METHYL BROMIDE CRITICAL USE NOMINATION FOR POST HARVEST USE FOR 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 for Food Processing Plants

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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.

X Yes ☐ No

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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

2. Descriptive Title of Nomination

Methyl Bromide Critical Use Nomination for Post-Harvest Use in Food Processing Plants

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; however, the rice millers and the pet food manufacturers may fumigate some products 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)
2006	**529,604**	**23,622**

5. Brief Summary of the Need for Methyl Bromide as a Critical Use *(Describe the particular aspects of the nominated use that make methyl bromide use critical, e.g. lack of economic alternatives, unacceptable corrosion risk, lack of efficacy of alternatives under the particular circumstances of the nomination)*

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 occur at low 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 such as food processing facilities located in the southern U. S.
- 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.

- Transition to newly available alternatives: Sulfuryl fluoride recently received a Federal registration. State registrations have not yet been issued. Further, it will take some time for applicators to be trained in the use of this chemical and for its incorporation into a pest control program. A registration decision concerning the establishment of sulfuryl fluoride tolerances on other processed food ingredients in a treated facility is still pending.
- 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 resist to phosphine (Taylor, 1989; Bell, 2000; Mueller, 2002).

Heat treatments have a number of problems in this industry. Not all areas of a plant can be efficiently treated with heat. 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 these areas plants have heaters and the power plants have the capacity to supply excess power as needed. When insects escape the heat they will die in the cold conditions. 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. Additionally, escaping insects can survive these outdoor temperatures and re-enter the facility after treatment, even when low volatility pesticides are used to treat the surfaces exiting the plant. Still, many southern and western facilities use heat treatments as a spot treatment whereas the northern facilities can use heat treatments more extensively.

TABLE A.1: EXECUTIVE SUMMARY*

		Rice Miller's Association	Bakeries	Pet Food Institute	North American Miller's Association
2006	Kilograms (kg)	202,756	23,814	48,081	328,854
2006	Application Rate (kg/1000m^3)	32.85	19.74	21.77	19.36
2006	Volume (1000m^3)	6,173	1,206	2,209	16,990
2006 Nominated Amount (kg)		114,305	14,742	48,081	328,854
Marginal Strategy		**Heat**	**Heat**	**Heat**	**Heat**
Time Lost		**17 DAYS**	**9 DAYS**	**1 DAY**	**9 DAYS**
Loss per 1000 m³		**$2,023**	**$7,513**	**$2,776**	**$12,439**
Loss per kg MB (US$/kg)		**$62**	**$381**	**$128**	**$616**
Loss as % of Gross Revenue (%)		**18.25%**	**7.50%**	**3.17%**	**14.43%**
Loss as % of Net Revenue (%)		**138%**	**58%**	**46%**	**57%**
Describe Economic Impacts		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 this alternative. There are some food processing facilities in areas of United States where heat treatment is not technically feasible.			

*See Appendix C 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 FOR FOOD PROCESSING PLANTS

	Historical Use[1,2]						Requested Use	
For each year specify:	1997	1998	1999	2000	2001	2002	2005	2006
Amount of MB (kg)	814,266	688,441	676,668	634,234	561,276	535,596	614,845	603,505
Volume Treated (1000 m³)	26,656	25,518	25,788	25,880	25,321	24,553	26,578	26,578
Formulation of MB	100%	100%	100%	100%	100%	100%	100%	100%
Dosage Rate (kg/1000 m³)	26.67	25.43	25.02	24.32	23.14	22.75	23.60	23.43

[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 fumigation may take place was not requested by the United States Government in the forms filled out by the applicants in the United States. Therefore, we do not have a complete listing of the actual addresses for each facility. However, location of the facilities is dictated by close proximity to the raw ingredients and to major markets. For example, the 22 rice mills are located primarily in the Gulf coast states and California.

TABLE A.2: 2006 NOMINATION - POST HARVEST USE FOR FOOD PROCESSING PLANTS*

2006 NOMINATION - POST HARVEST USE FOR FOOD PROCESSING PLANTS		RICE MILLER'S ASSOCIATION	BAKERIES	PET FOOD INSTITUTE	NORTH AMERICAN MILLER'S ASSOCIATION
Applicant Request for 2006	Requested Kilograms (kg)	202,756	23,814	48,081	328,854
	Requested Application Rate (kg/ 1000 m^3)	32.85	19.74	21.77	19.36
	Requested Volume (1000 m^3)	6,173	1,206	2,209	16,990
CUE Nominated for 2006	Nominated Volume (1000 m^3)	3,670	753	2,209	16,990
	Nominated Application Rate (kg/ 1000 m^3)	31	20	22	19
	Nominated Kilograms (kg)	114,305	14,742	48,081	328,854

2006 NOMINATION TOTALS – POST HARVEST FOOD PROCESSING PLANTS	
OVERALL PERCENT REDUCTION (%)	12%
Total 2006 U.S. Nominated Kilograms (kg) - Post Harvest Use for Food Processing Plants	**529,604**

*See appendix C for complete description of how the nominated amount was calculated.

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.
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.
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.
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, 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.

TABLE B.2: CHARACTERISTICS OF SECTOR - FOOD PROCESSING PLANTS: RICE MILLS

	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)*												
Retail Target Market Window	Not Applicable											

Rice Mills are fumigated, on average, about 5 times a year, whenever pests are a problem.

Most rice mills are located in the southern areas of the United States, which experience high temperatures year round. Subsequently theses mills are under extreme insect pressure all year long. Therefore, the average number of fumigations exceeds the average of the other members of this sector.

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. (℃)	NUMBER OF FUMIGATIONS PER YEAR	PROPORTION OF FACILITY TREATED AT THIS DOSE	FIXED (F) MOBILE (M) STACK (S)
Rice Miller's Association	32	24	variable	5	100% *	F
Bakeries North America	18	24	variable	2.5	100%	F
Pet Food Institute	22	24	variable	< 1 Avg. 1application /3-5 yrs	40%	F
North American Millers' Association	19	24	variable	2.5	100 %	F

*Unspecified type of rice is also fumigated along with the facilities.

TABLE 9.1: (b) FIXED FACILITIES

CUE	TYPE OF CONSTRUCTION AND APPROXIMATE AGE IN YEARS	% FACILITIES AT VOLUMES (1,000*m³*)	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	
Pet Food Institute[1]	Combination 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 A 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 critical 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, 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.

Many food processing facilities in the United States also use heat treatments to reduce insect populations. However, some areas (electronics and electrical portions) of facilities are sensitive to heat. Heat also causes rancidity in butters and oils and denatures proteins that may be used in the ingredients, plus, not all manufactured products can be heated to the temperature or for the time required in order to get an effective kill of insect pests. Some facilities, due to construction, are unable to use heat. There have been reports of structural damage resulting from heat treatments. 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.

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).

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.

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

ALTERNATIVE	PEST	STUDY TYPE	RESULTS	CITATION
DEET (N, N-diethyl-m-toluamide) and NEEM (azadirachthin)	*T. castaneum and others*	Lab	DEET repelled *S. oryzae* by 99%, *T. castaneum* by 86%, *Cryptolestes ferrugineus* by 97% and *O. surinamensis* by 91% Neem was less effective than DEET	Hou, et al. 2004

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 B, 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	Unknown	Recently registered in United States for some uses in this sector on January 23, 2004. The use of this chemical will require 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. May take up to 5 years before we know if it will replace methyl bromide and for industry conversion. See Section 17.2.1.
Not in Kind Alternative	**Technical Feasibility**	**Comments**
Heat Treatment	No	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. All these IPM strategies are currently practiced and widely implemented with the beneficial result of lengthening time between fumigations. These IPM strategies are not a replacement for methyl bromide.
Contact Insecticides	No	
Cultural Practices	No	
Electrocution	No	
Inert Dust	No	

Pest Exclusion/Physical Removal	No	
Pesticides of Low Volatility	No	
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	--
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 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

(Provide an analysis of how these costs were estimated as a separate attachment):

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

MB AND ALTERNATIVES	COST IN CURRENT YEAR (US$)	COST ONE YEAR AGO (US$)	COST TWO YEARS AGO (US$)
Rice Miller's Association			
Methyl Bromide	1 ($640 per 1000$m^3$)	1 ($640 per 1000$m^3$)	1 ($640 per 1000$m^3$)
Heat	3.16 ($2,023 per 1000$m^3$)	3.16 ($2,023 per 1000$m^3$)	3.16 ($2,023 per 1000$m^3$)
Bakeries			
Methyl Bromide	1 ($594 per 1000$m^3$)	1 ($594 per 1000$m^3$)	1 ($594 per 1000$m^3$)
Heat	12.65 ($7,513 per 1000$m^3$)	12.65 ($7,513 per 1000$m^3$)	12.65 ($7,513 per 1000$m^3$)
Pet Foods Institute			
Methyl Bromide	1 ($381 per 1000$m^3$)	1 ($381 per 1000$m^3$)	1 ($381 per 1000$m^3$)
Heat	7.29 ($2,776 per 1000$m^3$)	7.29 ($2,776 per 1000$m^3$)	7.29 ($2,776 per 1000$m^3$)
North American Miller's Association			
Methyl Bromide	1 ($601 per 1000$m^3$)	1 ($601 per 1000$m^3$)	1 ($601 per 1000$m^3$)
Heat	20.70 ($12,439 per 1000$m^3$)	20.70 ($12,439 per 1000$m^3$)	20.70 ($12,439 per 1000$m^3$)

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

NO.	METHYL BROMIDE ALTERNATIVE	ECONOMIC REASON (IF ANY) FOR THE ALTERNATIVE NOT BEING AVAILABLE	ESTIMATED MONTH/YEAR WHEN THE ECONOMIC CONSTRAINT COULD BE SOLVED
1	**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.

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 also required to retrofit them 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 likely have substantial cost implications to the facilities that have not been converted to heat in the food-processing sector.

The four economic measures in Table E.1 were used to quantify the economic impacts to post-harvesting uses for food-processing. The four economic measures are not independent in such a way that they can be calculated from the same financial data. The 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.

Production downtime was estimated at two more days per fumigation with heat and total capital expenditures for heat treatment was assumed to be $1,076 per 1000 m^3 with 10-years lifespan with 10% interest rate from the data provided by the CUE applicants for post-harvesting uses. The potential economic losses associated with the use of heat treatment mainly originate from the cost of capital investment. The estimated economic loss per 1000 m^3 ranges from $2,023 for rice milling to $12,439 for flour/grain milling. The estimated economic losses as a percentage of gross revenue ranges from 3% to 18% and the estimated economic loss as a percentage of net revenue are over 45% for all the CUE applicants in the food-processing sector. The industries that use methyl bromide for commodity fumigation are, in general, subject to limited pricing power, changing market conditions, and government regulations. Companies within these industries operate in a highly competitive global marketplace characterized by high sales volume, low profit margins, and rapid turnover of inventories. The results suggest that heat treatment is not economically viable as an alternative for methyl bromide in existing facilities that still use methyl bromide.

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

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

LOSS MEASURE	METHYL BROMIDE	HEAT TREATMENT
TOTAL COMMODITY TREATED (KG/1000 M^3)		
* AVERAGE MARKET PRICE (US$/KG)		
GROSS REVENUE (US$/1000 M^3)	$29,385	$27,720
- OPERATING COSTS (A+B) PER 1000 M^3	$27,916	$28,274
A) COST OF MB OR ALTERNATIVE	$427	$640
B) OTHER OPERATING COSTS	$27,489	$27,634
NET REVENUE (US$/1000 M^3) (NET OF OPERATING COSTS)	$1,469	$(554)
LOSS MEASURES		
TIME LOST (DAYS)	0 DAYS	17 DAYS
LOSS PER 1000 M^3 (US$/1000 M^3)	$0	$2,023
LOSS PER KILOGRAM MB (US$/KG)	$0	$62
LOSS AS A % OF GROSS REVENUE (%)	0%	18.25%
LOSS AS A % OF NET REVENUE (%)	0%	138%

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

LOSS MEASURE	METHYL BROMIDE	HEAT TREATMENT
TOTAL COMMODITY TREATED (KG/1000 M³)		
* AVERAGE MARKET PRICE (US$/KG)		
GROSS REVENUE (US$/1000 M³)	$258,334	$250,584
- OPERATING COSTS (A+B) PER 1000 M³	$245,417	$245,181
A) COST OF MB OR ALTERNATIVE	$396	$594
B) OTHER OPERATING COSTS	$245,021	$244,587
NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS)	$12,917	$5,403
LOSS MEASURES		
TIME LOST (DAYS)	0 DAYS	9 DAYS
LOSS PER 1000 M³ (US$/1000 M³)	$0	$7,513
LOSS PER KILOGRAM MB (US$/KG)	$0	$381
LOSS AS A % OF GROSS REVENUE (%)	0%	7.5%
LOSS AS A % OF NET REVENUE (%)	0%	58%

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

LOSS MEASURE	METHYL BROMIDE	HEAT TREATMENT
TOTAL COMMODITY TREATED (KG/1000 M³)		
* AVERAGE MARKET PRICE (US$/KG)		
GROSS REVENUE (US$/1000 M³)	$175,452	$175,013
- OPERATING COSTS (A+B) PER 1000 M³	$166,679	$169,016
A) COST OF MB OR ALTERNATIVE	$254	$381
B) OTHER OPERATING COSTS	$166,425	$168,635
NET REVENUE (US$/1000 M³) (NET OF OPERATING COSTS)	$8,773	$5,997
LOSS MEASURES		
TIME LOST (DAYS)	0 DAYS	1 DAYS
LOSS PER 1000 M³ (US$/1000 M³)	$0	$2,776
LOSS PER KILOGRAM MB (US$/KG)	$0	$128
LOSS AS A % OF GROSS REVENUE (%)	0%	3.17%
LOSS AS A % OF NET REVENUE (%)	0%	46.29%

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

LOSS MEASURE	METHYL BROMIDE	HEAT TREATMENT
TOTAL COMMODITY TREATED (KG/1000 M^3)		
* AVERAGE MARKET PRICE (US$/KG)		
GROSS REVENUE (US$/1000 M^3)	$437,472	$424,348
- OPERATING COSTS (A+B) PER 1000 M^3	$428,037	$412,325
A) COST OF MB OR ALTERNATIVE	$401	$601
B) OTHER OPERATING COSTS	$427,636	$411,724
NET REVENUE (US$/1000 M^3) (NET OF OPERATING COSTS)	$9,435	$12,023
LOSS MEASURES		
TIME LOST (DAYS)	0 DAYS	9 DAYS
LOSS PER 1000 M^3 (US$/1000 M^3)	$0	$12,439
LOSS PER KILOGRAM MB (US$/KG)	$0	$616
LOSS AS A % OF GROSS REVENUE (%)	0%	14.43%
LOSS AS A % OF NET REVENUE (%)	0%	57%

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 (see Section 17.2.1).

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 also recommend further studies on sulfuryl fluoride tolerances and combination treatments of heat/carbon dioxide/phosphine.

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. 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.

The flour milling industry is committed to IPM techniques in order to minimize reliance on any one tool. Many plants have reduced the amount 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 three manuals on fumigation best practices, which are widely utilized throughout the industry. The industry continues to test high heat, phosphine, alone and in combination; and the combination of heat, phosphine, and carbon dioxide.

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 (see below).

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.

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). It will take some time for potential applicators to be identified and to take this training before the product can begin testing in the specific circumstances of users.

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. Sulfuryl fluoride is being registered only for cereal and small grains and mills that contain and/or process these grains. Many mills also produce partial recipe products that contain such ingredients as sugar, baking soda, leavening agents, hydrogenated oils, etc. The registration of sulfuryl fluoride does not include tolerances for these ingredients and therefore would not be allowed in these facilities. 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).

Some states must also register sulfuryl fluoride. California needs to register this product through their regulatory process, and requires at least four months after receiving an application, as long as risk concerns do not appear in their assessments. At the time of this writing, however, California had not received an application from the sulfuryl fluoride registrant.

There are also data limitations preventing U.S. EPA, at this time, from estimating the degree to which sulfuryl fluoride might replace some methyl bromide use in fumigating grain and flour mills. We currently lack the information to evaluate sulfuryl fluoride's performance relative to methyl bromide. We have almost no relative product performance data (direct comparisons to methyl bromide), no experience in how well it performs in different facilities and climates over multiple years, no price data, and no information on what other costs might be associated with adopting sulfuryl fluoride. Lacking such information, we cannot reach science-based conclusions on the technical and economic feasibility of sulfuryl fluoride at this time.

For these reasons, and given the current state of data, U.S. EPA is refraining from speculating on the degree to which sulfuryl fluoride registrations might lead to amended CUE nominations. At the same time, U.S. EPA commits to carefully studying sulfuryl fluoride use during the next year, with the aim of identifying specific sectors where CUE requests can be modified, once we have (and have analyzed) the necessary data.

18. Additional Comments

19. CITATIONS

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APPENDIX A

APPENDIX A - 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 A - 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 (m^3) 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 B

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

SPECIES	FUMIGANT	THRESHOLD (ºC OR TIME)	TEMPERATURE (ºC)	
			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 B - 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 C. 2006 Methyl Bromide Usage Numerical Index (BUNI).

Methyl Bromide Critical Use Exemption Process

Date: 2/26/04

2006 Methyl Bromide Usage Numerical Index (BUNI)

Sector: STRUCTURES - FOOD FACILITIES

Average Volume in the US:	not avilable
% of Average Volume Requested:	not avilable

FOOD FACILITY TYPE	2006 Amount of Request: Kilograms (kgs)	Volume (1000m^3)	Use Rate (kg/1000m^3)	2001 & 2002 Average Use: Kilograms (kgs)	Volume (1000m^3)	Use Rate (kg/1000m^3)	Quarantine and Pre-Shipment	Regional Volume: 2001 & 2002 Average	% of Volume
RICE MILLER'S ASSOCIATION	202,756	6,173	33	142,881	4,587	31	20%	not avilable	not avilable
BAKERIES	23,814	1,206	20	29,937	1,529	20	0%	not avilable	not avilable
PET FOOD INSTITUTE	48,081	2,209	22	48,264	2,215	22	0%	not avilable	not avilable
NORTH AMERICAN MILLER'S ASSOCIATION	328,854	16,990	19	340,194	16,990	20	0%	not avilable	not avilable
TOTAL OR AVERAGE	603,504	26,578	23.43	561,277	25,322	23.13	5%	not avilable	not avilable

2006 Nomination Options	Subtractions from Requested Amounts (kgs)					Combined Impacts Adjustment (kgs)		MOST LIKELY IMPACT VALUE			
FOOD FACILITY TYPE	2006 Request	(-) Double Counting	(-) Growth or 2002 CUE Comparison	(-) Use Rate Difference	(-) QPS	HIGH	LOW	Amount (kgs)	Volume (1000m^3)	Use Rate (kg/1000m^3)	% Reduction
RICE MILLER'S ASSOCIATION	202,756	-	52,084	7,790	28,576	114,305	114,305	114,305	3,670	31	44%
BAKERIES	23,814	-	9,072	-	-	14,742	14,742	14,742	753	20	38%
PET FOOD INSTITUTE	48,081	-	-	-	-	48,081	48,081	48,081	2,209	22	0%
NORTH AMERICAN MILLER'S ASSOCIATION	328,854	-	-	-	-	328,854	328,854	328,854	16,990	19	0%
Nomination Amount	603,504	603,504	542,348	534,558	505,982	505,982	505,982	529,604	23,622	23	12%
% Reduction from Initial Request	0%	0%	10%	11%	16%	16%	16%	12%	11%		

Adjustments to Requested Amounts	Use Rate (kg/1000m^3)		(%) Key Pest Distribution		(%) Adopt New Fumigants		(%) Combined Impacts		Time, Quality, or Product Loss	Marginal Strategy
FOOD FACILITY TYPE	2006	Low	High	Low	High	Low	HIGH	LOW		
RICE MILLER'S ASSOCIATION	33	31	100%	100%	0%	0%	100%	100%		Heat
BAKERIES	20	20	100%	100%	0%	0%	100%	100%		Heat
PET FOOD INSTITUTE	22	22	100%	100%	0%	0%	100%	100%		Heat
NORTH AMERICAN MILLER'S ASSOCIATION	19	19	100%	100%	0%	0%	100%	100%		Heat

Other Considerations	Dichotomous Variables (Y/N)			Other Issues			Economic Analysis			
FOOD FACILITY TYPE	Currently Use Alternatives?	Research / Transition Plans	Pest-free Market Requirement	Change from Prior CUE Request (+/-)	Verified Historic MeBr Use / State	Frequency of Treatment /Yr	Loss per 1000 m^3 (US$/1000m)	Loss per Kg of MeBr (US$/kg)	Loss as a % of Gross Revenue	Loss as a % of Net Revenue
RICE MILLER'S ASSOCIATION	Y	Y	Y	0	N	2-3				
BAKERIES	Y	Y	Y	+	N	2				
PET FOOD INSTITUTE	Y	Y	Y	0	N	1/5 yr				
NORTH AMERICAN MILLER'S ASSOCIATION	Y	Y	Y	-	N	2.5				

Conversion Units: 1 Pound = 0.453592 Kilograms 1,000 cu ft = 0.028316847 1,000 cubic meters

Footnotes for Appendix C:

Values may not sum exactly due to rounding.

1. **Average Volume in the U.S.** – Average Volume in the U.S. is the average of 2001 and 2002 total volume fumigated with methyl bromide in the U.S. in this sector (when available).
2. **% of Average Volume Requested** - Percent (%) of Average Volume Requested is the total volume in the sector's request divided by the Average Volume in the U.S. (when available).
3. **2006 Amount of Request** – The 2006 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 thousand 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 U.S. nomination.
4. **2001 & 2002 Average Use** – The 2001 & 2002 Average Use is the average of the 2001 and 2002 historical usage figures provided by the applicants given in kilograms active ingredient of methyl bromide, total volume of methyl bromide use, and application rate in kilograms active ingredient of methyl bromide per thousand cubic meters. Adjustments are made when necessary due in part to unavailable 2002 estimates in which case only the 2001 average use figure is used.
5. **Quarantine and Pre-Shipment** – Quarantine and pre-shipment (QPS) is the percentage (%) of the applicant's requested amount subject to QPS treatments.
6. **Regional Volume, 2001 & 2002 Average Volume** – Regional Volume, 2001 & 2002 Average Volume is the 2001 and 2002 average estimate of volume of methyl bromide used within the defined region (when available).
7. **Regional Volume, Requested Volume %** - Regional Volume, Requested Volume % is the volume in the applicant's request divided by the total volume fumigated with methyl bromide in the sector in the region covered by the request.
8. **2006 Nomination Options** – 2006 Nomination Options are the options of the inclusion of various factors used to adjust the initial applicant request into the nomination figure.
9. **Subtractions from Requested Amounts** – Subtractions from Requested Amounts are the elements that were subtracted from the initial request amount.
   10. **Subtractions from Requested Amounts, 2006 Request** – Subtractions from Requested Amounts, 2006 Request is the starting point for all calculations. This is the amount of the applicant request in kilograms.
   11. **Subtractions from Requested Amounts, Double Counting** - Subtractions from Requested Amounts, Double Counting is the estimate measured in kilograms in situations where an applicant has made a request for a CUE with an individual application while a consortium has also made a request for a CUE on their behalf in the consortium application. In these cases the double counting is removed from the consortium application and the individual application takes precedence.
   12. **Subtractions from Requested Amounts, Growth or 2002 CUE Comparison** - Subtractions from Requested Amounts, Growth or 2002 CUE Comparison is the greatest reduction of the estimate measured in kilograms of either the difference in the amount of methyl bromide requested by the applicant that is greater than that historically used or treated at a higher use rate or the difference in the 2006 request from an applicant's 2002 CUE application compared with the 2006 request from the applicant's 2003 CUE application.
   13. **Subtractions from Requested Amounts, QPS** - Subtractions from Requested Amounts, QPS is the estimate measured in kilograms of the request subject to QPS treatments. This subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison then multiplied by the percentage subject to QPS treatments. *Subtraction from Requested Amounts, QPS = (2006 Request – Double Counting – Growth)*(QPS %)*
   14. **Subtraction from Requested Amounts, Use Rate Difference** – Subtractions from requested amounts, use rate difference is the estimate measured in kilograms of the lower of the historic use rate or the requested use rate. The subtraction estimate is calculated as the 2006 Request minus Double Counting, minus Growth or 2002 CUE Comparison, minus the QPS amount, if applicable, minus the difference between the requested use rate and the lowest use rate applied to the remaining hectares.
15. **Adjustments to Requested Amounts** – 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.

16. **Use Rate kg/ 1000 m^3 2006** – Use rate in pounds per thousand cubic feet, 2006, is the use rate requested by the applicant as derived from the total volume to be fumigated divided by the total amount (in pounds) of methyl bromide requested.
17. **Use Rate kg/ 1000 m^3 low** – Use rate in pounds per thousand cubic feet, low, is the lowest historic use rate reported by the applicant. The use rate selected for determining the amount to nominate is the lower of this rate or the 2006 use rate (above).
18. **(%) Key Pest Impacts** - 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.
19. **Adopt New Fumigants (%)** – Adopt new fumigants (%) is the percent (%) of the requested volume where we expect alternatives could be adopted to replace methyl bromide during the year of the CUE request.
20. **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).

21. **Qualifying Volume** - Qualifying volume (1000 cubic meters) is calculated by multiplying the adjusted volume by the combined impacts.
22. **CUE Nominated amount** - CUE nominated amount is calculated by multiplying the qualifying volume by the use rate.
23. **Percent Reduction** - Percent reduction from initial request is the percentage of the initial request that did not qualify for the CUE nomination.
24. **Sum of CUE Nominations in Sector** - Self-explanatory.
25. **Total U.S. Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.
26. **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.
    27. **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.
    28. **Research/ Transition Plans** – Research/ Transition Plans is 'yes' when the applicant has indicated that there is research underway to test alternatives or if applicant has a plan to transition to alternatives.
    29. **Pest-free Market. Required** - 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.
30. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked
    31. **Change from Prior CUE Request**- This variable takes a '+' if the current request is larger than the previous request, a '0' if the current request is equal to the previous request, and a '-' if the current request is smaller that the previous request. If the applicant has not previously applied the word 'new' appears in this column.
    32. **Verified Historic Use/ State**- This item indicates whether the amounts requested by administrative area have been compared to records of historic use in that area.
    33. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
34. **Economic Analysis** – provides summary economic information for the applications.
    35. **Loss per 1000 m^3** – This measures the total loss per 1000 m^3 of fumigation when a specific alternative is used in place of methyl bromide. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative, such as longer time spent in the fumigation chamber. It is measured in current U.S. dollars.
    36. **Loss per Kilogram of Methyl Bromide** – This measures the total loss per kilogram of methyl bromide when it is replaced with an alternative. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars.

37. **Loss as a % of Gross revenue** – This measures the loss as a proportion of gross (total) revenue. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars.
38. **Loss as a % of Net Operating Revenue** -This measures loss as a proportion of total revenue minus operating costs. Loss comprises both the monetized value of yield loss (relative to yields obtained with methyl bromide) and any additional costs incurred through use of the alternative. It is measured in current U.S. dollars. This item is also called net cash returns.
39. **Quality/ Time/ Market Window/Yield Loss (%)** – When this measure is available it measures the sum of losses including quality losses, non-productive time, missed market windows and other yield losses when using the marginal strategy.
40. **Marginal Strategy** -This is the strategy that a particular methyl bromide user would use if not permitted to use methyl bromide.

APPENDIX D. SUMMARY OF NEW APPLICANTS

A number of new groups applied for methyl bromide for 2005 during this application cycle, as shown in the table below. Although in most cases they represent additional amounts for sectors that were already well-characterized sectors, in a few cases they comprised new sectors. Examples of the former include significant additional country (cured, uncooked) ham production; some additional request for tobacco transplant trays, and very minor amounts for pepper and eggplant production in lieu of tomato production in Michigan.

For the latter, there are two large requests: cut flower and foliage production in Florida and California ('Ornamentals') and a group of structures and process foods that we have termed 'Post-Harvest NPMA' which includes processed (generally wheat-based foods), spices and herbs, cocoa, dried milk, cheeses and small amounts of other commodities. There was also a small amount requested for field-grown tobacco.

The details of the case that there are no alternatives which are both technically and economically feasible are presented in the appropriate sector chapters, as are the requested amounts, suitably adjusted to ensure that no double-counting, growth, etc. were included and that the amount was only sufficient to cover situations (key pests, regulatory requirements, etc.) where alternatives could not be used.

The amount requested by new applicants is approximately 2.5% of the 1991 U.S. baseline, or about 1,400,000 pounds of methyl bromide, divided 40% for pre-plant uses and 60% for post-harvest needs.

The methodology for deriving the nominated amount used estimates that would result in the lowest amount of methyl bromide requested from the range produced by the analysis to ensure that adequate amounts of methyl bromide were available for critical needs. We are requesting additional methyl bromide in the amount of about 500,000 Kg, or 2% or the 1991 U.S. baseline, to provide for the additional critical needs in the pre-plant and post-harvest sector.

Applicant Name	2005 U.S. CUE Nomination (lbs)
California Cut Flower Commission	400,000
National Country Ham Association	1,172
Wayco Ham Company	39
California Date Commission	5,319
National Pest Management Association	319,369
Michigan Pepper Growers	20,904
Michigan Eggplant Growers	6,968
Burley & Dark Tobacco Growers USA - Transplant Trays	2,254
Burley & Dark Tobacco Growers USA - Field Grown	28,980
Virginia Tobacco Growers - Transplant Trays	941
Michigan Herbaceous Perennials	4,200

Ozark Country Hams	240
Nahunta Pork Center	248
American Association of Meat Processors	296,800
Total lbs	**1,087,434**
Total kgs	**493,252**