METHYL BROMIDE CRITICAL USE NOMINATION
FOR POST-HARVEST USE IN STRUCTURES - FOOD PROCESSING PLANTS

FOR ADMINISTRATIVE PURPOSES ONLY:
DATE RECEIVED BY OZONE SECRETARIAT:
YEAR: **CUN:**

NOMINATING PARTY:	The United States of America
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	Methyl Bromide Critical Use Nomination for Post-Harvest Use in Structures - Food Processing Plants (Submitted in 2006 for 2008 Use Season)

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Following the requirements of Decision IX/6 paragraph (a)(1), the United States of America has determined that the specific use detailed in this Critical use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.

☐ Yes ☐ No

_________________ _________________ _________________
Signature Name Date

Title: _________________________________

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LIST OF DOCUMENTS SENT TO THE OZONE SECRETARIAT IN OFFICIAL NOMINATION PACKAGE

LIST ALL PAPER AND ELECTRONIC DOCUMENTS SUBMITTED BY THE NOMINATING PARTY TO THE OZONE SECRETARIAT

1. PAPER DOCUMENTS: Title of Paper Documents and Appendices	Number of Pages	Date Sent to Ozone Secretariat

2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: Title of Electronic Files	Size of File (kb)	Date Sent to Ozone Secretariat

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PART A: SUMMARY

1. NOMINATING PARTY

The United States of America (U.S.)

2. DESCRIPTIVE TITLE OF NOMINATION

Methyl Bromide Critical Use Nomination for Post-Harvest Use in Structures - Food Processing Plants (Submitted in 2006 for 2008 Use Season)

3. SITUATION OF NOMINATED METHYL BROMIDE USE

This sector includes rice mills, flour mills, pet food manufacturing facilities, and a few bakeries. Primarily this sector is treating only the portions of the facilities that contain electronic components and have machinery with copper and copper alloy parts. These facilities are under intense pressure from many insect pests. The flour millers and the bakeries in this sector do not target any of their commodities to be fumigated with methyl bromide, although some may be present during fumigation. However, rice millers and pet food manufacturers may target some of their products during fumigations with methyl bromide.

4. METHYL BROMIDE NOMINATED FOR FOOD PROCESSING PLANTS

TABLE 4.1: METHYL BROMIDE NOMINATED FOR FOOD PROCESSING PLANTS

YEAR	NOMINATION AMOUNT (KG)	NOMINATION VOLUME (1000 M^3)
2008	**362,952**	**18,950**

5. BRIEF SUMMARY OF THE NEED FOR METHYL BROMIDE AS A CRITICAL USE

The U. S. nomination is only for those facilities where the use of alternatives is not suitable. In U. S. food processing plants there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide, making these alternatives technically and/or economically infeasible.
- Geographic distribution of the facilities: some facilities are situated in areas where key pests usually occur at lower levels, such as those located in the northern part of the U. S. In such cases, the U. S. is only nominating a CUE for facilities where the key pest pressure is moderate to high.
- Age and type of facility: older food processing facilities, especially those constructed of wood, experience more frequent and severe pest infestations that must be controlled by fumigation.
- Constraints of the alternatives: some types of commodities (e.g., those containing high levels of fats and oils) prevent the use of heat as an alternative because of its effect on the final product (e.g., rancidity). Further, the corrosive nature of phosphine on certain metals

prevents its use in mechanical and electrical areas of the facilities. Additionally, both phosphine and sulfuryl fluoride are temperature sensitive.

- Transition to newly available alternatives: Sulfuryl fluoride recently received a federal registration for portions of this sector. It will take some time for sulfuryl fluoride to be incorporated into a pest management program.
- Delay in plant operations: e.g., the use of some methyl bromide alternatives can add a delay to production by requiring additional time to complete the fumigation process. Production delays can result in significant economic impacts to the processors.

Over the last decade, food processing facilities in the United States have reduced the number of methyl bromide fumigations by incorporating many of the alternatives identified by MBTOC. The most critical alternative implemented is IPM strategies, especially sanitation, in all areas of a facility. Plants are now being monitored for pest populations, using visual inspections, pheromone traps, light traps and electrocution traps. When insect pests are found, plants will attempt to contain the infestation with treatments of low volatility pesticides applied to both surfaces and cracks and crevices. These techniques do not disinfest a facility but are critical in monitoring and managing pests. However, when all these methods fail to control a pest problem, facilities will resort to phosphine, heat, and if all else fails, to methyl bromide.

Many facilities in the United States also are using both phosphine and heat treatments to disinfest at least portions of their plants. Phosphine, alone and in combination with carbon dioxide, is often used to treat both incoming grains and finished products. Unfortunately, phosphine is corrosive to copper, silver, gold and their alloys. These metals are critical components of both the computers that run the machines as well as some of the machines themselves. Therefore, phosphine is not feasible in all areas of food processing facilities. Additionally, phosphine requires more time to kill insect pests than does methyl bromide, so plants need to be shut down longer to achieve mortality, resulting in economic losses. There are also reports of stored product pests becoming resistant to phosphine (Taylor, 1989; Bell, 2000; Mueller, 2002).

Heat treatments are being used in this industry. However, not all areas of a plant can be efficiently treated with heat, nor can it be used to treat most products. Some food substances, for instance oils and butters will become rancid with heat treatments. Not all finished food products can be heated for the length of time heat is required for efficient kill of pests. In addition, geography of the United States plays a crucial role in the use of heat treatments. Food processing plants in the northern United States will experience winters with several weeks of sustaining temperatures of -32° to -35° C (-30° to -25° F). In some of these areas facilities have heaters and the power plants have the capacity to supply excess power as needed. However, the southern and parts of the western zones of the United States are geographically quite different. Winter temperatures there seldom reach –1.2° C (30° F) and when temperatures should fall that low, it is typically for only a few hours one night. For many winters, these areas of the U. S. don’t freeze at all. Subsequently, these facilities do not have heaters, nor do the power plants have enough power to allow them to heat such large areas and sustain the temperatures necessary for an effective kill of pest populations. Still, many southern and western facilities use heat treatments as a spot treatment whereas the northern facilities can use heat treatments more extensively.

Sulfuryl fluoride was registered by U.S. EPA in January 2004 for rice mills and flour mills, and for additional sites and commodities in July 2005. There are some constraints with this new fumigant: the initial uses were registered in California in May 2005; it is temperature dependent; its efficacy on eggs requires higher concentrations except at optimal temperatures; and it requires extensive training of the applicators to proficiently use the computerized fumigation guide. Many flour and rice mills have tried sulfuryl fluoride this year to fumigate their facilities. Many other facilities are waiting for state registrations and label clarifications to try this new fumigant. The industry is trying to incorporate this newly registered fumigant into their best management practices.

TABLE A.1: EXECUTIVE SUMMARY*

	RICE MILLER'S ASSOCIATION	BAKERIES	PET FOOD INSTITUTE	NORTH AMERICAN MILLER'S ASSOCIATION
2008 Requested Amount (kg)	145,603	16,670	47,174	292,113
2008 Nominated Amount * (kg)	81,258	14,269	26,660	240,765

**See Appendix A for complete description of how the nominated amount was calculated.*

6. METHYL BROMIDE CONSUMPTION FOR PAST 5 YEARS AND AMOUNT REQUESTED IN THE YEAR(S) NOMINATED FOR FOOD PROCESSING PLANTS :

TABLE 6.1: METHYL BROMIDE CONSUMPTION FOR THE PAST 5 YEARS AND THE AMOUNT REQUESTED IN THE YEAR(S) NOMINATED (RICE MILLERS)

	HISTORICAL USE[1,2]						REQUESTED USE
For each year specify:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**
Amount of MB (kg)	168,736	171,911	142,881	149,685	149,685	145,603	145,603
Volume Treated (1000 m³)	5,125	5,229	4,587	4,672	4,672	5,975	5,975
Formulation of MB	100%	100%	100%	100%	100%	100%	100%
Dosage Rate (kg/1000 m³)	32.92	32.88	31.15	32.04	32.04	24.37	24.37

[1]Best available estimate of United States Government
[2]Based on most current information.

TABLE 6.2: METHYL BROMIDE CONSUMPTION FOR THE PAST 5 YEARS AND THE AMOUNT REQUESTED IN THE YEAR(S) NOMINATED (BAKERIES)

	HISTORICAL USE[1,2]						REQUESTED USE
For each year specify:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**
Amount of MB (kg)	34,019	31,570	29,937	26,770	21,707	21,459	16,670
Volume Treated (1000 m^3)	1,699	1,586	1,529	1,501	1,614	1,416	833
Formulation of MB	100%	100%	100%	100%	100%	100%	100%
Dosage Rate (kg/1000 m^3)	20.02	19.91	19.58	17.84	13.45	15.16	20.02

[1]Best available estimate of United States Government
[2]Based on most current information.

TABLE 6.4: METHYL BROMIDE CONSUMPTION FOR THE PAST 5 YEARS AND THE AMOUNT REQUESTED IN THE YEAR(S) NOMINATED (PET FOOD FACILITIES)

	HISTORICAL USE[1,2]						REQUESTED USE
For each year specify:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**
Amount of MB (kg)	43,001	45,200	48,264	30,287	31,301	31,427	47,174
Volume Treated (1000 m^3)	1,974	2,075	2,215	1,390	1,695	1,706	2,163
Formulation of MB	100%	100%	100%	100%	100%	100%	100%
Dosage Rate (kg/1000 m^3)	21.79	21.79	21.79	21.79	18.46	18.42	21.81

[1]Best available estimate of United States Government
[2]Based on most current information.

TABLE 6.4: METHYL BROMIDE CONSUMPTION FOR THE PAST 5 YEARS AND THE AMOUNT REQUESTED IN THE YEAR(S) NOMINATED (NAMA)

	HISTORICAL USE[1,2]						REQUESTED USE
For each year specify:	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2008**
Amount of MB (kg)	442,252	419,573	408,233	385,553	362,874	340,194	292,113
Volume Treated (1000 m^3)	18,406	18,689	19,539	19,255	18,123	16,990	15,093
Formulation of MB	100%	100%	100%	100%	100%	100%	100%
Dosage Rate (kg/1000 m^3)	24.03	22.45	20.89	20.02	20.02	20.02	19.35

[1]Best available estimate of United States Government
[2]Based on most current information.

7. LOCATION OF THE FACILITY OR FACILITIES WHERE THE PROPOSED CRITICAL USE OF METHYL BROMIDE WILL TAKE PLACE

This nomination package represents 275 food processing facilities across the United States. These facilities are distributed across the United States from subtropical environments of Florida to the cold northern areas of the Great Plains. The location of each facility where methyl bromide fumigations may take place was not requested by the U.S. Government in the forms filled out by the applicants. However, location information has previously been submitted to MBTOC, which is included in this document as Appendix D.

In addition, a full list of all processing plants that apply any registered pesticide in the U.S. is available from the U.S. Department of Labor, Occupational Safety and Health Administration website located at http://www.osha.gov/pls/imis/sicsearch.html. EPA's Facility Registry System is publicly available and is located at http://www.epa.gov/enviro/html/fii/ez.html.

PART B: SITUATION CHARACTERISTICS AND METHYL BROMIDE USE

8. KEY PESTS FOR WHICH METHYL BROMIDE IS REQUESTED

TABLE 8.1: KEY PESTS FOR METHYL BROMIDE REQUEST

GENUS AND SPECIES OF MAJOR PESTS FOR WHICH THE USE OF METHYL BROMIDE IS CRITICAL	COMMON NAME	SPECIFIC REASON WHY METHYL BROMIDE IS NEEDED
Tribolium confusum	Confused flour beetle	Pest status is due to health hazard: allergens; plus body parts, exuviae, and excretia violate Food and Drug Administration (FDA) regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking) so phosphine and heat are not completely adequate. Sulfuryl fluoride was registered for some of these uses, requires high concentration to kill all life stages, requires higher concentrations as temperature decreases; experience needed to incorporate into best management plan.
Tribolium castaneum	Red flour beetle	
Trogoderma variable	Warehouse beetle	Health hazard: choking and allergens; plus body parts, exuviae, and excretia violate FDA regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking) so phosphine and heat are not completely adequate. Sulfuryl fluoride was registered for some of these uses, requires high concentration to kill all life stages, requires higher concentrations as temperature decreases; experience needed to incorporate into best management plan.
Lasioderma serricorne	Cigarette beetle	Food contamination violates FDA regulations[1]. Methyl bromide is needed because these insects can occur in areas with electronic equipment and materials that cannot tolerate high temperatures (i.e. cooking of some products; oils and butter go rancid with heat) so phosphine and heat are not completely adequate. Sulfuryl fluoride was registered for some of these uses, requires high concentration to kill all life stages, requires higher concentrations as temperature decreases; experience needed to incorporate into best management plan.
Sitophilus oryzae	Rice weevil	
Plodia interpunctella	Indianmeal moth	
Oryzaephilus mercator	Merchant grain beetle	
Cryptolestes pusillus	Flat grain beetle	

[1] FDA regulations can be found at: http://www.fda.gov/opacom/laws/fdcact/fdcact4.htm and http://www.cfsan.fda.gov/~dms/dalbook.html.

TABLE B.1: CHARACTERISTIC OF SECTOR - FOOD PROCESSING PLANTS: FLOUR MILLS, RICE MILLS, BAKERIES, AND PET FOOD FACILITIES

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Harvest or Raw Material In	X	X	X	X	X	X	X	X	X	X	X	X
Fumigation Schedule (MB)*					X				X			
Retail Target Market Window	Not Applicable											

* Plants in the southern United States may fumigate twice a year; plants in the northern United States may fumigate once every 3 years. However, fumigations may occur whenever a population explosion occurs.

Although fumigations occur at anytime a pest population explosion occurs, usually food-processing plants in the southern and western areas of the United States will be fumigated with methyl bromide on 3-day holiday weekends just prior to the summer and at summer's end. This maximizes efficiency since the facilities are usually closed and workers are not present; and prior to and immediately after very warm temperatures that increases insect pressure.

This year rice millers decreased their request because the number of fumigations they typically have conducted declined due to two good crop years, increased use of existing mill and storage space, use of a newly registered alternative, and some mills made capital investments on construction for better sealing and sanitation. However, some mills had increase in use due to high humidity, high temperatures, and excessive storms blowing in pests.

9. SUMMARY OF THE CIRCUMSTANCES IN WHICH THE METHYL BROMIDE IS CURRENTLY BEING USED

TABLE 9.1: (a) FOOD PROCESSING PLANTS

CUE	MB DOSAGE (*Kg/m³*)	EXPOSURE TIME (*hours*)	TEMP. (*°C*)	NUMBER OF FUMIGATIONS PER YEAR	PROPORTION OF FACILITY TREATED AT THIS DOSE	FIXED (F) MOBILE (M) STACK (S)
Rice Miller's Association	24	24	variable	2	100% *	F
Bakeries North America	20	24	variable	2.5	100%	F
Pet Food Institute	22	24	variable	< 1 Avg. 1application/1-2 yrs**	80%	F
North American Millers' Association	19	24	variable	2.5	100 %	F

*Unspecified type of rice is also fumigated along with the facilities.
** Highly variable. Some facilities need fumigating 2/year, but other facilities fumigate once every 3-5 years.

TABLE 9.1: (b) FIXED FACILITIES

CUE	TYPE OF CONSTRUCTION AND APPROXIMATE AGE IN YEARS	% FACILITIES AT VOLUMES (1,000m^3)	NUMBER OF FACILITIES	GASTIGHTNESS ESTIMATE*
Rice Miller's Association	Combination of wood, stone, brick, metal, and concrete	5% 1,416-28,317 90+% 28,317+	22	Poor to very poor
Bakeries North America	Combination of wood, stone, brick, metal, and concrete	28,317+	11	55% good, 27% fair, 18% poor
Pet Food Institute[1]	Combination of wood, stone, brick, metal, and concrete	25% 1,416-28,317 75% 28,317+	75	Good to poor areas
North American Millers' Association	Wood, stone, brick, concrete, metal; some about 100 yrs old, only a few less than 10 years old	50% <28 50% >28-142	167	10% good, 10% medium, 75% poor, 5% very poor

* Give gastightness estimates where possible according to the following scale: **good** – less than 25% gas loss within 24 hours or half loss time of pressure difference (e.g. 20 to 10 Pa ($t_{1/2}$)) greater than 1 minute; **medium** – 25-50% gas loss within 24 hours or half loss time of pressure difference greater than 10 seconds; **poor** – 50-90% gas loss within 24 hours or half loss time of pressure difference 1-10 second; **very poor** – more than 90% gas loss within 24 hours or a pressure half loss time of less than 1 second.

[1] See Appendix B for more information.

10. LIST ALTERNATIVE TECHNIQUES THAT ARE BEING USED TO CONTROL KEY TARGET PEST SPECIES IN THIS SECTOR

Many of the MBTOC not in kind alternatives to methyl bromide are critical to monitoring pest populations and managing those populations, but they do not disinfest food processing. The most crucial of these alternatives are sanitation and IPM strategies. Sanitation is important and constantly addressed in management programs (Arthur and Phillips 2003). Cleaning and hygiene practices alone do not reduce pest populations, but reportedly improve the efficacy of insecticides or diatomaceous earth (Arthur and Phillips 2003). The principles of IPM are to utilize all available chemical, cultural, biological, and mechanical pest control practices. These include pheromone traps, electrocution traps**,** and light traps to monitor pest populations. If pests are found in traps, then contact insecticides and low volatility pesticides are applied in spot treatments for surfaces, cracks and crevices, or anywhere the pests may be hiding. These applications are intended to restrict pests from spreading throughout the facility to try to avoid a plant fumigation (Arthur and Phillips 2003). However, IPM is not designed to completely eliminate pests from any given facility or to ensure that a facility remains free from infestation. Although FDA allows minimal contamination of food products, U.S. consumers have a zero tolerance for visible insect contamination in their food products. While sanitation and IPM strategies are used to manage pest populations and extend the time between methyl bromide fumigations, neither is an acceptable alternative to methyl bromide under high pest pressure.

Phosphine, alone and in combination with carbon dioxide, is used to fumigate portions of food processing facilities. Many facilities treat incoming raw ingredients and their storage facilities with phosphine, but the corrosive nature of phosphine limits its use throughout the entire plant, especially in areas with electronic components. In the United States it is specifically against the label (illegal) to fumigate in areas with susceptible metals (at: http://oaspub.epa.gov/pestlabl/ppls). Phosphine is also problematic in that some stored product pests are developing resistance to this chemical (Taylor, 1989, Bell, 2000, Mueller, 2002).

Many food processing facilities in the United States use heat treatments to reduce insect populations. Heat does kill insects, typically temperatures of 50-60° C sustained for 8 hours kills the more heat tolerant life stages of post-harvest pests. Unfortunately, some areas (electronics and electrical portions) of facilities are sensitive to heat. In addition heat is not a good alternative if ingredients or products will be a part of a fumigation because it causes rancidity in butters and oils, denatures proteins that may be used in the ingredients, and not all manufactured products can be heated to the high temperature or for the time required in order to get an effective kill of insect pests.

Heat stratifies (hot air raises) resulting in hot spots and cold areas during fumigations. Also, since various materials have different expansion coefficients (expand and contract at different rates) some facilities have reported structural damage resulting from heat treatments. Also, some facilities have glass atria and glass is a poor insulator, creating cold down drafts . A company that has a patented process of an air handling system can improve the air distribution to reduce the effects of heat stratification. They have reported multiple successes with their system. However, facilities in the southern and western parts of the United States do not have heat sources on the premises thereby making heat fumigations impractical without costly investments that are not economically feasible.

Sulfuryl fluoride was federally registered for flour and rice mills, tree nuts and dried fruits in January 2004. California registered this product for these uses in May 2005. It has been used in many mills. The industry is learning how to incorporate this product into its pest management strategy. It integrates temperature (requires less product as temperature increases) and dosages (choice of only post-embryonic stages or all life stages) into the mills' plans. More sites were added to the federal label in July 2005, including bakeries and pet food facilities. However, some of the manufactured products are not allowed to be directly fumigated and will need to be removed prior to fumigation of the facility. Many facilities will be unable to accomplish this since they do not have a way to separate ingredients and products within their facility. In addition, a fumigation to kill pest eggs within manufactured products will still require methyl bromide if a sulfuryl fluoride tolerance for the commodity has not been established.

Food processing facilities in the United States have incorporated sanitation, IPM strategies, heat and phosphine and yet, on occasion, insect pest populations will still become too high and a facility will need to fumigate with methyl bromide. However, by employing these alternatives, this sector has been able to lengthen times between methyl bromide applications, thereby reducing the total amount of methyl bromide. However, in some areas of the country, information suggests that some processors may employ a marginal strategy without major economic dislocation if given a reasonable time frame for the transition. The assessment of need was adjusted to account for this.

PART C: TECHNICAL VALIDATION

11. SUMMARIZE THE ALTERNATIVE(S) TESTED, STARTING WITH THE MOST PROMISING ALTERNATIVE(S)

TABLE 11.1: SUMMARY OF THE ALTERNATIVES TESTED

ALTERNATIVE	PEST	STUDY TYPE	RESULTS	CITATION
Heat	*T. castaneum*	Pilot feed and flour mills;	Insects contained in plastic boxes. Non-uniform heat. Number of hours to reach 50° C varied between the mills and within mills. 100% mortality at most locations of 50-60°C for 52 hrs. Old instars and pupae more heat tolerant	Mahroof, et al. 2003
Heat	*T. castaneum*	Lab	Mortality of each life stage increased with increase in temperature and exposure time. Young larvae most heat- tolerant and required 7.2 hr at >50°C.	Mahroof, et al. 2003
Heat and Diatomaceous Earth (DE)	*T. castaneum* & *T. confusum*	Lab	Mortality increased as temperature increased and decreased as humidity increased. Mortality at one week was greater than initial mortality probably due to delayed effects of DE. *T. confusum* mortality lower than *T. castaneum.*	Arthur 2000
Heat and DE	*T. confusum*	2nd & 3rd floors of a Pilot flour mill	Adult insects in open rings placed in mill. 100% mortality of beetles in 25 hr on the north end of the 3rd floor, but south end of 2nd floor had only 75% mortality with full DE and 50% mortality with partial DE after 64 hr.	Dowdy & Fields 2002
DE	*Ephestia kuehniella*	Lab	Efficacy was influenced by age of the medium with DE when investigated under driest conditions (58% rh). But this is not a pest of concern in the U. S.	Nielsen 1998
Low volatility insecticides	*T. castaneum* & *T. confusum*	Lab	Field collected flour beetles demonstrated varying degrees of resistance to several pesticides: malathion, chlorpyrifos, dichlorvos, phosphine, but not to resmethrin. *T. castaneum* more resistant than *T. confusum*.	Zettler 1991
Mountain Sagebrush Volatiles	*Rhyzopertha dominica; P. interpunctella;* & *T. castaneum*	Lab	Initial investigation of volatiles from mountain sagebrush demonstrated some activity in against these insects in bioassays. No indication of whether this is really a potential alternative	Dunkel & Sears 1998
Low volatility insecticides	*T. castaneum* & *T. confusum*	Lab	Malathion-resistant flour beetles were susceptible to cyfluthrin treated steel panels. Longer residuals on unpainted panels than on painted panels	Arthur 1992
DEET (N, N-	*T. castaneum and*	Lab	DEET repelled *S. oryzae* by 99%, *T.*	Hou, et al. 2004

ALTERNATIVE	PEST	STUDY TYPE	RESULTS	CITATION
diethyl-m-toluamide) and NEEM (azadirachthin)	*others*		*castaneum* by 86%, *Cryptolestes ferrugineus* by 97% and *O. surinamensis* by 91% Neem was less effective than DEET	

TABLE 11.2: SUMMARY OF REVIEW OR POSITION PAPERS CONCERNING ALTERNATIVES FOR STORED PRODUCT PESTS

SYNOPSIS OF REVIEW OR POSITION PAPERS	CITATION
Review of methyl bromide alternatives for stored product insects: 1) heat: gradients in buildings, insect refugia, rate can be problematic due to structures, some equipment heat sensitive, plastics warp, dust explosions, sugar, oils, butter & adhesives removed, not all food products can be heated; 2) phosphine: activity slow, flammability above concentrations of 1.8% by volume, corrosion of copper, silver, and gold, no data for in combination with CO_2 and heat; 3) modified atmospheres: activity slow, requires air-tight structures; 4) sulfuryl fluoride[1]: eggs require much higher concentrations than larvae for control	Fields & White 2002
Cites studies on: the development of resistance to phosphine in stored product pests; interaction of time, temperature and concentration of performance of phosphine; sulfuryl fluoride's difficulty in killing egg stage; Tables comparing phosphine to methyl bromide (Appendix C, Table 1).	Bell 2000
Theoretical paper based on a few lab studies and small field crop trials indicating that traps currently used for monitoring pest populations could be used to reduce those populations. No studies on a commercial scale or food processing/storage facility were present.	Cox 2004
Mostly lab studies on assorted stored product pests indicate that IGRs, especially methoprene and diflubenzuron, may play a role in controlling these insects	Oberlander, et al. 1997
A simulation model in Denmark suggests that increase temperatures inside mills drives moth outbreaks and if mills were cooled to outdoor temperatures, moth outbreaks would be less frequent.	Skovgard, et al. 1999
Investigations into chemical control strategies should include a thorough examination of physical, biological and environmental factors that can affect pesticide toxicity. These include: application rate, formulation, timing, surface substrate, and target pest. WP formulation of cyfluthrin applied to concrete lasted longer than the EC formulation. *T. confusum* was more susceptible than *T. castaneum* to WP.	Zettler & Arthur 2000

[1]Sulfuryl fluoride was not extensively reviewed because at the time the review was written there were no tolerances for food established in either the United States or Canada. More information regarding this chemical can be found in Section 17.2.1.

12. SUMMARIZE TECHNICAL REASONS, IF ANY, FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE FOR YOUR CIRCUMSTANCES (*For economic constraints, see Question 15*)

TABLE 12.1: SUMMARY OF TECHNICAL REASON FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE

IN KIND ALTERNATIVES	TECHNICAL FEASIBILITY	COMMENTS
Carbon Dioxide (high pressure)	No	Facilities in the United States are not airtight enough for modified atmospheres or carbon dioxide to be effective primarily because most are more than 25 years old. To implement these alternatives would require new construction of all facilities.
Controlled & Modified Atmospheres	No	
Ethyl/Methyl Formate	No	Not registered in United States (last product cancelled in Oct. 1989)
Hydrogen Cyanide	No	Not registered in United States (last product cancelled in Feb. 1988)
Phosphine, alone	No	Although does kill insects, it is corrosive to metals, especially copper and its alloys, bronze and brass. These metals are important components of the electronics that run the manufacturing equipment and some of the equipment itself (for example: motors, mixers, etc.). In addition, phosphine requires longer application time. This alternative is already being used in the areas without electronics and where temperatures are not a factor. Resistance to this fumigant has also been reported for several stored product pests. This alternative has already been implemented in areas without sensitive metals.
Phosphine, in combination	No	
Sulfuryl fluoride	Yes	Recently registered in United States for some uses in this sector on January 23, 2004 and July 14, 2005. The use of this chemical requires training of applicators by registrant, and each state must register this product as well. Efficacy of this chemical remains to be demonstrated in the field, but appears to be promising. May take up to 5 years before we know if it will replace methyl bromide and for industry conversion.
NOT IN KIND ALTERNATIVE	**TECHNICAL FEASIBILITY**	**COMMENTS**
Heat Treatment	Yes	Sufficiently high temperature will kill insects given enough time; but heat sources are not readily available in all areas of United States (such as those in the south where hot weather is the norm and no heaters are available); and heat requires longer time of exposure. In areas that can use heat, it is being used. It is not feasible in remaining plants or areas of a plant. In order to completely replace methyl bromide, some facilities would need to be relocated and others would need major reconstruction.
Cold Treatment	No	Does not disinfest facilities. Most of these IPM strategies are currently practiced and widely implemented with the beneficial result of lengthening time between fumigations. Facilities use sanitation and cleaning to maintain their plants. They monitor populations with pheromone traps. They try to limit incoming pests with electrocution traps by entrances/exits. When populations are discovered, they use physical removal and contact insecticides and low volatility pesticides. Facilities maintain rodenticide bait stations around their perimeter.
Contact Insecticides	No	
Cultural Practices	No	
Electrocution	No	
Inert Dust	No	
Pest Exclusion/Physical Removal	No	

Pesticides of Low Volatility	No	These IPM strategies are not a replacement for methyl bromide, but do lengthen time between fumigations.
Pheromones	No	
Physical Removal/Cleaning /Sanitation	No	
Rodenticide	No	

TABLE 12.2: COMPARISON OF ALTERNATIVES TO METHYL BROMIDE FUMIGATION

FUMIGANT	PREPARATION TIME (HR)	FUMIGATION TIME (HRS)	DISSIPATION TIME (HRS)	MINIMUM NUMBER OF APPLICATIONS TO REPLACE ONE MB APPLICATION*
Methyl Bromide	24	24	24	--
Sulfuryl fluoride	24	24	24	1
Phosphine, alone	24	48-72	24	2
Phosphine + CO2	24	48-72	24	1-2
Heat	36	48-52	24	2

*Additional treatments with the alternatives may be required because they are less effective on the eggs and pupae than methyl bromide.

PART D: EMISSION CONTROL

13. HOW HAS THIS SECTOR REDUCED THE USE AND EMISSIONS OF METHYL BROMIDE IN THE SITUATION OF THE NOMINATION?

By using sanitation and IPM the industry has been able to reduce methyl bromide use by extending the time between fumigations. According to the applicants, 10-12 years ago, plants in the southern United States used to fumigate with methyl bromide as much as 4-6 times a year. Currently, most southern facilities have reduced the number of methyl bromide fumigations to twice a year. These fumigations are typically at the beginning of the summer when pest pressure is significantly increasing and at the end of the summer.

In the northern regions of the United States, IPM strategies and sanitation methods have enabled some of these facilities to fumigate with methyl bromide once every 3 years, and a few facilities have gone without a methyl bromide fumigation for almost 5 years. The facilities in the northern United States have been able to exploit heat treatments more extensively than their southern counterparts, as well as opening up facilities during extremely cold weather for extensive cleaning coupled with low volatility pesticides (organophosphates, pyrethroids, insect growth regulators, botanicals) at the perimeters.

PART E: ECONOMIC ASSESSMENT

14. COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

TABLE 14.1: ANNUAL COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER A 3-YEAR PERIOD

MB AND ALTERNATIVES	COST RATIO	COST IN CURRENT YEAR (US$)	COST ONE YEAR AGO (US$)	COST 2 YEARS AGO (US$)
Rice Miller's Association				
Methyl Bromide	1	$2,596	$2,596	$2,596

Sulfuryl Fluoride**	1.3	$3,438	$3,438	$3,438
Heat	1.5	$3,894	$3,894	$3,894
Bakeries				
Methyl Bromide	1	$1,277	$1,277	$1,277
Sulfuryl Fluoride**	1.3	$1,719	$1,719	$1,719
Heat	1.5	$1,916	$1,916	$1,916
Pet Foods Institute				
Methyl Bromide	1	$519	$519	$519
Sulfuryl Fluoride**	1.3	$688	$688	$688
Heat	1.5	$779	$779	$779
North American Miller's Association				
Methyl Bromide	1	$1,277	$1,277	$1,277
Sulfuryl Fluoride**	1.3	$1,719	$1,719	$1,719
Heat	1.5	$1,916	$1,916	$1,916

* Costs in this table only include the cost of fumigation or heat treatment. Losses such as reductions in revenue due to lost days are included in Tables E.1 though E.4.
** Estimates of the cost of sulfuryl fluoride are based on application at 24 degrees centigrade (75 degrees Fahrenheit) targeting only embryonic (non-egg) pest life stages.

15. SUMMARIZE ECONOMIC REASONS, IF ANY, FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE FOR YOUR CIRCUMSTANCES

TABLE 15.1. SUMMARY OF ECONOMIC REASONS FOR EACH ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE

METHYL BROMIDE ALTERNATIVE	ECONOMIC REASON (IF ANY) FOR THE ALTERNATIVE NOT BEING AVAILABLE	ESTIMATED MONTH/YEAR WHEN THE ECONOMIC CONSTRAINT COULD BE SOLVED
Heat Treatment	For food processing facilities which are able to convert to heat treatment, economic losses are from additional production downtimes due to longer fumigation time and from capital expenditures required to adopt an alternative. There are other food processing facilities in areas of United States where heat treatment is not feasible.	Economic losses due to downtime with heat treatment are persistent.
Sulfuryl Fluoride	A small portion of the food processing facilities can economically convert to sulfuryl fluoride. Other facilities cannot due to economic losses that would result from inefficacious control of pests and higher treatment costs which arise at higher temperatures. See "Summary Of Technical Reason For Each Alternative Not Being Feasible Or Available."	Limitations of sulfluryl fluoride are persistent

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

The four economic measures in Table E.1 through E.4 were used to quantify the economic impacts to post-harvest uses for food-processing. The measures are not independent of each other since they can be calculated from the same financial data. The economic measures do, however, complement each other in evaluating the CUE applicant's economic viability. These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users.

Net revenue is calculated as gross revenue minus operating costs. This is a good measure as

to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this analysis. We did not include fixed costs because it is often difficult to measure and verify.

Sulfuryl Fluoride

Results of the assessment of using sulfuryl fluoride as an alternative to methyl bromide are provided in Tables 14.1, and E.1 through E.4. For purposes of this analysis, current prices of sulfuryl fluoride, the number of applications, and efficacy with methyl bromide were assumed equal and plant temperatures are assumed to be 24 degrees centigrade (75 degrees Fahrenheit). This analysis only covers cases where sulfuryl fluoride is a technically feasible alternative to methyl bromide and can be used and its use is not restricted. Fumigation with sulfuryl fluoride at lower temperatures controlling all pest life stages is infeasible due to prohibitively high application rates and minimal efficacy.

Heat Treatment

Potential economic losses were estimated for the food-processing facilities that have not been converted to heat treatment. This analysis only covers cases where heat treatment may potentially be technically feasible, and does not cover situations where heat would degrade the commodity being processed (those with fats and edible oils). Economic costs in the post-harvest uses of the food-processing sector can be characterized as arising from three contributing factors. First, the direct pest control costs are increased in most cases because heat treatment is more expensive, and labor is increased because of longer treatment time and increased number of treatments. For food-processing facilities that are not already using heat, capital expenditure is required to retrofit them to be suitable for heat treatment. Moreover, additional production downtimes for the use of alternatives are unavoidable. Many facilities operate at or near full production capacity and alternatives that take longer than methyl bromide or require more frequent application can result in manufacturing slowdowns, shutdowns, and shipping delays. Slowing down production would result in additional costs to the methyl bromide users. Economic cost per 1000 m^3 was calculated as the additional costs of methyl bromide if methyl bromide users had to replace methyl bromide with heat treatment. Implementations of heat treatment is likely have substantial cost implications to the facilities that have not been converted to heat in the food-processing sector.

Production downtime is estimated at almost two additional days per heat treatment. Potential economic losses associated with the use of heat treatment also include the cost of capital investment. The estimated economic losses are shown in Tables E.1 through E.4. The estimated economic loss as a percentage of net revenue are over 50% for all the CUE applicants in the food-processing sector and over 100% for the rice millers resulting in negative net revenues.

TABLE E.1: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR RICE MILLER'S ASSOCIATION

LOSS MEASURE	METHYL BROMIDE	SULFURYL FLUORIDE	HEAT TREATMENT
GROSS REVENUE (US$/1000 M^3)	$29,385	$29,385	$27,720
- OPERATING COSTS (A+B) PER 1000 M^3	$27,916	$28,758	$29,429
A) COST OF MB OR ALTERNATIVE	$2,596	$3,438	$3,894
B) OTHER OPERATING COSTS	$25,320	$25,320	$25,535
NET REVENUE (US$/1000 M^3) (NET OF OPERATING COSTS)	$1,469	$627	($1,709)
LOSS MEASURES			
TIME LOST (DAYS)	0 DAYS	0 days	17 days
LOSS PER 1000 M^3 (US$/1000 M^3)	$0	$843	$3,178
LOSS PER KILOGRAM MB (US$/KG)	$0	$8.43	$32
LOSS AS A % OF GROSS REVENUE (%)	0%	3%	11%
LOSS AS A % OF NET REVENUE (%)	0%	57%	216%

TABLE E.2: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR BAKERIES

LOSS MEASURE	METHYL BROMIDE	SULFURYL FLUORIDE	HEAT TREATMENT
GROSS REVENUE (US$/1000 M^3)	$258,334	$258,334	$250,584
- OPERATING COSTS (A+B) PER 1000 M^3	$245,417	$245,859	$246,271
A) COST OF MB OR ALTERNATIVE	$1,277	$1,719	$1,916
B) OTHER OPERATING COSTS	$244,140	$244,140	$244,355
NET REVENUE (US$/1000 M^3) (NET OF OPERATING COSTS)	$12,917	$12,475	$4,313
LOSS MEASURES			
TIME LOST (DAYS)	0 DAYS	0 days	9 days
LOSS PER 1000 M^3 (US$/1000 M^3)	$0	$442	$8,604
LOSS PER KILOGRAM MB (US$/KG)	$0	$9.02	$181
LOSS AS A % OF GROSS REVENUE (%)	0%	<1%	3%
LOSS AS A % OF NET REVENUE (%)	0%	4%	67%

TABLE E.3: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR PET FOOD INSTITUTE

LOSS MEASURE	METHYL BROMIDE	SULFURYL FLUORIDE	HEAT TREATMENT
GROSS REVENUE (US$/1000 M³)	$175,452	$175,452	$170,773
- OPERATING COSTS (A+B) PER 1000 M³	$166,679	$166,848	$167,154
A) COST OF MB OR ALTERNATIVE	$519	$688	$779
B) OTHER OPERATING COSTS	$166,160	$166,160	$166,375
NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS)	$8,773	$8,604	$3,619
LOSS MEASURES			
TIME LOST (DAYS)	0 DAYS	O days	8 days
LOSS PER 1000 M³ (US$/1000 M³)	$0	$169	$5,153
LOSS PER KILOGRAM MB (US$/KG)	$0	$3.45	$258
LOSS AS A % OF GROSS REVENUE (%)	0%	<1%	3%
LOSS AS A % OF NET REVENUE (%)	0%	2%	59%

TABLE E.4: ANNUAL ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES FOR NORTH AMERICAN MILLER'S ASSOCIATION

LOSS MEASURE	METHYL BROMIDE	SULFURYL FLUORIDE	HEAT TREATMENT
GROSS REVENUE (US$/1000 M³)	$437,472	$437,472	$424,348
- OPERATING COSTS (A+B) PER 1000 M³	$415,598	$416,040	$416,452
A) COST OF MB OR ALTERNATIVE	$1,277	$1,719	$1,916
B) OTHER OPERATING COSTS	$414,321	$414,321	$414,536
NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS)	$21,874	$21,432	$7,896
LOSS MEASURES			
TIME LOST (DAYS)	0 DAYS	0 days	9 days
LOSS PER 1000 M³ (US$/1000 M³)	$0	$442	$13,978
LOSS PER KILOGRAM MB (US$/KG)	$0	$9.30	$294
LOSS AS A % OF GROSS REVENUE (%)	0%	0.1%	3%
LOSS AS A % OF NET REVENUE (%)	0%	2%	64%

PART F: FUTURE PLANS

16. PROVIDE A DETAILED PLAN DESCRIBING HOW THE USE AND EMISSIONS OF METHYL BROMIDE WILL BE MINIMIZED IN THE FUTURE FOR THE NOMINATED USE.

The industry is committed to studying how to improve insect control with IPM strategies and sanitation and to further reduce the number of methyl bromide fumigations. They are also continuing to pursue research of heat treatments to maximize efficiency. The United States government is supporting research in this sector (see Section 17.1) and the United States Environmental Protection Agency (U.S. EPA) has made registering methyl bromide alternatives a priority (see Section 17.2). U.S. EPA registered sulfuryl fluoride for some commodities and some mills on January 23, 2004 and added more commodities and sites on July 14, 2005.

For further details regarding the transition plans for this sector please consult the national management strategy.

17. PROVIDE A DETAILED PLAN DESCRIBING WHAT ACTIONS WILL BE UNDERTAKEN TO RAPIDLY DEVELOP AND DEPLOY ALTERNATIVES FOR THIS USE:

17.1. Research

The number of available insecticides that can be used in and around food plants, processing mills, and food warehouses in the U. S. has declined in recent years. The research and development of chemical alternatives to be used by this sector is a critical need in the U. S. The post-harvest food-processing sector has invested substantial time and funding into research and development of technically and economically feasible alternatives to methyl bromide. Past and current research focuses on the biology and ecology of the pests, primarily insect pests. To implement non-chemical controls and reduce methyl bromide use requires a thorough understanding of the pests in order to exploit their weaknesses. Some of these investigations have studied the effects of temperature and humidity on the fecundity, development, and longevity of a specific species. Other studies have been to determine the structural preferences and microhabitat requirements of a species. Studies of factors affecting population growth (interactions within and among species) have been conducted. However, there is still much research that needs to be done.

IPM and sanitation methods are also under investigation. Studies have focused on food plant design, engineering modifications for pest exclusion, and insect-resistant packaging. New research is demonstrating a potential to incorporate chemical repellents into packaging materials (Arthur and Phillips 2003). Further studies with pheromones and trapping strategies are helping to improve IPM in food processing plants.

The USDA is continuing to fund research projects for post-harvest/food processing plants. Such activities include:

> **Biology and Management of Food Pests (Oct 2002- Sep 2007)** to: examine the reproductive biology and behavior of storage weevils, Indianmeal moth, and red and confused flour beetles; determine the influence of temperature on the population growth, mating and development of storage pests, specifically storage weevils, Indianmeal moth, and red and confused flour beetles; examine the use of CO_2 concentrations within a grain mass to predict storage weevils and flour beetle population growth; and examine the use of alternative fumigants on insect mortality (ozone, sagebrush, Profume®).
>
> **Chemically Based Alternatives to Methyl Bromide for Post harvest and Quarantine Pests (Jul 2000 - Dec 2004)** to: develop quarantine/post harvest control strategies using chemicals to reduce arthropod pests in durable and perishable commodities; develop new

fumigants and/or strategies to reduce methyl bromide use; develop technology and equipment to reduce methyl bromide emissions to the atmosphere; develop system approaches for control using chemicals combined with nonchemical methodologies which will yield integrated pest control management programs; and develop methods to detect insect infestations.

The rice milling industry has spent over U. S.$500,000 on research to develop alternatives since 1992, and plans to use additional pesticides, such as carbonyl sulfide, carbon dioxide, phosphine, magnesium phosphide (magtoxin), and dichlorvos (vapona) over the next few years. Non-chemical methods used by this sub-sector, to reduce methyl bromide use, include heat and cold treatments, and many individual companies are involved in further research and testing of alternatives. Industry experts have been trying to determine how best to incorporate sulfuryl fluoride into their IPM programs since its recent registration.

The bakery sector is implementing heat as an alternative at those facilities where heat is technically feasible. Currently, heat is being implemented at several facilities nationwide, but further trials are needed to determine the effects of heat on a long-term basis. However, older facilities with hardwood floors and plant electrical wiring systems are unsuitable for heat treatments. Some buildings are constructed in such a way that heat treatments have been problematic. Other methods being used to reduce reliance on methyl bromide are: exclusion, cleaning, early detection, improved design of equipment, trapping, and other integrated pest management (IPM) approaches. Phosphine continues to be tested. Sulfuryl fluoride, newly registered for this site, is undergoing trials in the states for which it is registered.

The flour milling industry is committed to IPM techniques in order to minimize reliance on any one tool. Many plants have reduced the number of annual fumigations from 4-5 per year to 2-3 per year. Some of these facilities combine methyl bromide with carbon dioxide. Further, these applicants have authored a manual on pest management best practices, which is widely utilized throughout the industry. This organization sponsors an open conference on pest management alternatives. The industry continues to test high heat, phosphine, alone and in combination; and the combination of heat, phosphine, and carbon dioxide. In addition, industry experts have been trying to determine how best to incorporate sulfuryl fluoride into their IPM programs since its recent registration.

The Pet Food Institute members have invested hundreds of thousands of dollars in research on a variety of alternatives to methyl bromide, including heat treatments. Sulfuryl fluoride has been tested in an inactive pet food facility last year, and with the recent registration has been tested at several commercial facilities. They have made improvements in worker training, pest monitoring, and sanitation to greatly reduce the necessity for fumigations with methyl bromide, or any other fumigant. Sulfuryl fluoride has been recently registered for this site (July 2005); however, ingredients and products will need to be removed from the facility during fumigation, limiting its replacement of methyl bromide in all pet food facilities.

17.2. Registration

Since 1997, the U.S. EPA has made the registration of alternatives to methyl bromide a high registration priority. Because the U.S. EPA currently has more applications pending in its registration review queue than the resources to evaluate them, U.S. EPA prioritizes the applications. By virtue of being a top registration priority, methyl bromide alternatives enter the science review process as soon as U.S. EPA receives the application and supporting data rather than waiting in turn for the U.S. EPA to initiate its review.

As one incentive for the pesticide industry to develop alternatives to methyl bromide, the Agency has worked to reduce the burdens on data generation, to the extent feasible while still ensuring that the Agency's registration decisions meet the Federal statutory safety standards. Where appropriate from a scientific standpoint, the Agency has refined the data requirements for a given pesticide application, allowing a shortening of the research and development process for the methyl bromide alternative. Furthermore, Agency scientists routinely meet with prospective methyl bromide alternative applicants, counseling them through the preregistration process to increase the probability that the data is done right the first time and rework delays are minimized

The U.S. EPA has also co-chaired the USDA/EPA Methyl Bromide Alternatives Work Group since 1993 to help coordinate research, development and the registration of viable alternatives. This coordination has resulted in key registration issues (such as worker and bystander exposure through volatilization, township caps and drinking water concerns) being directly addressed through USDA's Agricultural Research Service's U. S.$15 million per year research program conducted at more than 20 field evaluation facilities across the country. Also U.S. EPA's participation in the evaluation of research grant proposals each year for USDA's U. S.$2.5 million per year methyl bromide alternatives research has further ensured close coordination between the U.S. government and the research community.

Since 1997, the U.S. EPA has registered the following chemical/use combinations as part of its commitment to expedite the review of methyl bromide alternatives:

- 2000: Phosphine in combination to control stored product insect pests
- 2001: Indianmeal Moth Granulosis Virus to control Indianmeal moth in stored grains
- 2004: Sulfuryl fluoride as a post-harvest fumigant for stored commodities and some mills
- 2005: Sulfuryl fluoride for additional commodities and sites

17.2.1. Sulfuryl Fluoride

On January 23, 2004, U.S. EPA registered sulfuryl fluoride as a post-harvest fumigant for grains and flour mills. While registration for these uses will provide opportunities to reduce methyl bromide use, it must be emphasized that such replacement, if feasible, will only occur gradually over time. On July 15, 2005, U.S. EPA registered sulfuryl fluoride added more commodities and sites.

Alternatives must be tested by users and found technically and economically feasible before widespread adoption will occur. As noted by TEAP, a specific alternative, once available may take up to 5 fumigation cycles of use before efficacy can be determined in the specific circumstance of the user. The registrant is requiring that applicators be trained by them before using sulfuryl fluoride (there is a 3-tiered certification system). Several fumigation companies have teams trained by the registrant. Mills have begun testing sulfuryl fluoride in specific circumstances.

There are additional pesticide registration issues, however, that must be resolved before sulfuryl fluoride can be used in sectors for which the U. S. is nominating methyl bromide CUEs. Some mills manufacture products that are not listed on the current label, although the label allows "incidental" fumigation, the mills will need to move the products so that they are not fumigated. It is most likely that adoption of sulfuryl fluoride for some of these mills will be delayed until tolerances for these ingredients are sought by the registrant, reviewed by U.S. EPA, and granted (if they meet eligibility criteria).

U.S. EPA currently has limited sulfuryl fluoride product performance data (direct comparisons to methyl bromide), limited experience in how well it performs in different facilities and climates over multiple years, and limited information on what costs might be associated with adopting sulfuryl fluoride. Based on the limited data currently available, U.S. EPA believes that within 5 years sulfuryl fluoride may be able to replace methyl bromide in up to 75% of the rice and flour mills. U.S. EPA is committed to monitoring sulfuryl fluoride use during the next few years to amend future CUE nominations.

18. ADDITIONAL COMMENTS

Pheromone Traps

"One misconception about pheromone traps is that a pest population can be controlled by deploying these traps—that is not true for most situations. Traps usually attract only a small percentage of the population that is within the effective range of the trap. Also, female-produced sex pheromones attract only males; the females that lay eggs and perpetuate the infestation are not affected. Since males of the many insect species will mate with multiple females, any males that are not trapped can easily contribute to the production of a subsequent generation of pests. New methods are being researched for using pheromones in pest suppression, but current uses of pheromone traps are best used only for monitoring purposes." (Arthur and Phillips 2003)

Sulfuryl Fluoride

There are some industry concerns regarding sulfuryl fluoride. Primarily that it is temperature dependent and that higher concentrations are necessary to kill eggs of insect pests. The post harvest industry is very concerned about the price of sulfuryl fluoride at these concentrations required to control all life stages of pests, especially when temperatures are low.

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APPENDIX A. METHYL BROMIDE USAGE NEWER NUMERICAL INDEX

2008 Methyl Bromide Usage Newer Numerical Index - BUNNI — **Structures - Food Facilities**

January 24, 2006	Region		Rice Millers	Bakeries	Pet Food Institute	North American Millers	Sector Total or Average	Notes
Dichotomous Variables	Currently Use Alternatives?		Yes	Yes	Yes	Yes		
	Pest-free Requirements?		Yes	Yes	Yes	Yes		
Other Issues	Frequency of Treatment of Product		1	1	2	1		
	Quarantine & Pre-Shipment Removed?		Yes	Yes	Yes	Yes		
Most Likely Combined Impacts (%)	Regulatory Issues (%)		0%	0%	0%	0%		
	Key Pest Distribution (%)		100%	100%	100%	100%		
	Total Combined Impacts (%)		**100%**	**100%**	**100%**	**100%**		
Most Likely Baseline Transition	(%) Able to Transition		90%	72%	75%	58%		
	Minimum # of Years Required		5	5	5	5		
	(%) Able to Transition per Year		**18%**	**14%**	**15%**	**12%**		
EPA Adjusted Use Rate (kg/1000m3)			20	14	18	19		
2008 Applicant Requested Usage	*Amount - Pounds*	*Pounds*	*321,000*	*36,750*	*104,000*	*644,000*	*1,105,750*	
	Volume - 1000ft^3		*211,000*	*29,400*	*76,400*	*533,000*	*849,800*	
	Rate (lb/1000ft^3)		*1.52*	*1.25*	*1.36*	*1.21*	*1*	
	Amount - Kilograms	Metric	**145,603**	**16,670**	**47,174**	**292,113**	**501,559**	
	Volume - 1000m^3		5,975	833	2,163	15,093	24,064	
	Rate (kg/1000m^3)		24	20	22	19	21	
EPA Preliminary Value		**kgs**	**145,603**	**16,670**	**44,906**	**292,113**	**499,292**	
EPA Baseline Adjusted Value has been adjusted for:	MBTOC Adjustments, QPS, Double Counting, Growth, Use Rate, Miscellaneous Adjustments, and Combined Impacts							
EPA Baseline Adjusted Value		kgs	119,497	16,670	31,364	292,113	459,644	
EPA Transition Amount		kgs	(38,239)	(2,400)	(4,705)	(51,348)	(96,693)	
Most Likely Impact Value (kgs)		kgs	**81,258**	**14,269**	**26,660**	**240,765**	**362,952**	
		1000m^3	**4,063**	**1,002**	**1,446**	**12,440**	**18,950**	
		Rate	**20**	**14**	**18**	**19**	**19**	
Sector Research Amount (kgs)			**-**	**2008 Total US Sector Nomination**		**362,952**		

1 Pound = 0.453592 kgs; 1000 cubic feet= 0.028316847 1000 cubic meters

1 lb/1000 ft^3 = 0.0624 kg/1000 m^3 (ounces/1000 ft^3 ~ kg/1000 m^3)

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

1. **Dichotomous Variables** – dichotomous variables are those which take one of two values, for example, 0 or 1, yes or no. These variables were used to categorize the uses during the preparation of the nomination.
2. **Currently Use Alternatives** – Currently use alternatives is ‘yes’ if the applicant uses alternatives for some portion of pesticide use on the crop for which an application to use methyl bromide is made.
3. **Pest-free Requirements** - This variable is a ‘yes’ when the product must be pest-free in order to be sold either because of U.S. sanitary requirements or because of consumer acceptance.
4. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked
5. **Frequency of Treatment of Product** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
6. **Quarantine and Pre-Shipment Removed?** – This indicates whether the Quarantine and pre-shipment (QPS) hectares subject to QPS treatments were removed from the nomination.
7. **Most Likely Combined Impacts (%)** – Adjustments to requested amounts were factors that reduced to total amount of methyl bromide requested by factoring in the specific situations were the applicant could use alternatives to methyl bromide. These are calculated as proportions of the total request. We have tried to make the adjustment to the requested amounts in the most appropriate category when the adjustment could fall into more than one category.

8. **Regulatory Issues (%)** - Regulatory issues (%) is the percent (%) of the requested area where alternatives cannot be legally used (e.g., township caps) pursuant to state and local limits on their use.
9. **Key Pest Distribution (%)** - Percent (%) of the requested area with moderate to severe pest problems. Key pests are those that are not adequately controlled by MB alternatives. For structures/ food facilities and commodities, key pests are assumed to infest 100% of the volume for the specific uses requested in that 100% of the problem must be eradicated.
10. **Total Combined Impacts (%)** - Total combined impacts are the percent (%) of the requested area where alternatives cannot be used due to key pest, regulatory, and new fumigants. In each case the total area impacted is the conjoined area that is impacted by any individual impact. The effects were assumed to be independently distributed unless contrary evidence was available (e.g., affects are known to be mutually exclusive).
11. **Most Likely Baseline Transition** – Most Likely Baseline Transition amount was determined by the DELPHI process and was calculated by determining the maximum share of industry that can transition to existing alternatives.
12. **(%) Able to Transition** – Maximum share of industry that can transition
13. **Minimum # of Years Required** – The minimum number of years required to achieve maximum transition.
14. **(%) Able to Transition per Year** – The Percent Able to Transition per Year is the percent able to transition divided by the number of years to achieve maximum transition.
15. **EPA Adjusted Use Rate** - Use rate is the lower of requested use rate for 2008 or the historic average use rate or is determined by MBTOC recommended use rate reductions.
16. **2008 Amount of Request** – The 2008 amount of request is the actual amount requested by applicants given in total pounds active ingredient of methyl bromide, total volume of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per 1,000 cubic feet. U.S. units of measure were used to describe the initial request and then were converted to metric units to calculate the amount of the US nomination.
17. **EPA Preliminary Value** – The EPA Preliminary Value is the lowest of the requested amount from 2005 through 2008 with MBTOC accepted adjustments (where necessary) included in the preliminary value.
18. **EPA Baseline Adjusted Value** – The EPA Baseline Adjusted Value has been adjusted for MBTOC adjustments, QPS, Double Counting, Growth, Use Rate/ Strip Treatment, Miscellaneous adjustments, and Combined Impacts.
19. **EPA Transition Amount** – The EPA Transition Amount is calculated by removing previous transition amounts since transition was introduced in 2007 and removing the amount of the percent (%) Able to Transition per Year multiplied by the EPA Baseline Adjusted Value.
20. **Most Likely Impact Value** – The qualified amount of the initial request after all adjustments have been made given in total kilograms of nomination, total volume of nomination, and final use rate of nomination.
21. **Sector Research Amount** – The total U.S. amount of methyl bromide needed for research purposes in each sector.
22. **Total US Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.

APPENDIX B. SUPPORTING DATA

APPENDIX B - TABLE 9.1(A): SUMMARY OF THE CIRCUMSTANCES OF CURRENT METHYL BROMIDE USE IN PET FOOD PROCESSING PLANTS

FACILITY NO.	METHYL BROMIDE DOSAGE	EXPOSURE TIME (*hours*)	EXTERIOR TEMP. (ºC)	NUMBER OF FUMIGATIONS PER YEAR	PROPORTION OF PRODUCT TREATED AT THIS DOSE	FIXED (F) MOBILE (M) STACK (S)
1 Midwest	16 g/m^3	24	Day: 35-38	1 general 2 spot w/phos	30% [1]	Fixed [2]
2 Midwest	16 g/m^3	24	Day: 27 Night: 10	1 general	40% [1]	Fixed [2]
3 Southeast	16 g/m^3	24	24	1 general	16% [1]	Fixed [2]
4 Southeast	24 g/m^3	24	21	1 general	15% [1]	Fixed [2]
5 North	18 g/m^3	24	15 – 25 (outside)	Approx. one	<10%[1]	Fixed [2]
6 Midwest	16 g/m^3 - 24 g/m^3	24	17.8	Approx. one	40%[1]	Fixed [2]
7 West	16 g/m^3	24	20.6 - 29.4	Approx. one	40%[1]	Fixed [2]
8 Midwest	16 g/m^3	24	31.7 - 36.7	Approx. one	50%[1]	Fixed [2]

(1) Based on % of total volume treated
(2) Fixed = Fixed facility

APPENDIX B - TABLE 9.1(B): SUMMARY OF THE CIRCUMSTANCES OF CURRENT METHYL BROMIDE USE IN PET FOOD PROCESSING PLANTS - FIXED FACILITIES: PET FOOD INSTITUTE

PEST No.	TYPE OF CONSTRUCTION AND APPROXIMATE AGE IN YEARS	VOLUME (*m³*) OR RANGE	NUMBER OF FACILITIES (E.G. 5 SILOS)	GAS TIGHTNESS ESTIMATE*
1 Midwest	Tilt-up concrete, some corrugated metal	184,800 m^3	1	Medium Areas & Poor Areas
2 Midwest	Tilt-up concrete	114,800 m^3	1	Good Areas & Medium Areas
3 Southeast	Corrugated metal	72,973 m^3	1	Poor
4 Southeast	Corrugated metal	35,954 m^3	1	Medium Areas & Poor Areas
5 North	Corrugated Metal on slab (13 years)	7,420 m^3	< 1 (processing area only)	Good
6 Midwest	Corrugated Metal on Slab	218,400 m^3	1	Medium
7 West	Corrugated Metal on Slab	28,759 m^3	1	Medium to Poor
8 Midwest	Poured Concrete Walls/ Slab Floor	137,760 m^3	1	Very Good

* Give gastightness estimates where possible according to the following scale: **good** – less than 25% gas loss within 24 hours or half loss time of pressure difference (e.g. 20 to 10 Pa ($t_{1/2}$)) greater than 1 minute; **medium** – 25-50% gas loss within 24 hours or half loss time of pressure difference greater than 10 seconds; **poor** – 50-90% gas loss within 24 hours or half loss time of pressure difference 1-10 second; **very poor** – more than 90% gas loss within 24 hours or a pressure half loss time of less than 1 second.

APPENDIX C. PUBLISHED PERFORMANCE DATA

APPENDIX C - TABLE 1: EFFECT OF TEMPERATURE ON CONCENTRATION AND TIME THRESHOLDS FOR SOME PESTS OF STORED PRODUCTS. (FROM: BELL, C. H. 2000)

SPECIES	FUMIGANT	THRESHOLD (°C OR TIME)	TEMPERATURE (°C)	
			15	25
Sitophilus oryzae	Methyl Bromide	ºC (mg/l)	0.6-0.9	1.3-2.0
Tribolium confusum	Methyl Bromide	ºC (mg/l)	1.3-2.0	2.5-3.0
Tribolium castaneum	Methyl Bromide	ºC (mg/l)	1.3-2.0	3.0-3.5
Tribolium castaneum	Phosphine	ºC (mg/l)		0.005-0.0011
Tribolium castaneum	Phosphine	Time (h)		0.5-1.5

For phosphine relatively long exposure times are required for kill of all stages & time threshold is more important than the concentration for efficient fumigant action.

APPENDIX C - TABLE 2: CONCENTRATION-TIME PRODUCT RECOMMENDATIONS BY NATIONAL PEST MANAGEMENT ASSOCIATION

SPECIES	STAGE	TEMP (°C)	OUNCE-HOURS		MG/L	
			PHOSPHINE 72 HR	PHOSPHINE 144 HR	METHYL BROMIDE	SULFURYL FLUORIDE
Lasioderma serricorne	eggs	4.4			146.4	
	eggs	10	8.5	49.5	91.2	
	eggs	15.6	61.8	37.9	48	
	eggs	21.1	0.64	0.86	43.2	
	eggs	26.5				711.7
	larvae	4.4	6.9	1.2	379.2	
	larvae	10	3.7	0.86	206.4	
	larvae	15.6	0.94	0.72	132	
	larvae	21.1	0.5	0.43	120	
	larvae	26.5				55.9
	pupae	4.4	5.6	7.4	1046	
	pupae	10	5.6	4.6	324	
	pupae	15.6	5.2	1.3	124.8	
	pupae	21.1	0.58	0.3	108	
	adult	4.4	2.2	1.9	230.4	
	adult	10	1.8	1.1	105.6	
	adult	15.6	1	0.5	64.8	
	adult	21.1	0.36	0.3	57.6	
	adult	26.5				34.9
Sitophilus oryzae	adult	21	0.36		30	
Tribolium confusum	eggs	26.7				1124.8
	adult	4.4			209.3	178.2
	adult	15.6			92.8	97.6
	adult	25	0.48		64	55
	adult	26.7			74.2	76.5
Tribolium castaneum	adult	24	11.5		62	
Plodia interpunctella	eggs	15			53	
	eggs	20			29	
	eggs	25			22	
	eggs	30			21	
	larvae	15			34	
	larvae	20			31	
	larvae	25			24	
	larvae	30			25	
	pupae	15			64	
	pupae	20			50	
	pupae	25			43	
	pupae	30			35	

APPENDIX D. METHYL BROMIDE FACILITIES DATA

CUE Applicant	Facility ID	Size of Facility	Historic Usage									
			1999		2000		2001		2002		2003	
			Rate (lbs ai/1,000ft^3)	Frequency (X/yr)	Rate (lbs ai/1,000ft^3)	Frequency (X/yr)	Rate (lbs ai/1,000ft^3)	Frequency (X/yr)	Rate (lbs ai/1,000ft^3)	Frequency (X/yr)	Rate (lbs ai/1,000ft^3)	Frequency (X/yr)
NCHA	MP18	52,000	3	4	3	4	4	5	3	4	13	14
NCHA	MP19	--	0.5	8	0.5	5	0.5	6	0.5	6	0.5	3
NCHA	MP20	50,000 - 100,000	--	--	--	--	--	--	--	--	--	--
NCHA	MP21	10,000 - 50,000	1.5	4	1.5	4	1.5	3	1.5	3	1.5	3
NCHA	MP22	50,000 - 100,000	3	4	3	4	3	4	3	3	3	3
NCHA	MP23	176,200	8	400lbs	4	200lbs	8	400lbs	8	400lbs	6	300lbs
PFI	PFI1	>500,000	1.5	2	1.5	2	1.5	2	1.5	2	1.5	2
PFI	PFI2	--	--	20	--	20	--	15	--	10	--	5
PFI	PFI3	>500,000	--	--	1.5	1	--	--	1.5	1	--	--
PFI	PFI4	1,000 - 5,000	--	--	--	--	--	--	--	--	--	--
PFI	PFI5	>500,000	1	1	1	1	0	0	1	1	1	1
PFI	PFI6	>500,000	1	2	1	2	1.25	1	1.25	1	1	1
PFI	PFI7	>500,000	1-2	1	0	0	1-2	1	1-2	1	1-2	1
PFI	PFI8	3,000,000	1	1	1.25	1	1.25	1	1	1	1	1
PFI	PFI9	>500,000	1	1	1	1	1	1	1	1	1	1
PFI	PFI10	>500,000	1	1	1	1	1	1	1	1	1	1
PFI	PFI11	700,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI12	>500,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI13	100,000 - 500,000	--	0	--	0	--	0	--	0	--	0
PFI	PFI14	7,000,000+	0	1	0	0	1	1	0	0	1	1
PFI	PFI15	1,750,000cu ft	0	1	0	0	1	1	0	0	1	1
PFI	PFI16	>500,000	1	1	1	1	0	0	1	1	1	1
PFI	PFI17	>500,000	1.5	0	2	1	0	0	2	1	2	1
PFI	PFI18	100,000 - 500,000	--	0	--	0	--	0	--	0	--	0
PFI	PFI19	>500,000	1	1	0	0	1	1	1	1	1	1
PFI	PFI20	3,500,000 cu ft	1	1	0.8	1	0.8	1	0	0	0	0
PFI	PFI21	3,000,000 cu ft	1	1	0	0	0	0	1	1	1-1.5	1
PFI	PFI22	>500,000	1	1	0	0	0	0	0	0	1	1

PFI	PFI23	100,000 - 500,000	--	--	5lb/42 35	1	5lb/42 35	1	5lb/42 35	1	5lb/42 35	1
PFI	PFI24	100,000 - 500,000	0	0	1	1	0	0	0	0	0	0
PFI	PFI25	>500,000	1	1	1	1	1	1	1	1	1	1
PFI	PFI26	2,120,000	1	1	1	1	1	1	1	1	1	1
PFI	PFI27	1,100,000	1	1	1	1	1	1	1	1	1	1
PFI	PFI28	>500,000	1	1	1	1	0	0	1	1	1	1
PFI	PFI29	18.3 million ft^3	--	--	--	--	--	--	--	--	1	1 trailer
PFI	PFI30	2.5 million ft^3	--	0	1	1	1	1	1	1	--	01
PFI	PFI31	18.3 million ft^3	1.5	45 trailers	1.4	45 trailers	1.5	38 trailers	1.5	16 trailers	1.5	25 trailers
PFI	PFI32	1.4 million ft^3	1	1	1	1	1	1	1	1	1	1
PFI	PFI33	23.6 million ft^3 planned	--	--	--	--	--	--	--	--	--	--
PFI	PFI34	23.6 million ft^3 planned	--	--	--	--	--	--	--	--	--	--
PFI	PFI35	11.2 million ft^3	1	1	1	1	1	1	1	1	1	1
PFI	PFI36	8.2 million ft^3	--	--	--	Once, all warehous es	1.5 lbs	Twice (trailers)	0 lbs	--	1.5 lbs	Twice (trailers)
PFI	PFI37	6.9 million ft^3	--	0	1	1	1	1	1	1	1	1
PFI	PFI38	>500,000	--	0	--	0	1	1	--	0	--	0
PFI	PFI39	>500,000	1.5	1	1.5	1.5	1.5	1	1	1	1	2
PFI	PFI40	>500,000	1	1	1.5	1	1	1	1	1	0	0
PFI	PFI41	>500,000	1.5	1	0	0	0	0	0	0	1	0
PFI	PFI42	240,000ft^2; 4,800,000ft^3	--	--	--	--	--	--	1.0#/t^3	1	1.0#/ft^3	1
PFI	PFI43	7 million ft^3	--	--	--	--	--	--	--	--	--	--
PFI	PFI44	>500,000	1.5	1	1.5	1	1.5	1	1.5	1	1.5	1
PFI	PFI45	100,000 - 500,000	0	0	0	0	0	0	0	0	5	1
PFI	PFI46	5,000 - 10,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI47	10,000 - 50,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI48	>500,000	1	1	0	0	1	1	1	1	1	1
PFI	PFI49	>500,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI50	>500,000	0	0	0	0	0	0	0	0	0	0
PFI	PFI51	100,000 - 500,000	--	--	1.3	1	1	1	1.3	1	--	--
PFI	PFI52	100,000 - 500,000	--	NA	--	NA	--	0	--	0	--	0
Rice	1	>500,000	1	2	1	2	1	2	1	2	1	2

Millers												
Rice Millers	2	>500,000	1	2	1	2	1	2	1	2	1	2
Rice Millers	3	>500,000	1.5	1	1.5	2	1.5	2	1.5	2	1	2
Rice Millers	4	>500,000	1.5	2	1.5	2	1.5	2	1	2	1	2
Rice Millers	5	>500,000	1	2	1	2	1	2	1	2	1	2
Rice Millers	6	>500,000	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1
Rice Millers	7	10,000-50,000	2	2	2	2	2	2	2	4	2	2
Rice Millers	8	5,000-10,000	1	5	1	5	1	5	1	5	1	5
Rice Millers	9	5,000-10,000	1	4	1	4	1	4	1	4	1	4
Rice Millers	10	--	1	1	1	1	1	1	1	1	1	1
Rice Millers	11	>500,000	3	2	3	2	3	2	3	2	3	2
Rice Millers	12	5,000-10,000	2.15	1	2.2	1	2.2	2	2.19	1	2	2
Rice Millers	13	50,000-100,000	1	9	1	9	1	9	1	9	1	9
Rice Millers	14	--	24,000 lbs.	2	24,000 lbs.	2	12,000 lbs.	1	12,0000 lbs.	1	12,0000lbs	1
Rice Millers	BR549	>500,000	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1
NPMA	1	100,000-500,000	2	52	2	52	2	52	2	52	2	52
NPMA	2	>500,000	2	52	2	52	2	52	2	52	2	52
NPMA	3	>500,000	2	52	2	52	2	52	2	52	2	52
NPMA	4	100,000-500,000	2	52	2	52	2	52	2	52	2	52
NPMA	5	100,000-500,000	2	52	2	52	2	52	2	52	2	52
NPMA	6	50,000-100,000 (H2); 100,000-500,000 (H1)	2	52	2	52	2	52	2	52	2	52

NPMA	7	50,000-100,000 (F1 & F2)	2	52	2	52	2	52	2	52	2	52
NPMA	8	100,000-500,000	2	52	2	52	2	52	2	52	2	52
NPMA	9	50,000-100,000	2	52	2	52	2	52	2	52	2	52
NPMA	10	>500,000	1	1	1	1	1	1	1	1	1	1
NPMA	11	>500,000	2004: Rate – 1-3#/1000 COFT, Frequency - 2				--	--	--	--	--	--
NPMA	12	--	--	--	--	--	3	2	3	2	3	2
NPMA	13	--	--	--	--	--	3	16	3	17	3	3
NPMA	14	>500,000	1	2	1	3	1	2	1	2	1	1
NPMA	15	50,000-100,000	6oz/1000 cu ft	2	6oz/1000 cu ft	2	6oz/1000 cu ft	1	6oz/1000 cu ft	2	6oz/1000 cu ft	3
NPMA	16	>500,000	1.5	1	--	--			--	--	1.5	1
NPMA	17	100,000-500,000	3	2	3	2	3	1	3	2	3	3
NPMA	18	100,000-500,000	3	1	--	--	3	1	3	1	--	--
NPMA	19	--	25.5	2	25.5	2	25.5	2	25.5	2	25.5	2
NPMA	20	>500,000	--	--	1	1	--	--	--	--	--	--
LifeLine Foods		>500,000	--	--	--	--	--	--	1,800	1	--	--
NAMA	1	>500,000	1.5	3-4	1.5	3-4	1.5	3-4	2	3-4	1.5	3-4
NAMA	2	>500,000	1	3	1	3	1	3	1	3	1	3
NAMA	3	>500,000	1.5oz	2	1.5oz	1	1.5oz	2	1.5oz	2	1.5oz	2
NAMA	4	>500,000	1	2	1	2	1	2	1	3	1	2
NAMA	5	1,000-5,000	--	--	--	--	--	--	--	--	--	--
NAMA	6	1,000-5,000	1.25	1	1.25	1	1.25	1	1	1	1.25	1
NAMA	7	1,000-5,000	--	--	--	--	--	--	--	--	1	1
NAMA	8	1,000-5,000	1.12	2	1.12	2	1.12	1	1	1	1.12	1
NAMA	9	>500,000	1.65	1	1.57	1	1.57	1	2	1	1.55	1
NAMA	10	>500,000	--	--	--	--	--	--	--	--	0.81	1
NAMA	11	0-1,000	1.25	2	1.25	2	1.25	1	1	1	1.25	1
NAMA	12	>500,000	0.75	1	0.75	1	0.75	1	1	1	0.75	1
NAMA	13	>500,000	0.5	1	0.75	1	1	1	0	0	0	0
NAMA	14	1,000-5,000	1.5-3	2	1.5-3	2	1.5-3	2	1.5-3	2	1.5-3	2
NAMA	15	885000	0.75	2	0.75	2	0.75	2	1	2	0.75	2
NAMA	16	>500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	17	>500,000	925	2	1050	2	1050	2	1,100	1	1100	1

NAMA	18	>500,000	3325	1	2800	1	3400	1	3,700	1	3500	1
NAMA	19	>500,000	1.25	3	1.25	3	1.25	2	1	2	1.25	2
NAMA	20	>500,000	1.25	3	1.25	3	1.25	2	1	2	1.25	3
NAMA	21	>500,000	1.8	2	1.8	2	1.8	2	2	2	1.8	2
NAMA	22	>500,000	1	4	1	3	1	4	1	3	1.3	2
NAMA	23	>500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	24	>500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	25	>500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	26	>500,000	1.8	3	1.8	3	1.8	3	2	3	1.8	3
NAMA	27	>500,000	1	3	1	3	1	3	1	3	1	3
NAMA	28	100,000-500,000	1	3	1.2	3	1.5	4	1	3	1.4	3
NAMA	29	>500,000	?	?	?	?	?	?	?	?	?	?
NAMA	30	>500,000	1	4	1	4	1	3	1	3	1	3
NAMA	31	>500,000	N/A		N/A		N/A		1-1.5	3	1-1.5	3
NAMA	32	>500,000	1.5	3-4	1.5	3-4	1.5	3-4	2	3-4	1.5	3-4
NAMA	33	>500,000	--	--	--	--	--	--	1-1.5	3-4	1-1.5	3-4
NAMA	34	565	1.85	3	1.94	3	1.77	3	2	3	2.12	3
NAMA	35	50,000-100,000	1	2	1	2	1	3	1	3	1	2
NAMA	37	>500,000	.5-.75	3	.5-.75	2	.5-.75	3	.5-.75	3	.5-.75	3
NAMA	38	10,000-50,000	1.25	3	1.25	3	1.25	3	1	3	1.25	3
NAMA	39	945591	0.75	2	0.75	2	0.75	2	1	2	0.75	2
NAMA	40	>500,000	0.5	3	0.5	3	0.5	3	1	3	0.5	3
NAMA	41	50,000-100,000	1.5	3	1.5	3	1.5	2	2	2	1.5	2
NAMA	42	>500,000	1	2	1	2	1	2	1	2	1	2
NAMA	43	100,000-500,000	1.25	2	1.25	2	1.25	2	1	2	1.25	2
NAMA	44	50,000-100,000	0.5	2	0.5	2	0.5	2	1	2	0.5	2
NAMA	45	1,000-5,000	1	2	1	2	1	2	1	2	1	2
NAMA	46	0-1,000	--	--	--	--	--	--	--	--	--	--
NAMA	47	1,000-5,000	.5-1	4	.5-1	4	.5-1	4	.5-1	4	.5-1	4
NAMA	48	5,000-10,000	1	3	1	2	1	2	1	2	1	2
NAMA	49	--	1.5	3	1.5	3	1.5	3	2	3	1.5	3
NAMA	50	1,000-5,000	--	--	--	--	1.5	2	1.5, 3	2	1.5	1
NAMA	51	0-1,000	1.5	3	1.5	2	1.5	3	2	2	1.3	3
NAMA	52	>500,000	1.8	2	1.8	2	1.8	1	2	2	1.8	2
NAMA	53	100,000-500,000	1.5	3	1.5	3	1.5	3	2	3	1.5	1

NAMA	54	>500,000	1	1	1	2	1	2	1	1	--	0
NAMA	55	>500,000	--	--	--	--	--	--	1,800lbs	1	--	--
NAMA	56	100,000-500,000	3	23	3	34	3	18	3	17	3	15
NAMA	57	>500,000	1	2	1	2	1	2	1	2	1	2
NAMA	58	10,000-50,000	1.25	4	1.25	4	1.25	4	1	3	1.25	3
NAMA	59	50,000-100,000										
NAMA	60	1,000-5,000	16	1	16	2	16	2	16	2	16	2
NAMA	61	>500,000	1.5	2	1.5	2	1.5	2	2	2	N/A	N/A
NAMA	62	>500,000		3		3		3		3		3
NAMA	63	1,000-5,000	1.5	2	1.5	2	1.5	2	2	2	1	2
NAMA	64		0.25	3	0.25	3	0.25	3	0	3	0.25	3
NAMA	65	>500,000	1.5	2	1.5	2	1.5	2	2	2	N/A	N/A
NAMA	66	1,000-5,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	67	>500,000		3		4		3		3		3
NAMA	68	1,000-5,000	per label	3	per label	3	per label	3	per label	3	per label	3
NAMA	69	1,000-5,000	per label	3	per label	3	per label	3	per label	3	per label	3
NAMA	70	100,000-500,000	--	--	--	--	--	--	--	--	--	--
NAMA	71	>500,000	2	2	1.8	2	1.6	2	2	2	1.6	2
NAMA	72	100,000-500,000		N/A		N/A		N/A		N/A		N/A
NAMA	73	>500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	74	>500,000	1	4	1	3	1	3	1	3	1	3
NAMA	75	>500,000	1.5	3	1.5	3	1.5	3	2	2	1.5	2
NAMA	76	100,000-500,000	--	--	--	--	--	--	--	--	--	--
NAMA	77	>500,000	3	2	3	2	3	2	3	2	3	1
NAMA	78	100,000-500,000	1.25	1	1.25	1	1.25	1	1	1	1.25	1
NAMA	79	100,000-500,000	1.5	2	1.5	2	1.5	3	2	2	1.5	1
NAMA	80	100,000-500,000	1.5	2	1.5	2	1.5	1	2	2	1.5	1
NAMA	81	100,000-500,000	1.5	1	1.5	1	1.5	1	2	1	1.5	1
NAMA	82	100,000-500,000	1.5	2	1.5	2	1.5	2	2	2	1.5	2
NAMA	83	1,000-5,000	1.5	3	1.5	3	1.5	2	2	2	1.5	2
NAMA	84	10,000-50,000	0	0	1.5	3	1.5	4	2	6	1.5	4
NAMA	85	100,000-500,000	1	2	1	2	1	2	1	2	1	2
NAMA	86	100,000-500,000	1	2	1	2	1	2	1	2	1	2
NAMA	87	>500,000	0.75	2	0.75	2	0.75	2	1	2	0.75	2
NAMA	88	>500,000	1	2	1	2	1	2	1	2	1	2

NAMA	89	>500,000	0.75	2	0.75	2	0.75	2	1	2	0.75	2
NAMA	90	>500,000	0.6	2	0.6	2	0.6	2	1	2	0.6	2
NAMA	91	>500,000	1	1	1	1	1	1	1	1	1	1
NAMA	92	>500,000	1	2	1	2	1	2	1	2	1	2
NAMA	93	>500,000	1	1	1	1	1	1	1	1	1	1
NAMA	94	>500,000	1	2	1	2	1	2	1	2	1	2