UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OFFICE OF CHEMICAL SAFETY
AND POLLUTION PREVENTION

MEMORANDUM

SUBJECT: Human Health Risk Assessment of the New Active Ingredient *Bacillus licheniformis* strain 414-01 in the Proposed Manufacturing-use Product *Bacillus licheniformis* strain 414-01 MUP and End-use Products 414-02 and 414-03 for FIFRA Section 3 Registration and an Associated Petition Requesting a Tolerance Exemption

EPA Reg. No(s). / File Symbol(s):	70506-AET, -AEA, -AEL, -AEU
Submission No(s):	77988, 77990 through 77992
Action Code No(s):	00378464 through 00378468
Active Ingredient Name:	*Bacillus licheniformis* strain 414-01
PC Code:	006628
Tolerance Exemption Petition:	2F9017
MRID(s):	51662301 through 51662342 52065601 through 52065637 51662501 through 51662506 52066301,52066302, 52116501 51662401 through 51662406 52066201 through 52066202 52066401
Applicant Name:	UPL NA Inc.

FROM: Hojin Lee, Ph.D., Biologist
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TO: Bibiana Oe, Risk Manager
Microbial Pesticides Branch
Biopesticides and Pollution Prevention Division

I. Action Requested

Under Section 3 of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), UPL NA Inc. requests registration of two end-use products, 414-02 (end-use liquid product, EPA File Symbol: 70506-AEL), 414-03 (end-use dry product, EPA File Symbol: 70506-AEA) and a manufacturing-use product, *Bacillus licheniformis* strain 414-01 MUP containing the new active ingredient *Bacillus licheniformis* strain 414-01.

Because application of the active ingredient may result in residues on food, UPL NA Inc. also requests establishment of a tolerance exemption for *Bacillus licheniformis* strain 414-01 (ATCC number: K-357) in or on raw agricultural products and food products. In support of registration, the applicant has submitted a Confidential Statement of Formula (CSF) (dated 07/13/22), data matrix (dated 07/13/22), product analysis data (MRIDs 51662301 to 51662306, 51662501 to 51662503, 51662401 to 51662404), mammalian toxicology data (MRIDs 51662305 to 51662311, 51662405, 51662406, 51662504 to 51662506) and a tolerance exemption petition (2F9017).

II. Executive Summary

UPL NA Inc. has applied for registration of new products containing an active ingredient *Bacillus licheniformis* strain 414-01(EPA File Symbol 70506-AET). The application includes the proposed manufacturing-use product, *Bacillus licheniformis* strain 414-01 MUP (EPA File Symbol 70506-AEU) as well as two end-use products; 414-02 (EPA File Symbol 70506-AEL) and 414-03 (EPA File Symbol 70506-AEA). *Bacillus licheniformis* strain 414-01 is derived from the naturally occurring bacterium *B. licheniformis*, a ubiquitous motile gram-positive saprophytic soil bacterium found throughout the United States. The 414-01 strain was originally isolated in the late 1980's from a site on Tumamoc Hill in the Sonoran Desert of Arizona (MRID 51662305).

B. licheniformis colonizes the rhizosphere and releases its enzymes (i.e., chitinase) to impair the various stages of nematode development, including egg hatching, mobility and increased nematode mortality (MRID 51662305). The proposed *Bacillus licheniformis* strain 414-01 formulations are intended to be applied as a seed treatment, soil drench or soil incorporated to provide protection to seedlings from listed plant pathogenic nematodes that attack the root system in a variety of crops including corn, cotton, peanut, potato, sorghum, soybean, sugar-beet, and wheat.

The manufacturing-use product, *Bacillus licheniformis* strain 414-01 MUP contains 33% active ingredient by weight, and a minimum spore titer of 3×10^{10} CFU/g. This product is intended for manufacturing purposes only and is used to formulate a liquid end-use product, 414-02. The end-use product, 414-02 is a liquid formulation that contains 0.88% active ingredient by weight, and a minimum spore titer of 8×10^{8} CFU/g. This product is intended for use as a seed treatment, soil drench and/or soil incorporated. The end-use product, 414-03 is a dry powder formulation that

contains 33% active ingredient by weight, and a minimum spore titer of 3 x 10^{10} CFU/g. This product is intended for use as a seed treatment only and is identical formulation to 414-01 MUP.

Bacillus licheniformis strain 414-01 has no demonstrated infectivity and low acute toxicity based on the toxicity and infectivity study results and information presented for the active ingredient and its closely related species. Dietary and drinking water exposure is expected to be negligible since *Bacillus licheniformis* is a ubiquitous bacterium commonly found throughout the environment including soil and food consumed by people. The exposed levels of the bacterium as a pesticide are expected to decrease to background levels shortly after application (Feinberg, 2022).

There is potential for occupational exposure; however, no toxicological endpoints have been identified in guideline studies done at the limit dose. There are currently no residential uses proposed for the active ingredient. The Agency has determined that no further studies are needed at this time considering all the available hazard and exposure data on *Bacillus licheniformis* strain 414-01. FIFRA Determination: Based on the available toxicology and exposure information, no unreasonable adverse effects to humans are expected from the use of *Bacillus licheniformis* strain 414-01 as a pesticide when EPA-approved product label instructions are followed. FFDCA Determination: Further, there is a reasonable certainty that no harm will result to the U.S. population, including infants and children, from aggregate exposure to residues of *Bacillus licheniformis* strain 414-01 from the proposed pesticidal uses.

The conclusions conveyed in this assessment were developed in full compliance with EPA Scientific Integrity Policy for Transparent and Objective Science, and EPA Scientific Integrity Program's Approaches for Expressing and Resolving Differing Scientific Opinions. The full text of EPA Scientific Integrity Policy for Transparent and Objective Science, as updated and approved by the Scientific Integrity Committee and EPA Science Advisor can be found here: https://www.epa.gov/sites/default/files/2014-02/documents/scientific_integrity_policy_2012.pdf. The full text of the EPA Scientific Integrity Program's Approaches for Expressing and Resolving Differing Scientific Opinions can be found here: https://www.epa.gov/scientific-integrity/approaches-expressing-and-resolving-differing-scientific-opinions.

III. Background

Bacillus licheniformis strain 414-01 is derived from the naturally occurring bacterium *B. licheniformis*, a ubiquitous motile gram-positive saprophytic soil bacterium found throughout the United States. The 414-01 strain was originally isolated in the late 1980's from a site on Tumamoc Hill in the Sonoran Desert of Arizona (MRID 51662305).

B. licheniformis is also found on bird feathers, especially the chest and back plumage; most often ground-dwelling (e.g., sparrows) and aquatic species (e.g., ducks). The optimal growth temperature of the spores is around 50 °C, although it can survive at much higher temperatures, and its optimal temperature for enzyme secretion is 37°C. An interesting aspect of *B. licheniformis* spores is that it

can exist in a dormant spore form to resist harsh environments, or in a vegetative state when conditions are favorable (MRID 51662305).

Because *Bacillus licheniformis* is a ubiquitous organism found throughout the environment and the food we eat, it likely enters the human digestive system many times a day. While data regarding its ability to survive in the human gastrointestinal tract are sparse, it is likely that the spores will pass through without causing harm, especially since it has shown to be non-infective, non-pathogenic and non-toxic to rats (Claus and Berkeley, 1986 and MRID 51662305). Although *B. licheniformis* can grow over a wide range of temperatures, including that of the human body (Claus and Berkeley, 1986), the literature indicates that it is unlikely that this microorganism will colonize humans to any significant degree. Obi (1980) reported that a number of species of the genus *Bacillus*, including *B. licheniformis, B. subtilis, B. megaterium, and B. pumilus*, are able to produce a lecithinase, an enzyme that can disrupt the cell membrane of mammalian cells; however, there has not been a correlation with production of lecithinase and human disease. Edberg (1992) concluded that the virulence characteristics of *B. licheniformis* are very low, and likely not relevant, and stated that in order to achieve an infection, either the number of microorganisms must be very high or the immune status of the host low.

Dietary administration of *B. licheniformis* contributes to the improvement of laying performance and egg quality in laying hens (Wang et al., 2017). Similarly, dietary supplementation of *B. licheniformis* as a probiotic was reported to inhibit the growth of the pathogenic bacterium *Clostridium perfringens* in broiler chickens (Lin et al., 2017). Oral administration of a mixture of *B. licheniformis and B. subtilis* reprograms the gut microbiota and enhances goblet cell function to ameliorate enteritis caused by enterotoxigenic *Escherichia coli* in pigs (Zhang et al., 2017).

Bacillus spp. are classified as extracellular plant growth-promoting rhizobacteria inhabiting the rhizosphere or the spaces between the root cortex cells, with the majority having shown to be of minimal toxicity and of low risk (MRID 51662305). The enzymes produced by *B. licheniformis* contribute to natural nutrient cycling in the soil rhizosphere and have also been found to have many beneficial industrial uses, including in animal feed, in aquaculture, as a detergent additive to help break down organic stains, and within wastewater facilities (MRID 51662305). *B. licheniformis* has a long history of use in human foods and food applications, as well as animal feed, as recognized by several agencies (MRID 51662305):

- EPA: Granted an exemption from the requirement of a tolerance for *Bacillus licheniformis*; strain FMCH001 (40 CFR §180.1350)
- FDA: GRAS (Generally Regarded as Safe) status for producing enzymes for use in food and food processing (21 CFR §184.1027)
- AAFCO: Approved for use as a Direct Fed Microorganism (T36.14)
- Canada: Classified as a Risk Group 1 microorganism by the Public Health Agency of Canada (PHAC) and by the Canadian Food Inspection Agency (CFIA)

B. licheniformis is pesticide to control nematode pests in the rhizosphere. *B. licheniformis* works by colonizing the rhizosphere and releasing its enzymes (i.e., chitinase) to impair the various stages of nematode development, including egg hatching, mobility and increased nematode mortality. The proposed *Bacillus licheniformis* strain 414-01 formulations are intended to be applied as a seed treatment, soil drench or soil incorporated to provide protection to seedlings from listed plant pathogenic nematodes that attack the root system in a variety of crops including corn, cotton, peanut, potato, sorghum, soybean, sugar-beet, and wheat.

The *B. licheniformis* strain 414-01 product line consists of four products:

1) *Bacillus licheniformis* strain 414-01 TGAI: a lyophilized powder that contains 100% active ingredient by weight and a minimum spore titer of 9 x 10^{10} CFU/g. This product is intended for manufacturing purposes only.

2) 414-01 MUP: a dry powder [redacted] that contains 33% active ingredient by weight, and a minimum spore titer of 3 x 10^{10} CFU/g. This product is intended for manufacturing purposes only and is used to formulate a liquid end-use product.

3) 414-02: a liquid formulation [redacted] contains 0.88% active ingredient by weight, and a minimum spore titer of 8 x 10^{8} CFU/g. This product is an end-use product formulation intended for use as a seed treatment, soil drench and/or soil incorporated. The end-use product 414-02 is intended for use as a liquid bionematicide seed treatment and a soil application. The 414-02 can be applied with mechanical, slurry, or mist-type seed treating equipment to provide protection of seedlings from listed plant pathogenic nematodes that attack the root system in a variety of crops including corn, cotton, peanut, potato, sorghum, soybean, sugarbeet, and wheat at the listed application rate (e.g., 0.25 fl oz/cwt seed for potato, peanut, soybean and wheat). For soil application, 5 oz/Acre of the 414-02 for peanut and potato can be applied to soil with ground equipment including hose-end, pressurized, greenhouse and hand-held sprayers, sprinklers, or drip-type irrigation systems.

4) 414-03: a dry powder formulation [redacted] that contains 33% active ingredient by weight, and a minimum spore titer of 3 x 10^{10} CFU/g. This product is an end-use product formulation intended for use as a seed treatment only and is identical formulation to 414-01 MUP (i.e., TGAI [redacted] The end-use product 414-03 is intended for use as a dry bionematicide seed treatment and 0.013 oz/cwt (0.85 ml/100 kg) seed of the 414-03 can be applied with mechanical seed treating equipment to protect seedlings from listed plant pathogenic nematodes that attack the root system in peanut and potato.

Preliminary technical screening of the submitted data package identified deficiencies that were communicated to the applicant in a 10-day letter (letter dated December 1, 2022 from Alexandra Boukedes of the Agency to Audrey Sehn, Regional Regulatory Manager, UPL NA, Inc.). On December 19, 2022, the applicant responded to the Agency-identified deficiencies (response to 10-day letter from Audrey Sehn, UPL NA, Inc. to Alexandra Boukedes of the Agency) and submitted data and information included MRIDs 52065601 through 52065637 for the active

ingredient; MRIDs 52066301 to 52066302 for the EP 414-02; MRIDs 52066201 to 52066202 for the MUP; MRID 52066401 for the EP 414-03.

After the review of the applicant's response to 10-day letter, the Agency requested additional data and information including Analysis of Samples data for 414-02 through email (email dated 2-22, 2023 from Bibiana Oe of the Agency to Audrey Sehn, Regional Regulatory Manager, UPL NA, Inc.). On February 28, 2023, the applicant responded the Agency-identified deficiencies (letter dated 02-28, 2023 from Audrey Sehn, UPL NA, Inc. to Alexandra Boukedes of the Agency) and submitted preliminary Analysis of Samples for 414-02 and additional information [redacted] (MRID 52116501). Subsequent review of this applicant's response determined at the applicant addressed the deficiencies identified in the 10-day letter to the satisfaction of the Agency.

IV. Product Identity and Analysis Review

The applicant submitted data to comply with product identity and analysis data requirements published in 40 CFR § 158.2120 in support of the registration of *Bacillus licheniformis* strain 414-01 and two end-use products 414-02 and 414-03. In accordance with 40 CFR § 158.2120 for microbial product analysis data, the submitted data satisfy the requirement for the requested B590 action and are classified as **ACCEPTABLE**. Table A1 (*see Appendix A. Product Identity and Analysis Review*) provides the status of the data requirements as published in 40 CFR § 158.2120 for *Bacillus licheniformis* strain 414-01.

V. Summary of Toxicology Data

Table 1 provides the status of the data requirements as published in 40 CFR § 158.2140 for *Bacillus licheniformis* strain 414-01 and the associated pesticide products for human health risk assessment. Scientific rationales were submitted to satisfy the generic (TGAI, technical grade of the active ingredient) data requirements for acute oral toxicity/pathogenicity and acute injection toxicity/pathogenicity and the product-specific acute oral, inhalation, and dermal toxicity data requirements for the end-use products (EP) and the manufacturing-use product (MP), while studies were submitted to satisfy the remaining generic and product-specific toxicology data requirements. Information from the scientific rationales and studies is included in the section below, and Data Evaluation Records of the scientific rationales and studies are attached.

The information provided is sufficient to satisfy the Tier I toxicology data requirements for human health risk assessment for the active ingredient and the associated pesticide products. Further testing at higher tiers is not required for the current label uses.

Table 1. Summary of data submitted to comply with toxicology data requirements published in 40 CFR § 158.2140 for support of the registration of products containing *Bacillus licheniformis* strain 414-01.

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Generic (TGAI) Toxicology Data			
Acute Oral Toxicity/Pathogenicity	885.3050	Testing waived based on the clearance of the TGAI in the acute pulmonary toxicity/pathogenicity study (MRID 51662307) and lack of adverse clinical signs in the acute oral toxicity study (MRID 51662309) on the TGAI. An OCSPP 885.3150 Acute pulmonary toxicity/pathogenicity study conducted with the *Bacillus licheniformis* strain 414-01 TGAI via intra-tracheal injection at 6.97 x 10^8 CFU/animal, produced no clinical signs of persistent infection, toxicity, or pathogenicity in treated animals (MRID 51662307). **Classification: Acceptable**	51662305
Acute Pulmonary Toxicity/Pathogenicity	885.3150	A provided study showed a pattern of clearance. Not toxic, infective, and/or pathogenic to rats when administered by intra-tracheal instillation in a single dose of 6.97 x 10^8 CFU/animal. Complete clearance was achieved for blood, brain, liver, kidney, lymph nodes, and cecum contents. Partial clearance was achieved for spleen. Concentrations in spleen gradually decreased to below relative established limits of detection in females and to concentrations of 442.1 CFU/g for males and 226.3 CFU/g for males and females combined. Concentrations in lung samples gradually decreased over the duration of the study to concentrations of 1.1 x 10^4 CFU/g for males, 1.5 x 10^4 CFU/g for females and 1.3 x 104 CFU/g for males and females combined. This extended pattern of clearance is not uncommon with some strains of *Bacillus* and other spore forming organisms which are generally more resistant to the host's immune system when administered intra-tracheally. **Classification: Acceptable**	51662305, 51662307, 52065606
Acute Injection Toxicity/Pathogenicity	885.3200	Testing waived based on the clearance of the TGAI in the acute pulmonary toxicity/pathogenicity study (MRID 51662307) and lack of adverse clinical signs in the acute oral toxicity study (MRID 51662309). **Classification: Acceptable**	51662305

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Hypersensitivity Incidents	885.3400	The applicant reported that no hypersensitivity incidents, including immediate-type or delayed-type reactions of humans and domestic animals, occurred during research, development, or testing of the TGAI. Any future hypersensitivity incidents must be reported to the EPA (refer to test note #3 of 40 CFR § 158.2140(d)). **Classification: Acceptable**	51662305, 51662308
Cell Culture	885.3500	Not required because *Bacillus licheniformis* strain 414-01 is not a virus (refer to test note #4 of 40 CFR § 158.2140(d)). **Classification: Acceptable**	51662305
Acute Oral Toxicity	870.1100	Three Sprague-Dawley albino female rats were given a single oral dose of *Bacillus licheniformis* strain 414-01 Technical (100%, 414-01) diluted with distilled water (20% w/w) at doses of 5000 mg/kg. Animals were then observed for 14 days. During the study, there was no mortality and no clinical signs of toxicity. All animals exhibited weekly weight gain. Gross necropsy conducted at terminal sacrifice revealed no observable abnormalities. The test substance acute oral LD50 was determined to be greater than 5000 mg/kg. Therefore, *Bacillus licheniformis* strain 414-01 Technical (100%, 414-01) is classified in EPA Toxicity Category IV for acute oral toxicity in rat. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662309
Acute Eye Irritation	870.2400	TGAI was a mild irritant to the eyes of rabbits. All of the treated rabbits' eyes exhibited iritis and minimal conjunctivitis. There was no corneal opacity observed in any of the treated eyes during the study. The overall incidence and severity of irritation decreased with time. All animals were free of ocular irritation by 72 hours. The Maximum Mean Total Score was 7.3. The test substance was classified as a mild irritant to eyes. **Classification: Acceptable** **TOXICITY CATEGORY III**	51662305, 51662310

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Primary Dermal Irritation	870.2500	TGAI was a slight irritant to the skin of rabbits. All three treated sites exhibited very slight to slight erythema and edema. The overall incidence and severity of irritation decreased gradually with time. All animals were free of dermal irritation by day 7. The Primary Dermal Irritation Index (PDII) calculated for this test substance was 1.7. The test substance was classified as slightly irritating to the skin. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305, 51662311
Product-specific (MP/EP) Toxicology Data – 414-01 MUP (EPA File Symbol: 70506-AEU), 414-03 a dry powder EP (EPA File Symbol: 70506-AEA) ** 414-01 MUP is identical to 414-03			
Hypersensitivity Incidents	885.3400	The applicant reported that no hypersensitivity incidents, including immediate-type or delayed-type reactions of humans and domestic animals, occurred during research, development, or testing of 414-03 (414-01 MUP). Any future hypersensitivity incidents must be reported to the EPA (refer to test note #3 of 40 CFR § 158.2140(d)). **Classification: Acceptable**	51662308
Acute Oral Toxicity	870.1100	Testing waived based on the clearance of the TGAI in the acute pulmonary toxicity/pathogenicity study (MRID 51662307) and lack of adverse clinical signs in the acute oral toxicity study (MRID 51662309). Additionally, all inert ingredients found in the end use product are exempt from the requirement of tolerance (40 CFR §180), and according to the information provided in the safety data sheets, they pose no risk of acute oral toxicity. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305, 51662309
Acute Dermal Toxicity	870.1200	Testing waived based on the lack of acute oral toxicity (MRID 51662309), acute eye irritation (MRID 51662310) and primary dermal irritation (MRID 51662311) studies on TGAI, and acute eye irritation MRID 51662405) and primary dermal irritation (MRID 51662406) data on 414-03 EP. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Acute Inhalation Toxicity	870.1300	Testing waived based on the clearance of the TGAI in the acute pulmonary toxicity/pathogenicity study (MRID 51662307), lack of adverse clinical signs in the acute oral toxicity study (MRID 51662309), acute eye irritation (MRID 51662310), primary dermal irritation (MRID 51662311) studies on TGAI, and acute inhalation study on 414-02 EP demonstrating no toxicity (MRID 51662504). **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305
Acute Eye Irritation	870.2400	The test material was listed as minimally irritating. No corneal opacity was observed. The overall incidence and severity of irritation decreased with time although all three treated right eyes exhibited iritis and/or conjunctivitis within 1 hour after test substance instillation. Animals were free of ocular irritation by 24 hours. There was no eye irritation observed for any animals at 48 and 72 hours. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662405
Primary Dermal Irritation	870.2500	The test material was identified as moderately irritating to the skin. Within 30-60 minutes of patch removal, all three treated sites exhibited very slight to slight erythema and very slight edema. The overall incidence and severity of irritation decreased gradually with time. Although areas of dark discoloration and desquamation were noted at one dose site at 72 hours, all animals were free of erythema and edema by Day 7 (study termination). The Primary Dermal Irritation Index (PDII) calculated for this test substance was 2.4. The EP 414-03 is classified as moderately irritating to the skin. **Classification: Acceptable** **TOXICITY CATEGORY III**	51662406
Product-specific (EP) Toxicology Data – 414-02 a liquid EP (EPA File Symbol: 70506-AEL)			
Hypersensitivity Incidents	885.3400	The applicant reported that no hypersensitivity incidents, including immediate-type or delayed-type reactions of humans and domestic animals, occurred during research, development, or testing of 414-02. Any future hypersensitivity incidents must be reported to the EPA (refer to test note #3 of 40 CFR § 158.2140(d)). **Classification: Acceptable**	51662308

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Acute Oral Toxicity	870.1100	Testing waived based on the clearance of the TGAI in the acute pulmonary toxicity/pathogenicity study (MRID 51662307) and lack of adverse clinical signs in the acute oral toxicity study (MRID 51662309). Additionally, all inert ingredients found in the end use product are exempt from the requirement of tolerance (40 CFR §180), and according to the information provided in the safety data sheets, they pose no risk of acute oral toxicity. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305
Acute Dermal Toxicity	870.1200	Testing waived based on the lack of acute oral toxicity (MRID 51662309), acute eye irritation (MRID 51662310) and primary dermal irritation (MRID 51662311) studies on TGAI, and acute eye irritation MRID 51662505) and primary dermal irritation (MRID 51662506) data on 414-02 EP. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662305
Acute Inhalation Toxicity	870.1300	The acute inhalation LC50 of the test substance is greater than 5.31 mg/L in 5 male and 5 female rats via the inhalation (nose-only exposure) route for 4 hours. No animals were observed for mortality, signs of gross toxicity, and behavioral changes at least once daily for 14 days following exposure. All animals survived and gained body weight. Gross necropsy conducted at terminal sacrifice revealed no observable abnormalities. Following exposure, all rats showed irregular respiration. However, all animals recovered by Day 2 and appeared active and healthy for the remainder of the 14-day observation period. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662504
Acute Eye Irritation	870.2400	The test material was listed as minimally irritating. No corneal opacity was observed. The overall incidence and severity of irritation decreased with time. Animals were free of ocular irritation by 24 hours. There was no eye irritation observed for any animals at 48 and 72 hours. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662505

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary, Classification and Toxicity Category (As Applicable)	MRID
Primary Dermal Irritation	870.2500	The test material was identified as slightly irritating. Within 24 hours of patch removal, two treated sites exhibited very slight to slight erythema and all three sites had very slight to slight edema. The overall incidence and severity of irritation decreased gradually with time. Although desquamation was noted at one dose site on Day 7, all animals were free of erythema and edema by Day 7 (study termination). The Primary Dermal Irritation Index (PDII) calculated for this test substance was 1.5. The EP 414-02 is classified as slightly irritating to the skin. **Classification: Acceptable** **TOXICITY CATEGORY IV**	51662506

A. Toxicology Study Summaries

1. Generic (TGAI) Toxicology Data for *Bacillus licheniformis* strain 414-01 Technical

Study Title: Acute Pulmonary Toxicity/Pathogenicity Study in Rats
MRID No.: 51662307, 52065606
Classification: Acceptable
Study Summary:
In this study, rats received a dose of 6.97×10^8 viable spores in 0.1 ml of dosing solution by intra-tracheal administration, while a control group remained untreated. Lung, brain, liver, spleen, kidney, lymph nodes, cecum contents and blood were collected 3, 7, 15, 21, 29, 44, and 93 days after dosing, and lung samples were collected soon after dosing on Day 1.

There was no mortality in the study animals and no significant effect on body weight or body weight gain associated with strain 414-01. A pattern of microbial clearance from the organs of treated animals was demonstrated during the study. Although spleen and lung samples did not achieve complete clearance by Day 93 (study termination), a pattern of clearance was observed in these tissues. As 414-01 is in a spore form, a slower rate of clearance from certain tissue is not unexpected. This is commonly seen with other spore forming organisms which are generally more resistant to the host's immune system. Given a longer duration, complete clearance is likely to be achieved. 414-01 is considered to be non-infective and non-pathogenic following the pulmonary administration of single dose of 414-01.

Note that the transient "spike" seen on Day 7 might be the result of contamination at the time of tissue harvest and processing affecting all samples equally (except blood which is harvested and

processed differently). The data on Day 7 are not representative of the presence of the TGAI in the tissue and can be excluded from interpretation of the results. Exclusion of the data on Day 7 will not result in significant change in interpretation of the overall results.

The results of acute pulmonary toxicity/pathogenicity studies with mice submitted to the Agency to support registration of *B. licheniformis* have shown no adverse effects with a demonstrated pattern of clearance. Consequently, the Agency considers it unlikely that *B. licheniformis* strain 414-01 will cause infections in healthy people when used appropriately according to the directions outlined in the product label.

Study Title: Acute Oral Toxicity in Rats
MRID No.: 51662309
Classification: Acceptable
Toxicity Category: IV
Study Summary:
Three Sprague-Dawley albino female rats were given a single oral dose of *Bacillus licheniformis strain* 414-01 Technical (100%, 414-01) diluted with distilled water (20% w/w) at doses of 5000 mg/kg. Animals were then observed for 14 days.

During the study, there was no mortality and no clinical signs of toxicity. All animals exhibited weekly weight gain. Gross necropsy conducted at terminal sacrifice revealed no observable abnormalities. The test substance acute oral LD50 was determined to be greater than 5000 mg/kg. Therefore, *Bacillus licheniformis* strain 414-01 Technical (100%, 414-01) is classified in EPA Toxicity Category IV for acute oral toxicity in rats.

Study Title: Acute Eye Irritation in Rabbit
MRID No.: 51662310
Classification: Acceptable
Toxicity Category: III
Study Summary:
0.1 mL (0.076 g) of *Bacillus licheniformis* strain 414-01 Technical (100%, 414-01) was instilled into the conjunctival sac of right eye of 3 female New Zealand albino rabbits. Animals were then observed for 3 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within 24 hours after test substance instillation, all three treated eyes exhibited iritis and minimal conjunctivitis. There was no corneal opacity observed in any treated eye during this study. The overall incidence and severity of irritation decreased gradually with time. All animals were free of ocular irritation by 72 hours (study termination). During the study, there was no mortality and no clinical signs of toxicity or abnormal behavior. All animals exhibited weight gain.

Study Title: Primary Dermal Irritation in Rabbit
MRID No.: 51662311
Classification: Acceptable

Toxicity Category: IV
Study Summary:
Three New Zealand albino female rabbits were dermally exposed to 0.5 g [0.91 g of the substance mixed in distilled water as a dry paste, 55% (w/w)] of *Bacillus licheniformis* strain 414-01 Technical (414-01) to on 6-cm^2 intact dose site on each animal. Test sites were covered with a semi-occlusive 3-inch Micropore tape for 4 hours. After 4 hours of exposure to the test substance, the pads and collars were removed, and the dose sites were gently cleansed with a 3% soap solution followed by tap water and a clean paper towel to remove any residual test substance. Animals were then observed for 7 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within 30-60 minutes of patch removal, all three treated sites exhibited very slight to slight erythema and/or edema. The overall incidence and severity of irritation decreased gradually with time (see the Table below). All animals were free of dermal irritation by 7 Days (study termination). The Primary Dermal Irritation Index (PDII) for 414-01 is 1.7. During the study, there was no mortality and no clinical signs of toxicity or abnormal behavior. All animals exhibited weight gain.

2. Product-specific (EP) Toxicology Data – 414-02 (EPA File Symbol: 70506-AEL)

Study Title: Acute Inhalation Toxicity in Rats
MRID No.: 51662504
Classification: Acceptable
Toxicity Category: IV
Study Summary:
The groups (5/sex) of Sprague-Dawley albino rats were exposed nose only via the inhalation route to 414-02 for 4 hours at concentrations of 5.31 mg/L. Animals were then observed for 14 days.

During the study, there was no mortality and no clinical signs of toxicity. All animals exhibited weekly weight gain. Following exposure, all rats showed irregular respiration. However, all animals recovered by Day 2 and appeared active and healthy for the remainder of the 14-day observation period. Gross necropsy conducted at terminal sacrifice revealed no observable abnormalities among any animals tested. The test substance acute inhalation LD50 was determined to be greater than 5.31 mg/L. Therefore, the EP, 414-02 is classified in EPA Toxicity Category IV for acute halation toxicity in rats.

Study Title: Acute Eye Irritation in Rabbit
MRID No.: 51662505
Classification: Acceptable
Toxicity Category: IV
Study Summary:

0.1 mL of 414-02 EP (0.8% of 414-01 TGAI) was instilled into the conjunctival sac of right eye of 3 female New Zealand albino rabbits. Animals were then observed for 3 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within one hour after test substance instillation, two treated eyes exhibited iritis and minimal conjunctivitis. There was no corneal opacity observed in any treated eye during this study. The overall incidence and severity of irritation decreased gradually with time. Two animals were free of ocular irritation by 24 hours. There was no eye irritation observed for any of the animals at 48 and 72 hours.

During the study, there was no mortality and no adverse clinical signs of toxicity or abnormal behavior. All animals exhibited weight gain. 414-02 is minimally irritating to the eye based on that the maximum mean of irritating scores is 4.3 and is classified as EPA Toxicity Category IV for acute eye irritation in rabbits.

Study Title: Primary Dermal Irritation in Rabbit
MRID No.: 51662506
Classification: Acceptable
Toxicity Category: IV
Study Summary:
Three New Zealand albino female rabbits were dermally exposed to 0.5 mL of 414-02 the liquid EP (0.88% of 414-01 TGAI) applied to 6-cm^2 dose sites on each animal. Test sites were covered with a semi-occlusive 3-inch Micropore tape for 4 hours. After 4 hours of exposure to the test substance, the pads and collars were removed and the dose sites were gently cleansed with a 3% soap solution followed by tap water and a clean paper towel to remove any residual test substance. Animals were then observed for 7 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within 24 hours of patch removal, treated sites (left side) on two animals exhibited very slight to slight erythema and all three sites had very slight to slight edema. The overall incidence and severity of irritation decreased gradually with time. Although desquamation was noted at one dose site on Day 7, all animals were free of erythema and edema by Day 7 (study termination). The Primary Dermal Irritation Index (PDII) for 414-02 is 1.5. During the study, there was no mortality and no clinical signs of toxicity or abnormal behavior. All animals exhibited weight gain. 414-02 is slightly irritating to the skin and is classified as EPA Toxicity Category IV for primary dermal irritation in rabbits.

3. Product-specific (EP) Toxicology Data – 414-03 (EPA File Symbol: 70506-AEA)

Study Title: Acute Eye Irritation in Rabbit
MRID No.: 51662405
Classification: Acceptable

Toxicity Category: IV
Study Summary:
0.1 mL (0.045 g) of the test substance was instilled into the conjunctival sac of right eye of 3 female of New Zealand albino rabbits. Animals were then observed for 3 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within one hour after test substance instillation, all three treated right eyes exhibited iritis and/or minimal conjunctivitis. There was no corneal opacity observed in any treated eye during this study. The overall incidence and severity of irritation decreased gradually with time. All animals were free of ocular irritation by 24 hours. During the study, there was no mortality and no adverse clinical signs of toxicity or abnormal behavior. All animals exhibited weight gain.

In this study, 414-03 is minimally irritating to the eye based on that the maximum mean of irritating scores is 6.0 and is EPA Toxicity Category IV.

Study Title: Primary Dermal Irritation in Rabbit
MRID No.: 51662406
Classification: Acceptable
Toxicity Category: III
Study Summary:
Three New Zealand albino female rabbits were dermally exposed to 0.5 g [0.67 g of the substance mixed in distilled water as a dry paste, 75% (w/w)] of 414-03, a dry powder EP (33% of 414-01 TGAI) to on 6-cm^2 intact dose site on each animal. Test sites were covered with a semi-occlusive 3-inch Micropore tape for 4 hours. After 4 hours of exposure to the test substance, the pads and collars were removed and the dose sites were gently cleansed with a 3% soap solution followed by tap water and a clean paper towel to remove any residual test substance. Animals were then observed for 7 days. Irritation was scored by the Draize method (Draize, Woodard, and Calvery, 1944).

Within 30-60 minutes of patch removal, all three treated sites exhibited very slight to slight erythema and very slight edema. The overall incidence and severity of irritation decreased gradually with time. Although areas of dark discoloration and desquamation were noted at one dose site at 72 hours, all animals were free of erythema and edema by Day 7 (study termination). During the study, there was no mortality and no clinical signs of toxicity or abnormal behavior.

All animals exhibited weight gain. 414-03 is moderately irritating to the skin based on that the Primary Dermal Irritation Index for 414-03 is 2.4 and is classified in EPA Toxicity Category III.

VI. Human Exposure and Risk Characterization Assessment

A. Description of Uses

The end-use product 414-03 (EPA File Symbol: 70506-AEA) is intended for use as a dry bionematicide seed treatment and 0.013 oz/cwt (0.85 ml/100 kg) seed of the 414-03 can be applied with mechanical seed treating equipment to protect seedlings from listed plant pathogenic nematodes that attack the root system in peanut and potato.

The end-use product 414-02 (EPA File Symbol: 70506-AEL), is intended for use as a liquid bionematicide seed treatment and a soil application. The 414-02 can be applied with mechanical, slurry, or mist-type seed treating equipment to provide protection of seedlings from listed plant pathogenic nematodes that attack the root system in a variety of crops including corn, cotton, peanut, potato, sorghum, soybean, sugarbeet, and wheat at listed application rate (e.g., 0.25 fl oz/cwt seed for potato, peanut, soybean and wheat). For seed treatments, the maximum application rate is 3 oz/cwt. For soil application, a maximum application rate of 5 oz/Acre of the 414-02 for peanut and potato can be applied to soil with ground equipment including hose-end, pressurized, greenhouse and hand-held sprayers, sprinklers or drip-type irrigation systems.

B. Federal Food, Drug, and Cosmetic Act (FFDCA) Considerations

Section 408(c)(2)(A)(i) of FFDCA allows EPA to establish an exemption from the requirement of a tolerance (the legal limit for a pesticide chemical residue in or on a food) only if EPA determines that the exemption is "safe." Section 408(c)(2)(A)(ii) of FFDCA defines "safe" to mean that "there is a reasonable certainty that no harm will result from aggregate exposure to the pesticide chemical residue, including all anticipated dietary exposures and all other exposures for which there is reliable information." This includes exposure through drinking water and in residential settings but does not include occupational exposure. Pursuant to FFDCA section 408(c)(2)(B), in establishing or maintaining in effect an exemption from the requirement of a tolerance, EPA must take into account the factors set forth in FFDCA section 408(b)(2)(C) and (D), which require EPA to give special consideration to exposure of infants and children to the pesticide chemical residue in establishing a tolerance or tolerance exemption and to "ensure that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to the pesticide chemical residue . . . ." Additionally, FFDCA section 408(b)(2)(D) requires that EPA consider "available information concerning the cumulative effects of [a particular pesticide's] . . . residues and other substances that have a common mechanism of toxicity."

EPA performs a number of analyses to determine the risks from aggregate exposure to pesticide residues. First, for microbial pesticides, EPA determines the pathogenicity and toxicity of the pesticide. Second, EPA examines exposure to the pesticide through food, drinking water, and other exposures that occur as a result of pesticide use in residential settings, as well as other non-occupational exposure to the substance.

1. Aggregate Exposure and Risk Characterization

In examining aggregate exposure, FFDCA section 408 directs EPA to consider available information concerning dietary exposures from the pesticide residue (including food and drinking water) and all other non-occupational exposures to the pesticide residue. These non-occupational exposures include exposures through pesticide use in gardens, lawns, or buildings (residential and other indoor uses). However, because no adverse effects of concern were observed in toxicological tests with *Bacillus licheniformis* strain 414-01 described previously; therefore, the EPA did not conduct a quantitative exposure assessment.

a. Food Exposure and Risk Characterization

Bacillus licheniformis is a ubiquitous, saprophytic, soil bacterium which is thought to contribute to nutrient cycling due to its ability to produce a wide variety of enzymes (Claus and Berkeley, 1986). *B. licheniformis* is a bacterium commonly found in the soil, as well as on bird feathers, especially chest and back plumage, and most often in ground-dwelling birds (like sparrows) and aquatic species (like ducks) (Feinberg, 2022). Because *Bacillus licheniformis* is a ubiquitous organism, it likely enters the human digestive system many times a day (Feinberg, 2022). While pesticide applications of *Bacillus licheniformis* strain 414-01 may likely cause temporary increases in the population of *Bacillus licheniformis* in the environment, these levels are expected to decrease to background levels shortly after application (Feinberg, 2022). Therefore, the risk posed to adults, infants and children from food and drinking water related exposures to *Bacillus licheniformis* strain 414-01 is minimal due to the demonstrated lack of acute oral toxicity and pathogenicity. Therefore, the Agency did not conduct a quantitative food exposure assessment.

b. Drinking Water Exposure and Risk Characterization

As pesticides, *Bacillus licheniformis* strain 414-01 will be applied by seed treatment and direct soil applications which reduce the likelihood of off-site airborne movement of this active ingredient. If this active ingredient were to enter surface or ground water to some degree, it would likely be present at levels below that of the naturally occurring *Bacillus licheniformis* organism. Further, if the active ingredient were to ultimately enter drinking water systems, it would be even further reduced in numbers by way of standard drinking water treatment processes. In addition, the results of the guideline mammalian toxicology testing performed with this organism demonstrated a lack of significant adverse effects (toxicity, pathogenicity or infectivity). Consequently, as a result of these low exposure and hazard findings, quantitative drinking water exposure assessments were not performed for this microbial active ingredient.

c. Non-occupational, Residential Exposure and Risk Characterization

As previously noted, *Bacillus licheniformis* strain 414-01 is intended for agricultural use. Therefore, residential exposures resulting from this use would likely be infrequent and would pose

minimal concern due to the small amount of active ingredient involved. As a result, this use scenario is not expected to result in significant residential exposure. Further, since *Bacillus licheniformis* strain 414-01 will be applied agriculturally by seed treatment and direct soil applications, other non-occupational exposures through drift or other means are also considered unlikely. Should significant residential or non-occupational exposures occur, the results of the guideline mammalian toxicology testing performed with these active ingredients demonstrated a lack of significant adverse effects (toxicity, pathogenicity or infectivity). Therefore, quantitative non-occupational/residential exposure assessments were not performed for these microbial active ingredients.

2. Cumulative Effects

Section 408(b)(2)(D)(v) of FFDCA requires that, when considering whether to establish, modify, or revoke a tolerance, EPA consider "available information concerning the cumulative effects of [a particular pesticide's] . . . residues and other substances that have a common mechanism of toxicity."

Bacillus licheniformis strain 414-01 is not toxic and does not have a common mechanism of toxicity with other substances. Consequently, FFDCA section 408(b)(2)(D)(v) does not apply.

3. Determination of Safety for U.S. Population, Infants and Children

a. U.S. Population

For all of the reasons discussed previously, EPA concludes that there is reasonable certainty that no harm will result to the U.S. population, including infants and children, from aggregate exposure to residues of *Bacillus licheniformis* strain 414-01. This includes all anticipated dietary exposures and all other exposures for which there is reliable information.

b. Infants and Children

FFDCA section 408(b)(2)(C) provides that EPA shall apply an additional tenfold (10X) margin of safety for infants and children in the case of threshold effects to account for prenatal and postnatal toxicity and the completeness of the database on toxicity and exposure, unless EPA determines based on reliable data that a different margin of safety will be safe for infants and children. This additional margin of safety is commonly referred to as the Food Quality Protection Act Safety Factor. In applying this provision, EPA either retains the default value of 10X or uses a different additional safety factor when reliable data available to EPA support the choice of a different factor. As discussed previously, EPA has concluded that *Bacillus licheniformis* strain 414-01 is not toxic, pathogenic, or infective to mammals, including infants and children. Because there are no threshold levels of concern to infants, children, and adults when *Bacillus licheniformis* strain 414-01is used in accordance with label directions and good agricultural practices, EPA concludes that no additional margin of safety is necessary to protect infants and children.

c. Occupational Exposure and Risk Characterization

Based on the agricultural use pattern proposed for *Bacillus licheniformis* strain 414-01, there is potential for occupational exposure to applicators and other handlers through the oral, dermal, ocular, and inhalation routes. However, the supporting mammalian toxicological testing has shown a lack of irritation, toxicity, infectivity, or pathogenicity associated with the active ingredient.

The labels for the EPs 414-02 and 414-03 require that applicators and other handlers must wear long-sleeved shirts, long pants, waterproof gloves, shoes and socks. The proposed product label did not mention a requirement for a respirator; however, a NIOSH approved respirator is required for all commercially applied microbial pesticides. Therefore, these labels should contain information about required respirators. Because occupational exposure to *Bacillus licheniformis* strain 414-01 is not expected to exceed any toxicity thresholds when pesticide handlers follow the precautions and requirements identified on the product label, the Agency did not conduct a quantitative occupational assessment.

Literature Search and Incident Data

The Office of Pesticide Programs' (OPP) Incident Data System contains information dating back to the 1970s and is continuously updated as incidents are reported. A search of this database on August 18, 2023 revealed no incidents associated with *Bacillus licheniformis* active ingredients. A thorough literature search was also conducted using the term "*Bacillus licheniformis*" with and without the strain names of the currently registered *B. licheniformis* active ingredients (strains FMCH001 and SB3086). This search indicates that none are related to significant human or mammalian pathogenicity, toxicity or infectivity. However, the following considerations (below) were identified.

Cattle Abortion: Despite the frequent association of *Bacillus licheniformis* with abortion in cattle, it has not been scientifically established that *Bacillus licheniformis* is the causative agent of cattle abortion. According to a 10-year survey (1980-1989) investigated bovine abortions and stillbirths at the South Dakota Animal Disease Research and Diagnostic Laboratory, the incidence of bovine abortion caused by members of the *Bacillus* genus (both *B. licheniformis* and *B. cereus* grouped together) was 3.5% of the total abortions and stillbirths examined (8,962) over a 10-year period in South Dakota (Kirkbride, 1993, MRID 51662317). Overall, the total number of abortions and stillbirths caused by all bacteria was 14.49% (*Bacillus* ranked second in frequency of occurrence, after *Actinomyces pyrogenes*). However, the abortions associated with *Bacillus* species are less common compared to other microorganisms, particularly viruses and fungi. Therefore, the Agency considers it unlikely that *B. licheniformis* strain 414-01 as a single causative agent, will induce abortions in cows when used appropriately according to the directions outlined in the product label.

Pathogenicity: Pathogenicity of *B. licheniformis* was demonstrated in immunodeficient mice following intravenous inoculation of bacteria. Bacteria were reisolated from the liver, spleen and kidneys of artificially-inoculated immunodeficient mice and only brain and pulmonary lesions were definitively attributed to the infecting bacterium in this study (Agerholm, et al., 1997). *B. licheniformis* was isolated from the brain abscess of a 64-year old patient with acute myeloid leukemia (Mochiduki, et al., 2007), thus suggesting a cause for concern in immunocompromised hosts. However, *B. licheniformis* was also isolated from hemocultures of an immunocompetent patient with recurrent sepsis (Haydushka et al., 2012). A case of sinusitis caused by *B. licheniformis* has been also described in an immunocompetent French soldier stationed in Djibouti (Hejl et al., 2015). In summary, human infections of *B. licheniformis* have been reported in both immunocompromised and immunocompetent individuals, however such infections are extremely rare and not considered a concern for its use as a pesticide.

4. Human Health Conclusions

EPA concludes that use of *Bacillus licheniformis* strain 414-01 will not result in unreasonable adverse effects to humans and that there is a reasonable certainty that no harm will result to the U.S. population, including infants and children, from aggregate exposure to residues of *Bacillus licheniformis* strain 414-01. EPA does not expect dietary (food and drinking water) or other non-occupational risks from use of *Bacillus licheniformis* strain 414-01as an active ingredient in the proposed pesticide products. Data demonstrated that *Bacillus licheniformis* strain 414-01 is not toxic, pathogenic, irritating, or infective. Any risks resulting from exposure to individuals handling *Bacillus licheniformis* strain 414-01, such as sensitization resulting from repeated exposures, are expected to be minimized by use of the required personal protective equipment. In addition, residues of *Bacillus licheniformis* strain 414-01 will be covered by an exemption from the requirement of a tolerance in or on food commodities.

VII. References

Letter dated December 1, 2022 from Alexandra Boukedes, MPB/BPPD/OPP to Audrey Sehn, UPL NA, Inc. reporting 90-day preliminary technical screening results in a 10-day letter.

Letter dated December 19, 2022 from Audrey Sehn, UPL NA, Inc. to Alexandra Boukedes, MPB/BPPD/OPP reporting a response to Agency's 10-day letter.

Email dated February 22, 2023 from Bibiana Oe, MPB/BPPD/OPP to Audrey Sehn, UPL NA, Inc. RE: External :Re 10 day letter *Bacillus licheniformis* strain 414-01 Technical, 414-03, 414-02, *Bacillus licheniformis* strain 414-01 MUP EPA File Symbols: 70506-AET, 70506-AEA, 70506-AEL, 70506-AEU Preliminary Technical Screening.

Letter dated February 28, 2022 from Audrey Sehn, UPL NA, Inc. to Alexandra Boukedes, MPB/BPPD/OPP reporting a response to Agency's comment on 10-day letter response, 414-02 (EPA File Symbol 70506-AEL)-Inert Component.

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Appendix A. Product Identity and Analysis Review

Table A1. Summary of data submitted to comply with product analysis data requirements published in 40 CFR § 158.2120 for support of the registration of products containing *Bacillus licheniformis* strain 414-01. Confidential information has been omitted.

Data Requirement	OCSPP (OPPTS) Guideline No.	Results Summary and Classification (As Applicable)	MRID No.
Product Analysis Data [AI: *Bacillus licheniformis* strain 414-01] (EPA File Symbol: 70506-AET)			
Product Identity	885.1100	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662301 52065601
Manufacturing Process	885.1200	Submitted data fulfill the requirement for manufacturing process. **Classification: Acceptable**	52034601
Deposition of a Sample in a Nationally Recognized Culture Collection	885.1250	Submitted data fulfill the requirement for manufacturing process. **Classification: Acceptable**	51662302
Discussion of Formation of Unintentional Ingredients	885.1300	Submitted data fulfill the requirement for manufacturing process. **Classification: Acceptable**	51662301 52065602
Analysis of Samples	885.1400	Submitted data fulfill the requirement for manufacturing process. **Classification: Acceptable**	51662301 52065603
Color	830.6302	Brown	51662303
Physical State	830.6303	Powder	51662303
Odor	830.6304	Musty	52065604
Stability to Normal and Elevated Temperatures, Metals, and Metal Ions	830.6313	These data are not required. *Bacillus licheniformis* strain 414-01 Technical will not come into contact with metals during its storage and use.	52065604
Storage Stability	830.6317	The product is stable at ambient temperature for 12 months.	51662304
pH	830.7000	3.99	51662303
Density/Relative Density/Bulk Density (Specific Gravity)	830.7300	Pour density: 0.53 g/mL Tap density: 0.68 g/mL	51662303
Product Analysis Data for 414-02, a liquid EP (EPA File Symbol: 70506-AEL)			

Product Identity	885.1100	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662501
Manufacturing Process	885.1200	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662501
Discussion of Formation of Unintentional Ingredients	885.1300	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662501
Analysis of Samples	885.1400	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	52116501, Email dated February 22, 2023 from Bibiana Oe, MPB/BPPD/OPP to Audrey Sehn, UPL NA, Inc.
Certification of Limits	885.1500	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662501
Storage Stability	830.6317	The product is stable at ambient temperature for 12 months.	51662503
Miscibility	830.6319	Not applicable The product is not intended to be mixed with oil or to be included in oil-based tank mixes.	52066301
Corrosion Characteristics	830.6320	No corrosion was visually observed and evident.	Cover letter of the response to 10-day letter
pH	830.7000	3.86	51662502
Viscosity	830.7100	4.52 Centistokes (20°C) 2.75 Centistokes (40°C)	51662502
Density/Relative Density/Bulk Density (Specific Gravity)	830.7300	1.165 g/mL at 20°C	51662502
Product Analysis Data for 414-03, a dry powder EP (EPA File Symbol: 70506-AEA), 414-01 MUP (EPA File Symbol: 70506-AEU); 414-03 is identical to 414-01 MUP			
Product Identity	885.1100	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662402
Manufacturing Process	885.1200	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662402
Discussion of Formation of	885.1300	Submitted data fulfill the requirement for product identity.	51662401 52066202

Unintentional Ingredients		**Classification: Acceptable**	
Analysis of Samples	885.1400	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662401
Certification of Limits	885.1500	Submitted data fulfill the requirement for product identity. **Classification: Acceptable**	51662402
Storage Stability	830.6317	The product is stable at ambient temperature for 12 months.	51662404
Miscibility	830.6319	Not applicable	52066401 52066201
Corrosion Characteristics	830.6320	No corrosion was visually observed and evident.	Cover letter of the response to 10-day letter
pH	830.7000	4.03	51662403
Viscosity	830.7100	Not applicable	52066401 52066201
Density/Relative Density/Bulk Density (Specific Gravity)	830.7300	0.50 g/mL (pour density) 0.53 g/mL (tap density)	51662403