task A - Specific Questions

Responses to specific questions noted under Task A of the Agencies' December 13th letter are as follows:

1. Is Cresol A the same compound as o-cresol?

Cresol has three isomers (o-, m-, p-). The 1967 DoD Report does not state which isomer(s) was used. The only reference in the 1967 DoD Report is to "Cresol A." A search of various on-line and hard copy chemical references did not produce any reference to "Cresol A". No other information on Cresol A could be obtained.

2. Please provide additional chemical information on Cassiar AC.

The 1967 DoD Report only identifies Cassiar AC as an additive (at 0.9 to 5.0 weight percent) in six formulation samples that were only studied for storage stability (ref. p. 176, 178 of the 1967 DoD Report) in the laboratory. The 1967 DoD Report does not describe Cassiar AC. A 1966 research paper found on-line identifies Cassiar AC as chrysotile asbestos from the Cassiar mine in British Columbia (http://www.minsocam.org/ammin/AM51/AM51_711.pdf). No other information on Cassiar AC could be obtained.

3. Please provide additional chemical information on Resin CB-4-34.

Based on information obtained on-line, Resin CB-4-34 is an aromatic, chemically inert, and non-saponifiable plasticizer that was manufactured by Rhone-Poulenc, Inc. (acquired by Shell Oil in 1993). The 1967 DoD Report identifies Resin CB-4-34 as an additive (at 5.0 weight percent) in one formulation (ref. p. 172, 175 of the 1967 DoD Report).

4. Clarification is needed on what type of carbitol was used.

Carbitol is only identified in the 1967 DoD Report as being used in a bench-top experiment of the solubility of auxiliary herbicides in various solvents (p. 39 of the 1967 DoD Report), and on the graph of Table 3 as information copied from others, not measured by FMC (see response to cellosolve below). The 1967 DoD Report does not indicate the type of carbitol used in the solubility experiment. Today, Carbitol is a trademark of Dow Chemical Co., and is comprised of diethylene glycol ethyl ether, also known as carbitol cellosolve. The 1967 DoD Report does not indicate whether carbitol was a trade name of a product or a term for a carbitol compound.

5. Clarification is needed on what type of cellosolve was used.

Cellosolve was not used in the experiments described in the 1967 DoD Report. The word cellosolve only appears on the graph of Table 3 (p. 34 of the 1967 DoD Report), which depicts data collected by FMC for evaporation rates of various solvents, but also includes data provided in a technical bulletin from Shell Oil for comparison (ref. p. 6 of the 1967 DoD Report). Cellosolve does not appear in Table 4 (p. 36 of the 1967 DoD Report), which provides FMC's test results. As discussed in above Section 22.1, item i), cellosolve should be deleted from the 2007 FMC-DoD Chemical List.

2.4 Investigative Activity 1, Tasks B and C - Types of Chemicals in the Revised 2007 FMC-DoD Chemical List

A total of 64 chemicals that are not on the 1988 MCL were identified as being used in the 1967 DoD Report. The 1967 DoD Report describes the testing of two DoD tactical herbicides (referred to as MIL 1 and MIL 3, as discussed above) combined with various commercially available auxiliary herbicides and other materials that were used to achieve certain flow and storage characteristics. These other materials consisted of solvents, surfactants and anti-caking or suspending agents (i.e., in the agricultural chemical vernacular, considered to be inert additives).

The 64 chemicals on the revised 2007 FMC-DoD Chemical List were categorized into the following usage types: herbicide, solvent, surfactant and additives, as presented on the attached Table 4. Of these 64 chemicals, 16 are herbicides, 16 are solvents, 11 are surfactants, and 21 are additives. Table 4 also identifies where each of the 64 chemicals was cited in the 1967 DoD Report, as well as pertinent comments concerning the usage of the chemical.

Of the 21 additives, 10 have been identified to be common thickeners or modifiers used in household products, such as cosmetics, food and/or medicine. These 10 chemicals, their descriptions, and their common uses are provided below.

- #34 cab-o-sil M-5 (colloidal silica used in medicine)
- #52 carbopol 934 (polymer used in cosmetics)
- #35 cab-o-sil H-5 (colloidal silica used in medicine)
- #36 cab-o-sil EH-5 (colloidal silica used in medicine)
- #38 avicel C (cellulose used in food, cosmetics, medicine)
- #49 PVP/VA I-535 (polymer used in cosmetics)
- #66 PVP/VA E535 (polymer used in cosmetics)
- #71 thixcin 25C (castor oil base used in cosmetics)
- #72 thixcin E (castor oil base used in cosmetics)
- #73 thixcin R (castor oil base used in cosmetics)

2.5 Investigative Activity 1, Task C - Estimated Quantities Used in the Experiments Cited in the 1967 DoD Report and Evaluation for Inclusion on the SSPL

The experiments described in the 1967 DoD Report included:

- laboratory measurement of physical properties (e.g., viscosity, specific gravity, surface tension, evaporation rate, solubility, drop volume, area of spread) of the ingredients and/or certain formulations;
- laboratory evaluation of the storage stability of formulations;

- greenhouse application of various formulations directly applied to individual plants within separate, dedicated enclosures inside a greenhouse; and
- field application of a subset of formulations directly applied to woody plants within separate enclosures situated in a nearby field (total of 0.08 acres). Field tests were performed with a total of 73 separate cubical enclosures that were 7-foot wide by 7-foot long by 7-foot high.

The 1967 DoD Report does not describe the actual quantities of chemicals that were procured to conduct the studies. The 1967 DoD Report states that with respect to auxiliary herbicides, “basic suppliers were contacted and sample of most of those requested were received” (p. 5 of the 1967 DoD Report). The 1967 DoD Report continues to state that “a 50-pound lot of 2,4,5-T butyl ester obtained commercially...analysis by gas chromatography showed it to be essentially equivalent with previously employed samples.” The 1967 DoD Report does not specify the source of the 2,4-D and 2,4,5-T mixtures used in the actual tests. The 2006 DoD Report states that MIL 1 and MIL 3 were provided by the Army Biological Laboratories, Fort Detrick, Maryland.

The 1967 DoD Report provides information from which the quantities of chemicals used in the studies can be estimated. Approximately one-half of the chemicals were only used in one type of testing. Most of the individual chemicals were only used in minute amounts. For example, the evaporation rate of candidate solvents was measured using “a drop” of solvent (p. 36 of the 1967 DoD Report), and in preparing test formulation samples “20 to 100 grams were prepared in each case depending upon equipment used” (p. 9 of the 1967 DoD Report). In testing formulations in the laboratory and greenhouse only “pipette” (p. 13 of the 1967 DoD Report) volumes were directly applied to plants within enclosures. In field testing of formulations, “test tube” volumes were directly applied to plants within an enclosure (i.e., a “7 foot cube”) (p. 27 of the 1967 DoD Report).

Table 5 presents a summary of the estimated total amount of all chemicals used in all the experiments, including inert additives and including chemicals that are on FMC’s 1988 MCL. Table 5 is organized by bench-top experiments conducted in a laboratory (Table 5a), formulations applied in enclosures within a greenhouse (Table 5b), and formulations applied within cubical enclosures located in a nearby field (Table 5c). As presented in Table 5, it is estimated that approximately 4.1 to 10.6 gallons of chemicals were used in the tests/studies conducted in the laboratory, approximately 0.07 gallon combined was directly applied to plants in greenhouse enclosures, and approximately 0.92 gallon was directly applied to plants in the field test enclosures. An additional 14 gallons of formulations was reported to have been prepared and sent to the Fort Detrick Army laboratory in Maryland.

As discussed in the 1988 MCL Document, in developing the SSPL, among other criteria considered, an individual chemical was excluded if it satisfied both of two conditions: (1) an annual volume of less than 100,000 pounds per year or an annual volume of 250,000 pounds per year if used for a period of two years or less; and (2) effective process and/or environmental controls were used such that any significant emission to air, ground, water or sewer was improbable. The estimated total amount of all chemicals combined that was used in the actual studies discussed in the 1967 DoD Report (less than 12 gallons) is orders of magnitude below these individual chemical “small volume” thresholds.

In addition, the testing activities described in the 1967 DoD Report utilized effective process and/or environmental controls such that any significant emission to air, ground, water or sewer were improbable. The 1967 DoD Report describes handling of the chemicals in “test tubes” and similar applications in controlled research settings. Page 6 of the 1967 DoD Report states the following:

“The high volatility of the butyl esters of 2,4-D (2,4-dichlorophenoxyacetic acid) and 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) made necessary adoption of extra precautions in carrying out this work. To avoid contamination of other experiments carried out in the laboratory, work was restricted to the maximum possible extent to one bench and one fume hood. Glassware was marked so that it did not get into general use in the laboratory. Tomato plants were placed about the laboratory to monitor the presence of vapors of the ester mixture.”

The 1967 DoD Report also specified that both the field and greenhouse application of the formulations were performed within enclosures. Accordingly, it can be concluded that the testing described was performed under controlled conditions that would not result in any appreciable releases to the air, ground, water or sewer.

FMC believes that none of the 64 chemicals on the revised 2007 FMC-DoD Chemical List warrants inclusion in the SSPL consistent with the combined deletion criteria (as defined in the 1988 MCL Document) of 1) C - Small Volumes, which represents annual usages of less than 100,000 pounds; 2) D – Effective Process and/or Environmental Controls, which includes controls used “such that any significant emission to air, ground, water or sewer are improbable; and 3) F – Compound Specific Deletion Criterion, which is specific justification for deletion from the SSPL. With respect to Criterion F, FMC believes that none of the 64 chemicals warrant inclusion in the SSPL because they were used in very minuscule amounts (less than 11 gallons total was used or present in the laboratory and approximately 1 gallon was used in a greenhouse and in the field), in a single research study, under very tight material controls. The chemicals were not used in the manufacturing or commercial formulation operations.

2.6 Investigative Activity 1, Tasks D and E

Task D (identification of degradation products and impurities) and Task E (revision of the SSPL and analytical methods) are not required since none of the 64 chemicals on the revised 2007 FMC-DoD Chemical List warrants inclusion in the SSPL.

3.0 INVESTIGATIVE ACTIVITY 2

Historically, FMC conducted Research and Development (R&D) activities on the northwestern portion of the FMC Plant Site in buildings (Buildings 51, 60, 61, 61B, and 66) and a greenhouse, most of which were demolished in the mid 1980s, as discussed in FMC’s Middleport Site Investigation Final Report (Conestoga-Rovers & Associates, May 1987). Figure 1 identifies the location of these buildings.

Those R&D activities included development and testing in laboratories and greenhouse(s), and pilot-scale and full-scale testing of pesticide production and formulations methods. In 1964, FMC constructed R&D offices and laboratory facilities which were housed in two new buildings (Buildings 100 and 102) and up to five greenhouses at the southwest corner of the then Plant property (see Figure 1) for laboratory-scale testing activities. Pilot-scale and full-scale testing of pesticide production and formulation methods continued to be performed on the northwestern portion of the Plant Site.

In 1983, the R&D operations at the Plant were moved to FMC's R&D Center in Princeton, New Jersey. In 1983-1985, FMC decommissioned the laboratory and greenhouse facilities situated in the southwest corner of the Plant. The decommissioning activities included isolation of the storm sewers, sanitary sewers, and other utilities, and removal and/or decontamination of the greenhouses and laboratory areas and removal of the greenhouses.

FMC sold its R&D property (consisting of Buildings 100 and 102 and approximately 10 acres of associated land) in 1985 to Huntingdon Analytical Services, Inc. Huntingdon Analytical Services operated a commercial analytical laboratory on the property from 1986 to 1995. On May 9, 1995, Maxim Technologies, Inc. (Maxim) purchased all capital stock of Huntingdon Analytical Services, Inc., which included the property in Middleport. Maxim continued to operate the analytical laboratories until it sold the property in 1996 to 71 Pearce Avenue, Inc., a holding company for Don Enderby Realty, Inc. After 1996, two of the three parcels of land that comprise FMC's Former R&D Property were sold to Dunn and Schoolcraft Transportation LLC. Since 1996, the property has been used for various commercial purposes including a school bus and trucking facility.

FMC used small amounts of radiological material from 1971 to 1982 in its research laboratories at the southwest corner of the Middleport property under a license issued by the New York State Department of Labor (NYSDOL). This material was used by highly trained technicians and research personnel primarily in tracer studies similar to what a hospital laboratory may perform and was present in laboratory instruments (i.e., gas chromatographic electron capture detector). The usage and disposal of those materials complied with applicable regulatory requirements.

Areas where this radiological material was used were properly decommissioned at the time of closure of the laboratory facilities in the early 1980's to the satisfaction of the NYSDOL. Wastes (including any greenhouse soils used in the tracer studies) that were generated from the decommissioning process were properly managed and transported from the site for disposal in accordance with applicable requirements. Any remaining useable radiological material was relocated to FMC's Princeton, NJ research facility at the time research activities were transferred to that location.

FMC had two former waste storage areas (Solid Waste Management Units-SWMUs) on the former R&D parcel in Middleport. SWMU #27 was an outdoor drum storage area used to store waste solvents from the R&D laboratories and SWMU #37 was an indoor drum storage area used to store waste soils containing pesticides from research activities. Both SWMUs #27 and #37 were closed, decontaminated and verified clean by wipe testing in 1982 in accordance with a

closure plan. The closure of both units was certified and approved by the NYSDEC. Figure 4 identifies the location of these two SWMUs.

The “RCRA Facility Assessment Preliminary Review” report (NYSDEC, 1988; revised by FMC on May 1, 1989) stated that it was unlikely that any releases occurred from the SWMUs onto the former FMC R&D property. Soil sampling for analysis of volatile organic compounds was performed near SWMU #27 as part of the Agencies’ approved 1993-1996 RFI sampling and analysis activities. Those sample results did not identify VOC contamination near SWMU #27. FMC does not believe any additional sampling is warranted to complete the RFI for this area.

As part of FMC’s R&D operations, FMC also owned and operated a 280 acre active, commercial farm (“Gasport Farm”) at 7018 Slayton Settlement Road, Gasport, in Niagara County. The Gasport Farm was purchased in the early 1950’s and sold to Huntingdon Analytical Services, Inc. in 1985 at the same time as the R&D facilities at the southwest corner of the Plant Site. The farm is located approximately 8.5 miles northwest of the FMC plant site. FMC does not have any information on the ownership of the Gasport Farm subsequent to its purchase by Huntingdon Analytical Services, Inc.

During FMC’s ownership, the Gasport Farm operated primarily for commercial production of fruits and vegetables. A portion of the farm, approximately 18%, was used by FMC for evaluation of pesticides. Typically, this would involve small plots along the lines of 10 by 20 feet, with minor amounts of materials applied (grams and ounces) in a single growing season. The exact locations of any research activities that occurred on the farm are not known at this time. The current ownership and use of the Gasport Farm is not known. There is no reason to believe that the use and management of agricultural chemicals by FMC, its former owners, past owners, or current owners is different than any agricultural farming enterprise in New York.

3.1 Investigative Activity 2 – Location of On-Site Laboratories and Fate of Associated Waste Materials

FMC has no specific documentation on the exact location and size of the lab room(s) and greenhouse(s) utilized in the 1965-1967 study. Based on interviews, FMC understands that the laboratory formulation and testing occurred in the then new R&D facilities (Buildings 100 and 102) located on the southwest corner of the facility, and that greenhouse testing occurred in the greenhouse then located on the northwestern portion of the facility (in the vicinity of former Buildings 51, 60, 61, 61B, and 66 – see description in Section 3.0, above). The greenhouse testing involved testing of individual plants within enclosures.

In accordance with the retention periods in FMC document retention policies, few records from the period when R&D activities were conducted in Middleport remain. The 1965-1967 research study occurred prior to enactment of the Resource Conservation and Recovery Act (RCRA) and issuance of the associated waste management regulations, which required the use and retention of hazardous waste manifests. FMC is not aware of the existence of any specific documentation concerning the fate of wastes produced as part of this study. However, it is likely that any laboratory waste generated at the R&D facility at the southwest corner of the FMC Plant Site was transferred to the other waste management areas of the Plant Site. These other areas likely included SWMU # 20-R&D Soil Lugging Area, SWMU # 23-Formulations Generation Area (outdoor drum storage),

SWMU #24-Formulations Waste Storage Area (outdoor drum storage), SWMU #25-Product Formulations Waste Area (indoor drum storage), SWMU #26-Formulations Waste Storage Area (indoor drum storage), SWMU # 43 – R&D Waste Area (East) Dust House and SWMU #44 – R&D Waste Area (West) Dust House. Figure 4 depicts the locations of these SWMUs. It was reported that there was no chemical waste generated in the course of the greenhouse testing. The materials used were in vials, and any remaining material after application was returned to the laboratory. The fate of the enclosures used during application to prevent release of vapors is unknown.

3.2 Investigative Activity 2 – Existing Data

Table 6 summarizes soil, sediment, surface water and groundwater sample data for 2,4-D and 2,4,5-T collected as part of the environmental studies conducted to date by FMC. Table 7 identifies the detections of 2,4-D and 2,4,5-T in soil and sediment data, and Figure 1 identifies historic soil sample locations at and near the FMC Plant Site where 2,4-D and 2,4,5-T samples were collected.

2,4-D was detected in only one soil sample collected from the former Northwest Conrail Area of the FMC-owned North Railroad Property. 2,4,5-T has not been detected in any soil/sediment samples collected from the Plant Site and the off-Site study areas.

Table 8 summarizes the 2,4-D and 2,4,5-T detections in groundwater samples collected from monitoring wells located at the Plant Site, off-Site monitoring wells and private wells. Figure 2 identifies the locations of all existing and historic monitoring wells installed at the Plant Site and in the off-Site areas and Figure 3 identifies the location of all private wells around the Plant Site.

Table 9 presents soil sample data collected from borehole location BH-J1, installed near the former R&D Buildings 100 and 102, and from boreholes BH-I1 and BH-I2, both installed near the demolished former R&D buildings and greenhouse at the northwestern portion of the FMC Plant Site.

Based on review of the 1967 DoD Report, any existing information currently available to FMC, and existing sampling data, FMC believes that further sampling and analysis at FMC's former R&D property (at the southwest corner of the facility), the location of the former greenhouse in the northwestern corner of the facility, or in the unknown field test location is not warranted based on the following:

- During the research study, FMC utilized **less than 12 gallons of total chemicals** in the laboratory, greenhouse and field tests over a period of 2 1/2 years (January 1965 to July 1967).
- The 1965-1967 DoD laboratory, greenhouse and field activities were **performed under strict controls** (e.g., application to plants within enclosures, use of plant sentinels in the lab to identify any drifts), such that any significant releases to air, ground, water or sewer were improbable.
- Field tests were conducted in the summers of 1965 and 1966. As discussed in Section 2.5 above, it is estimated that 0.92 gallons were directly applied on seven-foot square

field plots enclosed within a seven-foot cube (page 26 of the 1967 DoD Report). Based on information contained in the 1967 DoD Report, it is estimated that 73 plots (3,577 square feet or 0.08 acre) were tested over a two year period. It is estimated that on average approximately **0.2 teaspoon of chemicals was applied to one square foot of the overall test area**. If the application rates and the number of replicates are taken into account, **the range of chemical application in the field is estimated to be 0.05 to 0.26 teaspoon of chemicals per square foot** (based on 3-5 replicate applications at rates of 1-3 gallons per acre). For comparison purposes, based on the label of a currently available lawn treatment product that contains 2,4-D (i.e., Ortho Weed B Gon[®]), the application rate is calculated to be approximately 0.04 teaspoon of product per square foot of lawn per application (typically applied two times per year). Therefore, it is concluded that the amounts of test formulations/chemicals applied during the DoD research study are similar to the amounts used in currently available lawn treatment products.

- Soil sample data for 2,4-D and 2,4,5-T collected from the production/manufacturing areas of the Plant Site and from off-Site study areas did not identify any significant presence of 2,4-D and 2,4,5-T. Therefore, it can be concluded that **there is no “Agent Orange” contamination in the FMC Middleport study areas**.
- FMC’s R&D Facility in Middleport was constructed in 1964 and was considered to be a “state of the art” research facility for that time. The R&D activities were conducted by highly skilled and educated research personnel, who **utilized specialized procedures and methods with appropriate scientific and environmental controls**. The activities conducted in those facilities consisted of office/administrative related activities; testing in laboratories (equipped with appropriate ventilation and lab hoods filters); testing in greenhouses within constructed “floors” (typically soil/plants were contained in “tables” and not planted in the ground); small-quantity chemical storage in cabinets; and waste management in containers within two waste storage areas (SWMUs #27 and 37). Pilot testing or any production/manufacturing activities did not occur in or around the R&D Facility located at the southwest corner of the Plant Site. Further, based on our current knowledge and existing records, **no spills or releases to the environment occurred at FMC’s R&D Facility** at the southwest corner of the Plant Site.

4.0 INVESTIGATIVE ACTIVITY 3 – Location of Field Test Sites

FMC has recently located some field/lab reports associated with the research activities discussed in the 1967 DoD Report at its Princeton R&D facilities. One of those reports identified that the test plots were located at “Paynes”. No further information on location was provided. The author of the report, Dr. Edward Hagood, performed the field tests; he is known to have passed away. He did own property north of the Erie Canal between Middleport and Medina, in the vicinity of the FMC Dublin Road Site. There is or was one or more parcels close to Dr. Hagood’s property that was owned by persons with the surname Payne. One of the members of the FMC R&D team that conducted the 1965-1967 DoD study believes that the field testing occurred on Dr. Hagood’s property, but said that it could have been on property adjacent or close to the Hagood property. He described the site as very overgrown, possibly a former orchard area. According to the

contemporaneous field report, the “site . . . was infested with 21 deciduous species of brush,” and “each of the tree or brush species or combination of species . . . was of size or was trimmed to a size that would fit within a seven foot cube. This cube was constructed of wood, metal and plastic, such that it could be assembled over each plot and would serve to confine the sprays during a 15 minute settling period.” This confirms that the estimated 0.92 gallons of the research formulation was used at this location under very controlled conditions, which is estimated to be an average of 0.2 teaspoon of chemicals applied to one square foot of test area.

As part of a groundwater monitoring program conducted pursuant to the selected remedy for the FMC Dublin Road Site, in the late 1990’s, over a five-year period, FMC did sample water supply wells on two properties owned by persons named Payne located next to the former Hagood property. The analyses included 2,4-D and 2,4,5-T, and were all non detect for these compounds.

FMC believes that additional efforts to identify the test location(s) is a waste of resources and will not yield any meaningful information. As discussed in the above Section 3.2, sampling and analysis of the field test area is not warranted based on the small quantities used in the field tests (an average of 0.2 teaspoon of chemicals per one square foot of test area), the controls (i.e., use of enclosures during application) used in the field study, and other reasons discussed in above Section 3.2. The amounts of test formulations applied in the field are similar to the amounts used in currently available lawn treatment products that contain 2,4-D.

5.0 INVESTIGATIVE ACTIVITY 4 – Other Federal Contract Studies

In accordance with the retention periods in FMC document retention policies, few records from the period when R&D activities were conducted in Middleport remain. FMC has completed a search of existing records in FMC’s law department and in its R&D facilities in Princeton, and did not identify additional “classified” or “unclassified” research contracts with the Federal Government relative to operations or R&D projects at Middleport.

Table 1: List of Chemicals Developed by the Agencies from DoD Report - "Agencies' 2007 FMC-DoD Chemical List"

The chemicals following a bolded chemical are synonyms.

aminotriazole

imazapyr
2-(4-isopropyl-4-methyl-5-oxo-2-imidazolin-2-yl) nicotinic acid
isopropylamine salt
3-amino-1H-1,2,4-triazole

ammonium thiocyanate

atrazine
2-chloro-4-ethylamino-6-isopropylamino-S-triazine

bromacil

5-bromo-3-sec-butyl-6-methyluracil
borea
bromax

diuron

3-(3,4-dichlorophenyl)-1, 1-dimethylurea

carbitol

2-(2-butoxyethoxy)ethanol
diethylene glycol monobutyl ether

colloidal silica

silican dioxide

decalin

bicyclo(4,4,0)decane
naphthalene
perhydronaphthalene
dehydronaphthalene

diacetone alcohol

4-hydroxy-4-methyl-2-pentanone
diacetone

dimethyl sulfoxide

DMSO
methyl sulfoxide

ethomeen T15

ethomeen C15

No. 2 Fuel Oil

mesityl oxide

isopropylideneacetone
2,2-dimethylvinylmethyl ketone
methyl isobutenyl ketone
4-methyl-3-penten-2-one
isobutenyl methyl ketone

tordon 22K

kerosene
kerosine

surfactant L-77

polyalkyleneoxide modified heptamethyltrisiloxane
Amitrole
Amerol
amino triazole

Amitrol

Amizine

Amizol

Azolan

Azole

Cytrol

Diurol

Weedazol

cresol A (cresol?)

cresylic acid

crysolol

tricrosol

ethanol

ethyl alcohol

alcohol

ethyl hydrate

Synasol

Tecsol

isophorone

isoacetophorone

isoforon

1,1,3-trimethyl-3-cyclohexene-5-one

3,3,5-trimethyl-5-cyclohexen-1-one

3,3,5-trimethyl-2-cyclohexene-1-one

methylpyrrolidone

N-methylpyrrolidinone

N-methyl-2-pyrrolidone

NMP

M-Pryol

N-methyl-2-pyrrolidinone

1-methyl-2-pyrrolidinone

monuron

3-(4-chlorophenyl)-1,1-dimethylurea

Urea, 3-(p-chlorophenyl)-1,1-dimethyl-

3-(p-chlorophenyl)-1,1-dimethylurea

Urea, n-(4-chlorophenyl)-n,n-dimethyl-

CMU

chlorfenidim

monurex

telvar

1-(4-chlorophenyl)-3,3-dimethylurea

methyl ethyl ketone

2-butanone

methylacetone

ethyl methyl ketone

MEK

MEETCO

butanone

Simazine

6-chloro-n2,n4-diethyl-1,3,5-triazine-2,4-diamine

1,3,5-triazine-2,4-diamine, 6-chloro-n,n-diethyl-

chlorobis ethyl amino triazine

2-chloro-4,6-bis(ethylamino)-s-triazine

s-triazine, 2-chloro-4,6-bis(ethylamino)-

Gesapun