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Importation of Solid Wood Packing Material

Draft Environmental Impact Statement—October 2002

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Executive Summary

In recent years, the United States has faced an increasing threat from harmful invasive alien species (pests and pathogens) found in the solid wood packing material (SWPM) that accompanies shipments in international trade. Wooden pallets, crating, and dunnage can harbor environmentally and economically harmful species that use the wood as host material, feed upon it, or hitch a ride on it. Outbreaks of the Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky), pine shoot beetle, *Tomicus piniperda* (L.), and the emerald ash borer, *Agrilus planipennis* Fairmaire, have been traced to importations of SWPM.

After the Asian longhorned beetle infestations were traced to SWPM from China, the Animal and Plant Health Inspection Service (APHIS) promulgated two interim rules regulating solid wood packing material from China (September 18, 1998, 63 Federal Register (FR) 50099, Docket No. 98–087–1; amended December 17, 1998, 63 FR 69539, Docket No. 98–087–4). These rules (referred to below as the China Interim Rule) required all SWPM from China, including Hong Kong, to be treated with preservatives, heat treated, or fumigated prior to arrival in the United States (7 Code of Federal Regulations 319.40). Although the interceptions of invasive species in SWPM from China and Hong Kong have decreased subsequent to promulgation of the China Interim Rule, interceptions from other parts of the world continue to rise. Because of the potential for serious environmental and economic harm from the continued entry of invasive species associated with SWPM, it is clear that the United States must do something further to diminish the threat.

To further reduce the threat from SWPM, APHIS is proposing to adopt standards that have been published by the Food and Agriculture Organization of the United Nations. These phytosanitary standards are contained in the International Plant Protection Convention's (IPPC) "Guidelines for Regulating Wood Packaging Material in International Trade." The IPPC Guidelines are an attempt to provide effective, equitable, and uniform standards (prescribed treatments, certification procedures, and standardized markings) that all nations would use to mitigate the risk from wood packaging material (or SWPM, in APHIS' terminology).

This draft environmental impact statement (EIS) has been prepared to consider the potential environmental impacts of the proposal and alternatives, in accordance with the National Environmental Policy Act of 1969 (NEPA) and the Council on Environmental Quality's Regulations for

Implementing the Procedural Provisions of the National Environmental Policy Act. Alternatives considered within this draft EIS include (1) no action (no change in the current regulation), (2) extension of the treatments in the China Interim Rule to all countries, (3) adoption of the IPPC Guidelines (the preferred alternative), (4) a comprehensive risk reduction program, and (5) substitute packing materials only (prohibition of SWPM). Each alternative contains an array of component control methods.

Each alternative (including no action) has the potential for adverse environmental consequences. Generally, those consequences may be considered to be the aggregate of their individual effectivenesses (efficacies) and the direct and indirect impacts (including cumulative impacts) of their component control methods. The no action alternative would result in the greatest degree of risk from invasive species, with impacts from component control methods that would be expected to increase, as international trade increases. Extension of the treatments in the China Interim Rule to all countries would substantially reduce the pest risk from invasive species, but would have the greatest potential for adverse environmental impact from its component control methods. Adoption of the IPPC Guidelines also would provide substantial reduction of pest risk, with substantial environmental impact from its component control methods. A comprehensive risk reduction program could provide substantial reduction of pest risk, with variable impact from its component control methods, depending upon which were selected. Substitute packing materials only (prohibition of SWPM) would achieve the greatest reduction of pest risk, with the least environmental impact from its component control methods.

The potentially affected environment for this proposed action includes the United States (confronted with threats to its agricultural and environmental ecosystems), the other nations (which would sustain environmental impacts because of measures required by United States import requirements), and the Global Commons (which also could sustain environmental impacts because of measures required by United States import requirements). Of particular concern is the potential effect of increased use of the fumigant methyl bromide, a chemical that may have a role in the depletion of the atmosphere's ozone layer, which shields life on our planet from the harmful effects of ultraviolet radiation.

The rationale for proposing to adopt the IPPC Guidelines, rather than selecting one of the other alternatives, involves a number of factors. First, the serious environmental and economic threats impart a degree of urgency to this rulemaking process; although APHIS is considering a long-term strategy that will deal with the problem of SWPM in a more thorough way, an effective strategy is required to be implemented as soon as practicable. There are substantial logistical and operational barriers associated with some of the alternatives, even though they may present lesser environmental impact. Also, APHIS must work within the framework of international agreements to which the United States is a party, including the IPPC. APHIS is committed to developing regulations that reduce the threat of invasive species, yet which promote the harmonization of international regulatory efforts and the facilitation of trade. Thus, APHIS will be considering environmental, economic, scientific, and social factors in its effort to derive an appropriate and effective strategy for the regulation of imported SWPM.

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I. Purpose and Need

A. Introduction

In recent years, the United States has experienced an enormous increase in international trade. Those import shipments have been accompanied by commensurately increasing amounts of untreated solid wood packing material (SWPM) consisting of pallets, crating, and dunnage. SWPM has the potential to harbor environmentally and economically devastating invasive species that may use it as host material, feed upon it, or simply hitch a ride on it. For example, the United States has experienced introductions and costly infestations of the Asian longhorned beetle, *Anoplophora glabripennis* (Motschulsky), and pine shoot beetle, *Tomicus piniperda* (L.), that were traced to importations of SWPM. More recently, an infestation of the the emerald ash borer, *Agrilus planipennis* Fairmaire, has been found in Michigan. Between August 1995 and March 1998, 97 percent of the pests intercepted by the U.S. Department of Agriculture's Animal and Plant Health Inspection Service (APHIS) inspectors at U.S. ports and recognized as potential threats to U.S. forest resources were associated with SWPM.

Approximately 52 percent of maritime shipments and 9 percent of air shipments into the United States are accompanied by SWPM. Between 1996 and 1998, pest interceptions associated with SWPM were recorded for 64 different countries of origin. SWPM usually arrives in sealed containers and may not be listed on the shipping manifest, making it difficult for inspectors to select shipments for inspection. With containerized cargo, only 1–5 percent of the SWPM may be visible from the opening of the container. In addition, most of the pests would probably go undetected in a visual inspection, because the insect pests or plant pathogens of concern are often buried in the wood, and are unable to be readily detected, isolated, or identified upon inspection.

Because of the increased risk of pests in SWPM from China (the Asian longhorned beetle infestations were traced to that source), APHIS promulgated two interim rules regulating solid wood packing material from China (September 18, 1998, 63 Federal Register (FR) 50099, Docket No. 98–087–1; amended December 17, 1998, 63 FR 69539, Docket No. 98–087–4). These rules (referred to below as the China Interim Rule) required all SWPM from China, including Hong Kong, to be treated with preservatives, heat-treated, or fumigated prior to arrival in the United States (7 Code of Federal Regulations 319.40). Since then, in calendar years 2000 and 2001, APHIS intercepted more than 700 quarantine pest species in SWPM at 58 ports of entry. Given the enormous quantity of shipments (in the millions), the negative consequences of the introduction and establishment of invasive species, and the barriers to detecting and efficiently eradicating invasive species at the U.S. ports-of-entry, it is clear that the United States must find a more effective way of protecting its valuable resources.

A variety of methods have been proposed by exporters or government regulatory agencies to reduce the risk of invasive pests in SWPM. Those methods range from intensive inspection programs, through various kinds of controls (e.g., fumigation, heat treatment, and irradiation), to the use of substitute packing materials (prohibition of SWPM). Many of those methods are more efficacious against one type of organism than another, and no single method (with the exception of substitute packing materials, if hitch-hiking pests are not included) appears capable of eliminating the risk from all types of invasive pests. Some of the materials available for control, such as methyl bromide used in fumigations, are believed to be associated with environmental degradation, and their uses are diminishing. Finally, there are a number of issues that must be considered, along with the potential environmental effects of the SWPM alternatives before a regulatory strategy may be developed; these include (1) foremost, the efficacy of the alternative in mitigating risk; (2) the relative costs of the alternatives/methods; (3) the differing capabilities of exporting nations to comply with quarantine requirements; and (4) the need for harmonization of regulatory efforts among trading partner nations.

The United States is not alone in its recognition of and concern for the risk from imported SWPM. The International Plant Protection Convention (IPPC), under the Food and Agriculture Organization of the United Nations, as a part of its “International Standards for Phytosanitary Measures,” has published “Guidelines for Regulating Wood Packaging Material in International Trade” (referred to hereafter as the IPPC Guidelines). The IPPC Guidelines are an attempt to provide effective, equitable, and uniform standards (prescribed treatments, certification procedures, and standardized markings) that all nations would use to mitigate the risk from wood packing material (or SWPM, in APHIS’ terminology). As a signatory to the IPPC, the United States had input into the development of the IPPC Guidelines and would be expected to support/adopt them.

B. Purpose and Need for Action

APHIS is required by virtue of its mission and statutory responsibilities to take action to minimize the potential risk and resultant damage from foreign invasive species to agricultural, forest, and environmental resources of the United States. Accordingly, APHIS is considering alternatives for mitigating, to the extent feasible, the risk associated with the importation into the United States of SWPM. Because of the nature and severity of the risk from SWPM, APHIS is proposing to adopt the IPPC Guidelines while it considers a more long-term and permanent solution to the SWPM problem.

This environmental impact statement (EIS) analyzes concisely and in a broad fashion the alternatives for the mitigation of pest risk from SWPM, including APHIS' preferred alternative, Adoption of the IPPC Guidelines. It has been prepared to satisfy the requirements of the National Environmental Policy Act of 1969 (NEPA), 42 United States Code (U.S.C.) 4321, *et seq*. This EIS also is intended to comply with the requirements of Executive Order 12114, "Environmental Effects Abroad of Major Federal Actions."

APHIS' authority to exclude, eradicate and/or control invasive alien agricultural pests is based on Title IV–Plant Protection Act, 7 U.S.C. 7701 *et seq*., which authorizes the Secretary of Agriculture to take measures to prevent the dissemination of a plant pest that is new to or not known to be widely prevalent or distributed within or throughout the United States. APHIS has been delegated authority to administer this statute and has promulgated Foreign Quarantine Regulations, 7 Code of Federal Regulations (CFR) 319, which regulate the import of commodities.

C. Scope and Focus of the Environmental Impact Statement

APHIS conducted scoping for the EIS between the period August 9, 2002, to September 9, 2002. Oral and written comments received during the scoping period were considered fully by APHIS in the planning of the EIS. Potential issues identified by APHIS at the outset included: new treatment methods, logistical considerations, environmental regulations and constraints, and harmonization of regulatory efforts. The organizational scope of the EIS involves a broad range of program alternatives, many with arrays of component mitigation methods. Refer to section 2 for a more detailed discussion of the alternatives. The geographical scope of the EIS includes the entire world, in that regulatory treatments (with potential environmental impacts) are being proposed for the importation of SWPM from all nations of the world. Refer to section 3 for a concise discussion of the affected environment.

This EIS is intended to serve as a preliminary tool, to be used along with other resources, for the development of an effective strategy for the mitigation of risk from SWPM. Such a strategy is necessary because of the severity of the risk from SWPM and the corresponding need for prompt action. Despite the urgency for action, the proposed strategy has the capacity for substantial adverse environmental impacts and thus requires appropriate, comprehensive analysis. Then too, the nature of international trade is such that industry will require substantial lead time before any new restrictions may be enforced—great numbers of shipments will be in transit already and additional treatment requirements likely would require the purchase and installation of new equipment, on a broad scale. It may seem paradoxical, therefore, that APHIS must develop the new restrictions at an accelerated rate, but must wait an extended period of time before they can be implemented and enforced.

Because there is an immediate need for this rulemaking, APHIS is proposing the adoption of the IPPC Guidelines while it deliberates separately on a long-term and permanent regulatory strategy for SWPM. The framework of need is reflected in this unusually concise and subjective EIS. This EIS uses a subjective comparison of the potential impacts of the alternatives, rather than intensive and exhaustive individual analyses of the alternatives. Such a concise and subjective comparison appears more suitable for this rulemaking than an intensive and exhaustive treatment of the alternatives. That is because the absolute quantification of impacts is of lesser importance than the basic need to rank the alternatives relative to their anticipated impacts, so that an informed decision may be made from them. The important thing is to make sure that an equitable and efficacious solution is provided in a timely fashion to the other nations of the world.

While it is reasonably possible to compare and contrast the environmental affects of some of the alternatives (especially those which have been implemented previously by APHIS), it is more difficult, if not impossible at this time, to identify the array of methods which might be employed within a hypothetical comprehensive regulatory strategy, or to predict the proportional use of those methods by the world's SWPM exporting nations. For example, such a regulatory strategy might allow various options for compliance, depending upon such factors as the individual nations' economic status, technological capabilities, and internal policies (especially with respect to pesticide uses). For that reason, it is impossible to predict with certainty the impacts of such an alternative, and much of the analysis of impacts will fall within the realm of “incomplete and unavailable information,” as defined by NEPA. To the extent possible, as where it might be surmised that a single method might be used for the policy (e.g., substitute packing materials), a reasonable prediction of cumulative impacts has been made.

APHIS will consider this EIS and other relevant resources (including associated assessments cited within the EIS) for the development, proposal, and implementation of its strategy for the mitigation of risk from SWPM. In addition, it will fully consider relevant guidance such as the IPPC Guidelines, as well as the North American Plant Protection Organization’s “Import Requirements for Wood Dunnage and Other Wood Packing Materials into a NAPPO Member Country.” APHIS intends, within a separate environmental and rulemaking process subsequent to this one, to develop, propose, and implement a final and permanent strategy for the mitigation of risk from SWPM.

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II. Alternatives

A. Introduction

The Animal and Plant Health Inspection Service (APHIS) analyzed a range of alternatives and their associated component methods in this environmental impact statement (EIS). The alternatives are broad in scope, and represent alternate means for mitigating the risk of pests and pathogens from the importation of solid wood packing material (SWPM). The alternatives include: (1) no action (no change in the current regulation), (2) extension of the treatments in the China Interim Rule to all countries, (3) adoption of the IPPC Guidelines, (4) a comprehensive risk reduction program, and (5) substitute packing materials only (prohibition of SWPM). Each of the alternatives consists of specific component methods for the mitigation of risk from SWPM.

The alternatives represent the most definable choices for further regulatory action by APHIS. They have been framed in a way that facilitates the identification and consideration of specific issues and the choices that will need to be made by APHIS decisionmakers. Additional alternatives could be designed (and may be recommended by interested parties) by varying the mixture of component methods, but there are too many possible combinations to consider all of those individually within the context of this EIS. We have taken the best approach that we can conceive, and that is to identify one of the alternatives (alternative 3, the comprehensive risk reduction program) to be analyzed as representative of various methods used in combination.

The alternatives and individual component risk mitigation methods have varying degrees of efficacy, and all have the potential to cause adverse environmental consequences. Each of the alternatives is described within this section. The component risk mitigation methods are both described and analyzed within this section, as well. Section 4, "Environmental Consequences," considers the potential efficacies of the alternatives, estimates the direct and indirect effects of their component control methods, and integrates the efficacy information with the potential effects of the component control methods to provide a summary of aggregate consequences for each alternative. Refer to table 2–1, which follows, for a tabular listing of the alternatives and their component methods.

Table 2–1. Alternatives and Their Component Methods

Alternatives	Methods							
	Inspection	Heat treatment	Fumigants	Wood preservatives	Irradiation	Controlled atmosphere	Substitute packing materials	Disposal
1. No Action	•	•[1]	•[1]	•[1]				
2. Extension of China Interim Rule	•	•	•	•				
3. Adoption of IPPC Guidelines	•	•	•					
4. Comprehensive Risk Reduction	•	•	•	•	•	•	•	•
5. Substitute Packing Materials Only (Prohibition of SWPM)	•						•	

[1] For China and Hong Kong only.

B. Alternatives Described

Analysis has determined that there are potential environmental consequences for each of the alternatives. Those consequences vary in intensity for each of the alternatives, with the degree of protection they offer from pests and pathogens associated with SWPM, and with the inherent environmental consequences of their component methods. Lack of adequate protection would result in risk to the environment, our agricultural resources, and our economy. Environmental consequences may also result from the use of methods to control plant pests and pathogens, especially the use of chemical methods.

The environmental consequences of efforts to reduce risk from SWPM may be predicted generally and in a comparative fashion, but cannot be quantified with absolute confidence because of many uncertainties regarding: (1) proportional uses of available methods, (2) the degree of compliance to be attained following the implementation of regulatory changes, (3) fluctuations in trade, and (4) changes in pests' prevalence in their countries of origin. Ultimately, this EIS has been designed to make optimum use of the information available at the time of its preparation to first assess the anticipated impacts of the methods, subsequently make inferences regarding the combinations of methods most likely to be used within the individual alternatives, and eventually compare and contrast those alternatives with regard to their potential impacts.

1. No Action (No Change in the Current Regulation)

The No Action alternative is characterized as no change in the existing regulations regarding the importation of SWPM. At the time of writing, the importation of SWPM is regulated under 7 Code of Federal Regulations (CFR) 319.40, "Logs, Lumber, and Other Unmanufactured Wood Articles." Under 7 CFR 319.40, SWPM is defined as ". . .wood packing materials, other than loose wood packing materials, used or for use with cargo to prevent damage, including, but not limited to, dunnage, crating, pallets, packing blocks, drums, cases, and skids." The regulation does not restrict packing materials made of synthetic or highly processed wood materials (e.g., plywood, oriented strand board, particle board, corrugated paperboard, plastic and resin composites).

APHIS had issued a general permit for the importation of SWPM providing that it is free of bark, and appropriately certified. However, because of the increased risk of pests from China, the China Interim Rule placed additional restrictions on China. SWPM from China or Hong Kong is now required to be heat treated, fumigated, or treated with preservatives, and certified prior to being exported from China or Hong Kong. Thus, the current regulation has two sets of import requirements—one that applies to China and Hong Kong, and another for the rest of the world.

With no change in the regulation, there would be no additional reduction in the pest risk from the introduction of pests and pathogens associated with SWPM. However, that pest risk, the adverse environmental consequences associated with treatments (e.g., environmental degradation and human health risks from use of preservatives and fumigants), and the use of resources would be expected to increase proportionally with the increase in world trade. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

2. Extend Treatments in China Interim Rule to All Countries

This alternative would require all SWPM from all foreign origins to be heat treated, fumigated, or treated with preservatives, and certified prior to being exported from their countries of origin (or exporting countries). It would apply the same SWPM importation requirements that are in the China Interim Rule to all countries of the world.

If this alternative were implemented, there would be a further reduction in the pest risk from the introduction of pests and pathogens associated with SWPM and a commensurate increase in the adverse environmental consequences associated with treatments and the use of resources. The pest risk and adverse environmental consequences associated with treatments and the use of resources could be expected to increase proportionally with any increase in world trade. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

The adoption of this alternative would result in substantial reduction in risk of introduction of pests and pathogens from SWPM. However, it would result in the greatest level of anticipated adverse environmental consequences from component methods because (1) it would require treatments of SWPM from all countries, (2) it would result in the greatest use of methyl bromide, and (3) it would continue to increase the demand for forest products. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

3. Adoption of the IPPC Guidelines (Proposed Alternative)

The International Plant Protection Convention (IPPC) dates back to 1952, and is aimed at promoting international cooperation to control and prevent the spread of harmful plant pests. The signing of the 1995 World Trade Organization Agreement on the Application of Sanitary and Phytosanitary Measures Agreement (SPS agreement) placed more rigorous requirements on international phytosanitary regulations. Phytosanitary regulations are those regulations of imported and exported commodities for the purpose of protecting plant health. These regulations may be enforced domestically by individual countries, regionally by groups of countries, or world-wide based on an international agreement. The SPS agreement indicated that all countries are to base their phytosanitary measures on relevant standards, guidelines, and recommendations developed under the auspices of the IPPC.

If this alternative were implemented, APHIS would adopt the International Plant Protection Convention’s “Guidelines for Regulating Wood Packaging Material in International Trade” (IPPC Guidelines). Adoption of the IPPC Guidelines would mean that SWPM from all countries would be required to be heat treated (to a minimum wood core temperature of 56 °C for a minimum of 30 minutes) or fumigated with methyl bromide (treatment schedule per the IPPC Guidelines), and then marked to show that it has been treated.

The adoption of the IPPC Guidelines would result in substantial reduction in risk of introduction of pests and pathogens from SWPM. Next to Alternative 2 (Extend Treatments of the China Interim Rule to All Countries), this alternative would result in the greatest level of anticipated adverse environmental consequences from component methods because (1) it would require treatments of SWPM from all countries, (2) it would result in substantial use of methyl bromide, and (3) it would continue to increase the demand for forest products. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

4. Comprehensive Risk Reduction Program

The Comprehensive Risk Reduction Program alternative is a hypothetical risk mitigation strategy that could involve various options for complying with United States import requirements. Our concept of such a program is that it would consist of an array of approved mitigation methods that is more extensive than that contained in either the China Interim Rule or the IPPC Guidelines. In such a program, the complete array of methods might be available to all nations who export to the United States, or different combinations of methods might be allowed for various countries, depending upon the countries' economic and technological capabilities, and their pest status.

Component risk mitigation methods that could be applied in this program differ greatly from one to another in respect to their capability to mitigate pest and disease risk. For example, increased inspection appears to afford the least degree of protection from risk, while selective prohibition (substitute packing materials) seems to afford the greatest degree of protection from risk. The approval of methods for such an array would be based upon the degree of protection from pests and pathogens that would be acceptable to APHIS. That necessary degree of protection might be attained from the sole use of one of the analyzed component methods, or from a combination of component methods.

It is not likely that different combinations of methods would be required of various countries, based upon the prevalence of pests within those countries—a determinative process to support such a practice would be herculean in scope and would not be scientifically or economically practical. For this alternative to be practical and worthy of detailed consideration by APHIS, the array of approved treatments for this alternative would have to be available equally to all countries.

The most likely effect of the selection of this alternative and the implementation of an as yet undefined (but effective) array of control methods would be a reduction of pest risk and an increasing level of adverse environmental consequences and use of resources, commensurate with the increase in world trade. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

5. Substitute Packing Materials Only (Prohibition of SWPM)

Requiring the use of substitute packing materials only equates to prohibiting the importation of SWPM from all countries. Countries could use any of the substances that are not restricted under the SWPM regulation (plywood, oriented strand board, particle board, corrugated paperboard, plastic and resin composites) as substitutes for SWPM, or use other materials that are not capable of being hosts for pest or disease organisms (e.g., metal, rubber, or fiberglass).

Prohibition of SWPM would achieve the greatest possible reduction in risk from the introduction of pests and pathogens associated with SWPM—***if no SWPM were imported, there could not be any harmful organisms imported with it.*** This alternative also would achieve the greatest reduction of adverse environmental consequences from the use of control methods (chemical and/or physical). It would result in diminished use of wood resources, but could result in increased use of other resources (e.g., ores for metal production and petroleum for plastics) and energy for manufacturing processes. Refer to section 4 for a discussion on the anticipated aggregate impacts of this alternative.

C. Component Methods Evaluated

A variety of component methods for reducing the risk of importation of agricultural pests and pathogens associated with SWPM were analyzed for this EIS. The methods vary widely with respect to their efficacies (their capacities to reduce pest and disease risk), their effect on the human environment (human health, nontarget species, and the physical environment), and their effect on the conservation of natural resources.

Methods may have nonpermanent or permanent characteristics. Non-permanent methods such as fumigation may eliminate pests or pathogens in SWPM prior to its use, but are incapable of providing protection against reinfestation by those organisms subsequent to treatment. Permanent methods such as chemical preservatives may eliminate pests or pathogens in SWPM at the time of treatment and prevent reinfestation for long periods following treatment.

It is anticipated that some exporters will prefer to do treatments of containerized cargo that contains SWPM, thereby providing disinfestation of the cargo as well as the SWPM. This presents a number of issues and regulatory concerns over potential environmental effects on the cargo or on its consumption. Compliance with tolerances for food items would then become a part of the consideration of efficacy for treatments such as fumigation.

1. Inspection

a. Description

Inspection involves the visual examination of SWPM in shipments. This may include de-vanning cargo, some destructive examination of pallets or packing material, and submission of specimens to entomologist or pathologist identifiers. Currently, a representative percentage of SWPM is inspected on the United States borders. The primary intent of inspection is to ensure compliance with the regulations.

The serious adverse consequences associated with noncompliance have resulted in an APHIS policy that provides a strong deterrent. APHIS keeps importers and shippers informed of the penalties from inadequate compliance. Importers or shippers are subject to civil penalties, criminal fines, jail sentences, and losses of revenue for failure to follow regulations. APHIS issues permits, executes compliance agreements, and rejects commodities that do not comply with regulatory requirements. APHIS has the option to refuse entry, require treatment, or require destruction of the SWPM. All of these options are costly to the shipping line and exporter (costs may be passed on to importers), who must assume all costs for the delays and any treatments. Thus, there are strong incentives for full compliance with SWPM regulations.

b. Anticipated Consequences

Monitoring of inspections of SWPM from China and Hong Kong following enforcement of the interim rule in 1998 revealed that proper compliance with the requirements for SWPM were met approximately 98 percent of the time. Based upon that, one could expect live insects in 0.1 to 0.2 percent of the shipments, lack of treatment in 0.7 to 0.9 percent of the shipments, and incorrect treatments for 0.05 to 0.2 percent of the shipments. Closer inspection of shipments from sources with previous inadequate or non-compliance has been shown to increase likelihood to detect cargo with increased pest risks. Using this cargo information, inspection rates for SWPM by inspectors could be set statistically to meet a desired level of compliance that maximizes exclusion and minimizes the likelihood of plant pest introduction. However, in the absence of any treatment requirements, the frequency of infested SWPM would be anticipated to remain much higher and to pose pest risks that inspection efforts alone could neither contain nor exclude.

Recommendations have been made to APHIS to increase the level of inspection (quantity and intensity of inspections) for SWPM. To increase the level of inspection, especially up to 100 percent inspection, would require substantially more resources and would impede the movement of shipments. The intensity of inspections could also be increased if port personnel were trained in new diagnostic procedures and spent more time on each shipment. APHIS could increase user fees in an amount sufficient to support additional personnel and more intensive inspection of SWPM. However, the amount of material to inspect and the ever-increasing levels of commerce would tend to make increased inspection an expensive and difficult proposition. Inspection alone (even increased inspection) would not diminish the risk of pests and pathogens associated with SWPM, because some control method still would have to be applied to destroy the pests and/or pathogens that are detected.

The ability of inspection to exclude pests could be greatly enhanced by requiring additional documentation for each shipment. The use of certification markings of wood required under the IPPC Guidelines for SWPM would provide evidence of proper compliance. Based upon similar documentation for all SWPM to that for cargo manifests from China, one could selectively inspect only those shipments for which the likelihood of quarantine pest infestation in SWPM is elevated.

2. Heat Treatment

a. Description

Heat treatment appears to be a viable method for eliminating pests and pathogens in wood and unmanufactured wood products. The efficacy of heat treatment is dependant upon the time and temperature, as well as humidity, of the treatment. Heat treatment with moisture (water or steam) kills pest and disease organisms by coagulating or denaturing the proteins, particularly enzymes. Heat treatment with moisture reduction (kiln drying) relies primarily on an oxidation process, generally using dry heat to reduce the wood's moisture content to 20 percent or less, to kill pest and disease organisms.

Heat treatment standards (required to ensure the efficacy of the treatments) are provided in 7 CFR 319.40–7, which also requires inspection of the heat treatment facilities by the national government of the country where the facilities are located. APHIS' heat treatment requirements now require the core of each regulated article to be raised to at least 71.1 °C and maintained at that temperature for at least 75 minutes. By contrast, the IPPC Guidelines require a treatment protocol that is somewhat less—56 °C for at least 30 minutes. Heat treatment with moisture reduction is required to reduce the moisture content of the regulated article to 20 percent or less as measured by an electrical conductivity meter.

b. Anticipated Consequences

The environmental impacts of heat treatments relate primarily to the type of heat source that is used. In all cases, the heat from individual treatments is released to the atmosphere and dissipates readily with no anticipated long-term or cumulative effects on global temperatures. Expansion of the frequency of heat treatments to cover pest risks from other parts of the world is not likely to add substantially to the global heat load. However, an additional issue relates to the source of heating for treatments. Heating the SWPM in a compartment may be achieved by an electrical apparatus or by fossil fuel combustion. The amount of emissions released from fossil fuel combustion or generation of electricity for the treatment of SWPM would be far less than the amount released from transportation sources or the generation of electricity for public consumption. All of these releases of carbon dioxide and hydrocarbons from fuel combustion do contribute to global warming. Although no quantitative assessment has analyzed the amount of exhaust gases contributed by quarantine heat treatments, the amounts are relatively low compared to other sources of carbon dioxide and hydrocarbon emissions.

The cost of heat treatment is generally greater than the cost of fumigation with methyl bromide. The costs associated with construction of heat treatment facilities and the use of fossil energy sources to fuel them usually exceed the costs for fumigation (which is frequently done under tarps). Expenses associated with treatment of SWPM are an external cost that shippers desire to minimize. Heat treatment is usually done only for high quality wood and for specific needs that justify the higher treatment costs. Because exporters and shippers try to minimize costs associated with SWPM, there is a strong tendency to prefer methyl bromide fumigation to heat treatment. The low demand for heat treatment facilities and the high costs to set them up have resulted in few of the facilities being built. Based upon these cost factors, it is anticipated that heat treatment will not expand greatly with the continuing availability of less expensive alternate methods. The frequency of heat treatment of SWPM is expected to remain low under all of the alternatives that could include this method. The amount of heat and associated gas emissions with heat treatments is less under the IPPC alternative than under an extension of the China interim rule. The amount associated with a comprehensive pest risk reduction program would depend upon the degree to which heat treatment would be employed. Based upon the limited usage of heat treatment of SWPM and low projected cumulative future usages, heat treatment emissions are not expected to contribute substantially to global warming.

3. Fumigants

a. Description

Fumigation uses chemical gases to kill pest organisms found on or within wood and wood products. The fumigants considered in depth for this EIS include carbonyl sulfide, methyl bromide, phosphine, and sulfuryl fluoride. APHIS is reviewing data and research on the use of other fumigants, but efficacy and environmental data are lacking on the others, and they are not ready for serious consideration. The fumigants analyzed vary considerably in their efficacies, and their effectiveness appears to be enhanced when administered at higher temperatures. The fumigants show varying degrees of effectiveness on pests and pathogens that can be found in SWPM, such as longhorned beetles, powder-post beetles, drywood termites, and fungi. There are a number of environmental considerations associated with the use of fumigants, including human health hazards from toxic gases, potential damage to the Earth's protective ozone layer, and damage to some of the commodities that SWPM support in shipments.

(1) Carbonyl Sulfide

Carbonyl sulphide (COS) is a naturally occurring gas that is emitted to the atmosphere from volcanic activity, some combustion processes, and various natural decomposition processes (in marshes, soil, and forests). It is the most common form of sulphur in the atmosphere. It occurs at low levels in many foodstuffs including cheese, grains, and seeds. It is a common byproduct of various industrial combustion processes and of recovery boiler processing of wood pulp.

The use of COS as a fumigant was patented in Australia in 1992. Applications as a fumigant are applied in a manner similar to methyl bromide or phosphine from gas canisters. Tests have shown that it will control a wide range of pests, such as beetles, fruit flies, moths, mites, termites, molds, and nematodes. It has shown good efficacy in tests of grains, legumes, dried fruit, cut flowers, and both hard and soft timbers.

Although carbonyl sulfide shows promise in controlling pests on certain commodities (especially stored products), its efficacy on wood products at commercial application levels has not been conclusively demonstrated, particularly for insect pests and fungi of quarantine significance. Any future decisions by APHIS to allow use of COS to treat SWPM for quarantine certification must be based upon its efficacy against these quarantine pests.

Carbonyl sulfide is a toxic, flammable gas that presents acute inhalation danger to humans. It may cause narcotic effects, and irritate eyes and skin.

It has not undergone a complete evaluation and determination by EPA, and data concerning its effects are incomplete.

(2) Methyl Bromide

Methyl bromide (or bromomethane), one of the oldest fumigants, has good penetration properties and is effective against most insects and against fungi. It has been used to fumigate agricultural commodities, grain elevators, mills, ships, clothes, furniture, and greenhouses. The regulation under 7 CFR 319.40–7 requires the fumigated articles and ambient air to be at 5 °C or above throughout fumigation. Specific treatment requirements may be found in schedules T–312 and T–404 of APHIS' Plant Protection and Quarantine (PPQ) Treatment Manual (USDA, APHIS, 1998a). The IPPC Guidelines require a treatment protocol that is somewhat less stringent.

Although methyl bromide has been used a long time as a fumigant and is known to be highly effective, there are a number of environmental concerns regarding its use. Methyl bromide is a highly toxic compound in EPA Toxicity Class I. It is a Restricted Use Pesticide (may be purchased and used only by certified applicators) and its labels must bear the Signal Word "DANGER." It has been identified as an ozone-depleting substance under the terms of the Montreal Protocol and Clean Air Act. The United States Environmental Protection Agency (EPA) is phasing it out of production and use in the United States, except for quarantine and preshipment uses, and critical use exemptions. Methyl bromide has other detrimental qualities, including adverse effects on commodities conveyed by SWPM, such as leather and some varieties of fresh produce.

Methyl bromide is currently being used by APHIS for the fumigation of SWPM and some commodities. Its future use is subject to further regulations and changing perspectives on its environmental impact.

(3) Phosphine

Phosphine (also known as phosphane, hydrogen phosphide, or phosphorus hydride) is one of the most toxic fumigants known. It is also an industrial gas used in silicon chip manufacture. Phosphine is applied as a fumigant to commodities either from gas cylinders or released by off-gassing from loose solid sources. The solid sources of phosphine are aluminum phosphide or magnesium phosphide, which may be packaged as tablets, pellets, prepacks, in bags, or on plates. High humidity is needed to generate the gas from solid sources. Phosphine is a colorless gas with a garlic-like odor. It is highly penetrative to many commodities, but has somewhat limited penetration of wood. Phosphine gas is produced naturally at low concentrations by decomposition in swamps and sewers.

As a fumigant, phosphine is widely used to kill insects in stored products. It is used in low concentrations, but because it is less effective than other fumigants, must be used in treatments that have long exposure periods. High humidity is needed to generate the gas and temperatures above 4.4 °C are required for satisfactory results. Wood regulation requirements in 7 CFR 319.40–7 do not provide minimum treatment conditions for phosphine. Phosphine is highly flammable when in direct contact with liquid (especially water), and is highly penetrative to many commodities. Phosphine formulations are Restricted Use Pesticides because of their acute inhalation toxicity. Phosphine is in EPA Toxicity Class I and its product labels must bear the Signal Word "DANGER."

APHIS has removed phosphine treatment from its PPQ Treatment Manual. Efficacy tests showed the schedule for this fumigant was not effective, so it was removed until additional testing can be completed.

(4) Sulfuryl Fluoride

Sulfuryl fluoride (most common trade name–Vikane) is a colorless, odorless, nonflammable compressed-gas fumigant that was developed in the late 1950's as a structural fumigant, primarily for termite control. It is widely used in structures, vehicles, and wood products against a wide range of pests, including: dry wood termites, wood infesting beetles, other insects, and rodents. Sulfuryl fluoride is considered to have excellent penetrability for wood (USDA, APHIS, 1991), with dosages similar to those used for methyl bromide. Treatment requirements in 7 CFR 319.40–7 provide no minimum treatment standard for sulfuryl fluoride. Specific treatment requirements may be found in schedules T404(b)(2) and T404(b)(3) of the PPQ Treatment Manual.

Sulfuryl fluoride is less reactive than methyl bromide and produces no objectionable colors or odors to treated commodities. This fumigant also is effective against other major insect pests of timber such as bark beetles, wood-wasps, longhorn beetles, and powderpost beetles (UNEP, 1998). However, the eggs of many insects are tolerant to even high concentrations of sulfuryl fluoride (USDA, APHIS, 1991). Sulfuryl fluoride is no longer approved by APHIS as a treatment for wood boring beetles because it has difficulty in penetrating insect eggs; many insect eggs still hatch following fumigation. Sulfuryl fluoride treatment should be considered only for hitchhikers and surface feeders, or for brood-tending species of insects such as termites, bees, wasps, and ants (because even if all the eggs are not killed, the hatching larvae will die anyway because of lack of care). This limited use pattern for sulfuryl fluoride minimizes the possible applications for SWPM, which is often infested with wood-boring beetles.

All formulations of sulfuryl fluoride are registered as Restricted Use Pesticides and bear the Signal Word "DANGER" on their labels because of inhalation danger. Sulfuryl fluoride is EPA Toxicity Class I—highly toxic. Sulfuryl fluoride is less reactive than methyl bromide, penetrates wood easily, is non-corrosive, and produces no objectionable color or odor in treated materials. There are no labeled uses of sulfuryl fluoride on food or feed crops.

(5) Other Fumigants

A number of other fumigants are being studied with relation to their efficacy and environmental consequences as wood product treatments. These include, but are not limited to, methyl iodide, chloropicrin, metam sodium, propargyl bromide, iodinate hydrocarbons, and propylene oxide. These products have varying properties and undetermined environmental consequences, and are not considered ready for implementation at this time.

b. Anticipated Consequences

(1) Carbonyl Sulfide

COS is a colorless gas with rotting egg odor. COS breaks down quickly and has extremely low residue levels. The rapid degradation ensures that bioaccumulation will not occur in living organisms or soil. One of the degradation products, hydrogen sulfide, is extremely toxic. It has minimal effect on durable commodities. It can corrode copper in the presence of contamination with hydrogen sulfide, but commercial fumigations can be made with pure enough COS to prevent this. It can also be corrosive under moist conditions and direct exposure to water should be avoided. COS is flammable and potential ignition sources should be kept away from the fumigation stack during an application.

Although COS produces a rotting egg odor that warns of its presence, the concentrated nature of gas in fumigation chambers can quickly overwhelm any person with inadequate protective gear. The required protective gear and safety precautions for COS fumigations are comparable to other fumigations. The required use of self-contained breathing apparatus for any workers or supervising authorities within the restricted fumigation area prevents potential adverse respiratory and systemic effects. COS can cause depression and damage to the central nervous system with inadequate personal protection (BOC Gases Australia Limited, 2000). Excess breathing of COS results in formation of hydrogen sulphide in the lungs and adsorption into the blood stream. This lack of protection can lead to asphyxiation in fatalities, but none of these effects should occur with adherence to proper safety precautions.

COS can cause skin and eye irritation and cold burns from evaporating liquid, but proper handling of gas cylinders by applicators precludes this exposure. Inhalation of COS at low concentrations causes marked dryness and irritation of the nose and throat. This should be minimized by adherence to entry restrictions within the fumigation area. Inhalation of higher concentrations can cause a temporary loss of smell, severe irritation, headache, nausea, vomiting, and dizziness (BOC Gases Australia Limited, 2000). Narcotic effects associated with these higher exposures are precluded by required safety precautions. A complete evaluation of potential health and environmental risks of COS has not been completed by EPA.

(2) Methyl Bromide

Methyl bromide is one of the oldest and most widely used fumigants for phytosanitary purposes. This fumigant has a long history of use for treatment of logs and other wood articles because of the chemical's high volatility, ability to penetrate most materials, and broad toxicity against a wide variety of plant pests (all life stages of insects, mites, ticks, nematodes including cysts, snails, slugs, and fungi such as oak wilt fungus) (USDA, APHIS, 1991). Currently, APHIS uses only methyl bromide as an authorized fumigant for SWPM and requires its use only on a limited basis (i.e., SWPM from China).

Penetration of methyl bromide into wood is inversely proportional to the moisture content of the article and therefore, it does not penetrate as well into wood with high moisture content (e.g., green logs). Radial diffusion (against the grain) is many times slower than longitudinal diffusion (along the grain) and therefore, penetration to the center of the wood will not occur as readily as along the length of the log (Michelson, 1964). Cross (1992) found that, in practice, it is difficult to achieve insecticidal doses much beyond a depth of 100 millimeters in green materials using conventional tent fumigation techniques. The removal of bark has been found to facilitate the penetration of the fumigant into the wood (Ricard *et al.*, 1968). A test shipment from New Zealand was fumigated in early 1992 and found to be infested with a blue stain fungus upon arrival in the United States (USDA, FS, 1992). The efficacy data of methyl bromide for many pests and pathogens do not exist (USDA, APHIS, 2000). Although methyl bromide may not be effective against all organisms in wood, agency review of the efficacy of methyl bromide fumigations against pests and diseases in SWPM has been found acceptable for two treatments listed in the APHIS' PPQ Treatment Manual (USDA, APHIS, 1998a).

Methyl bromide is three times heavier than air and diffuses outward and downward readily from the point of release. The release of methyl bromide from a cylinder requires a volatilizer to heat the liquid form of the methyl bromide released from the cylinder to a gaseous state. Fan circulation is required to ensure even distribution and penetration of the methyl bromide within the fumigation chamber or fumigation stack. Monitoring at given intervals throughout the fumigation is necessary to ensure that efficacious concentrations of methyl bromide remain during the required treatment period. After the treatment period, the gas is vented from the treatment chamber to the surrounding atmosphere or, in some cases, can be recaptured with methyl bromide extraction devices. Although residual methyl bromide may be trapped in or bind to treated commodities, the majority of methyl bromide from a fumigation remains as free gas in the fumigation chamber. The amount of methyl bromide vented from a fumigation chamber may vary from 69 to 79 percent of the total applied (UNEP, MBTOC, 1998). Methyl bromide in the atmosphere readily degrades to bromine gas. Methyl bromide residues (bromine) in the stratosphere have a half-life of 1.6 years or less (Mix, 1992).

Methyl bromide is produced naturally by processes in the ocean (Singh *et al.*, 1983; Sturges and Harrison, 1986). Bromine and methyl bromide occur naturally in soils, plants, and food. A level of 50 parts per million (ppm) in humans is considered normal (Hayes and Laws, 1991). Methyl bromide is readily degraded and bioaccumulation in natural systems and living organisms is not expected from any exposures to fumigant from phytosanitary treatments. The removal of bromine and methyl bromide from the atmosphere by oceanic processes and uptake by soils serves as a substantial sink to these compounds (NOAA *et al.*, 1998).

Human health effects from methyl bromide have been described in detail in a chemical background statement prepared for APHIS (LAI, 1992). That document is incorporated by reference into this EIS and the more important information is summarized here.

The mechanism of intoxication of methyl bromide targets several organs including liver, kidneys, adrenals, lungs, thymus, heart and brains (Medinsky *et al.*, 1985; Eustis *et al.*, 1988). Methyl bromide is an alkylating agent, a substance that deactivates enzymes and disrupts nucleic acid synthesis. The actual biochemical mechanism remains unclear, but may be related to irreversible inhibition of sulfylhydryl enzymes (Hayes and Laws, 1991). The central nervous system is the primary focus of toxic effects of methyl bromide (Honma *et al.*, 1985).

Methyl bromide is an odorless, acutely toxic vapor that is readily absorbed through the lungs by inhalation. The reference concentration derived by EPA for general population exposure to methyl bromide was determined to be 0.48 mg/m^3 (EPA, 1992). The American Conference of Governmental Industrial Hygienists (ACGIH, 1990) has established an exposure standard (Threshold Limit Value) of 5 ppm (20 mg/m^3) of methyl bromide for unprotected workers against potential adverse neurotoxic and pulmonary effects. After venting of the fumigation chamber, entry without protective gear is not permitted until methyl bromide concentrations are at least as low as 5 ppm. Other potential routes of exposure are through ingestion and contact with eyes or skin. Most recorded injuries from methyl bromide exposure are the result of fumigation of residential and commercial structures for pests. Preventing acute exposures to methyl bromide is the primary concern. However, the half-life of methyl bromide in human blood is approximately 12 days and as a result, its toxic effects may be delayed and prolonged. With this extended half-life, multiple exposures to methyl bromide from inadequate personal protection can result in cumulative effects to health.

Symptoms of excessive exposure to methyl bromide include headaches, dizziness, nausea, chest and abdominal pain, dry throat, slurred speech, blurred vision, temporary blindness, mental confusion, and sweating. More severe symptoms include lung swelling; hemorrhaging of the brain, heart, and spleen; and severe kidney damage. Fatalities to methyl bromide are generally the result of respiratory failure. Contact with the liquid can cause skin burns and skin irritation, but this exposure can be prevented by proper handling of the gas cylinders. Access within the stack barrier zone during regulatory fumigations is limited to certified personnel wearing self-contained breathing apparatus. Use of proper protective gear in this zone is required until the ambient air concentrations of methyl bromide decrease to 5 ppm or less during aeration. Adherence to required safety precautions and proper protective clothing as described in the PPQ Treatment Manual (USDA, APHIS, 1998a) preclude these acute adverse effects to humans.

Some chronic and subchronic effects have been determined for ongoing, elevated exposures to methyl bromide. A NOEL for neurotoxicity was determined to be 55 ppm for 36 week exposure to rodents (Anger *et al.*, 1981). Oncogenicity was negative for rats exposed for 29 months at concentrations up to 90 ppm (EPA, OPP, 1990). Mutagenic potential of methyl bromide is considered to be low by most researchers (Hayes and Laws, 1991). Reproductive and developmental toxicity effects have been observed at higher exposures than would be expected from program fumigations. The maternal NOEL for rats was determined to be 30 ppm and the fetotoxic NOEL was determined to be 3 ppm for constant exposure to methyl bromide (EPA, OPP, 1990). Adherence of workers to required safety precautions and proper protective clothing precludes any adverse chronic health effects.

The toxicity of methyl bromide depends on the exposed organism's respiration rate. Temperature (of air and commodity) is a factor in the organism's respiration rate. A lower temperature lowers the organism's respiration rate, which decreases the susceptibility to the toxicity from methyl bromide. Thus, methyl bromide is most effective against target organisms when the temperature is warm. Fumigants, such as methyl bromide, used to treat commodities such as wood are designed to kill organisms present in the commodity. Other organisms such as wildlife and domestic animals that do not have access to the fumigation chamber are not expected to be adversely affected by fumigations. The aeration vent from a fumigation stack or chamber may regularly release gas at a specific location, which could affect those organisms immediately below the vent. However, methyl bromide gas is anticipated to disperse quickly and few organisms would be expected to reside in close enough proximity to the off-gassing vent to be adversely affected. Most fumigation facilities and stacks are placed on physically disturbed sites that are not preferred habitat for wildlife.

The primary environmental issue related to the potential use of methyl bromide as a fumigant is its capacity to contribute to ozone layer depletion in the global stratosphere. The 1987 Montreal Protocol on Substances That Deplete the Ozone Layer is an international agreement designed to reduce and eventually eliminate the emissions of man-made ozone-depleting substances. The Montreal Protocol lists methyl bromide as a regulated ozone-depleting substance under Article 2H. The current best estimate of the ozone depletion potential of methyl bromide is 0.4 (NOAA *et al.*, 1998). The United States has signed the Protocol and ratified all amendments except the 1997 Montreal amendments. Phaseout requirements for methyl bromide under the Montreal Protocol mirror those recently set by the EPA under the Clean Air Act (EPA, 1999). Title VI of the Clean Air Act requires that all compounds with an ozone depletion potential of 0.2 or greater be phased out in the United States by the year 2005. Based upon their review of known ozone depletion potential, the EPA has classified methyl bromide as a class I ozone-depleting chemical.

The Montreal Protocol maintains an exemption to the phaseout requirements on methyl bromide for quarantine and preshipment uses (QPS). This exempts phaseout of required fumigation uses against regulated pests of SWPM. The intent of this Protocol, however, is to phase out these use patterns or promote the development of effective alternative quarantine treatments, where possible.

The environmental consequences of the cumulative effects of all quarantine uses of methyl bromide were discussed in considerable detail in a previous EIS (USDA, APHIS, 2000). The content and findings of that EIS, as related to potential impacts of methyl bromide quarantine use on ozone depletion from this program, are incorporated by reference into this document and summarized here.

To understand the potential environmental impacts, it is necessary to first consider the function of the stratospheric ozone layer. A primary function of the ozone layer in the stratosphere (a part of the Earth's atmosphere existing between 15 and 35 kilometers above the surface) is to prevent the penetration of ultraviolet (UV) radiation through the atmosphere to the Earth's surface. Releases of halogens such as methyl bromide at the Earth's surface take up to 6 years lag time to fully spread to the stratosphere (NOAA *et al.*, 1998). Ozone is a compound consisting of three connected oxygen atoms. The ozone layer provides the greatest protection from the harmful effects of exposure to UV-B, a specific category of ultraviolet radiation. Depletion of the ozone layer over Europe and North America reached 6 to 7 percent during the summer/autumn seasons and 12 to 13 percent during the winter/spring seasons of 1998 (NOAA *et al.*, 1998). This level of atmospheric ozone loss resulted in an estimated 8 to 15 percent increase in the amount of UV radiation reaching the surface of the Earth, with other influencing factors like clouds and pollution being constant (Bell *et al.*, 1996). Exposure to UV-B radiation can cause conditions ranging from minor sunburn to more severe effects such as snowblindness (the formation of temporary cataracts resulting from sunburn within the eye) and destruction of DNA within cells. Exposure to UV-B radiation has been identified as a major factor in the incidence of various types of cancers (UNEP, 1998; Bell *et al.*, 1996). The effects vary with the amount of radiation, the exposure duration, and the exposure frequency. In addition to human health effects, the increased UV-B exposure associated with ozone depletion has adverse impacts to the health of plants and animals. The productivity of agriculture, forestry, and fisheries could be expected to diminish with excess exposure to UV-B (Bell *et al.*, 1996). The physical environment can be affected by increased production of pollutants in smog from the increased UV and more rapid degradation of polymers and related materials used in construction (Bell *et al.*, 1996).

To assess the potential impacts from methyl bromide use on ozone depletion, it is necessary to understand the impact of the current usage on stratospheric ozone levels. Methyl bromide is only one of a number of substances that react with ozone in the atmosphere. The sum of all global production of methyl bromide has been determined to contribute 1 percent to the overall annual stratospheric ozone depletion (NOAA *et al.*, 1998). The primary substances responsible for stratospheric ozone depletion are various chlorofluorocarbons (CFCs) and the regulatory phaseout of the use of CFCs is associated with much greater decreases in stratospheric ozone depletion than could occur with the phaseout of methyl bromide. CFCs have long half-lives in the atmosphere (80 to 100 years), but methyl bromide has a half-life in the stratosphere of only 1.6 years or less (Mix, 1992). The calculated annual global consumption (anthropogenic use) of methyl bromide in 1996 amounted to 63,960 metric tons (MT) (UNEP, 1998). Of this, the United States consumption of methyl bromide accounts for about 33 percent of the total.

Many of the current uses of methyl bromide are being eliminated as part of the mandatory phaseout required to comply with the Montreal Protocol and Clean Air Act. The QPS uses of methyl bromide are not required to be phased out and these usages account for only 28 percent of all uses of methyl bromide worldwide (Thomas, 1999). The comparable QPS usage for consumption in the United States is about 9 percent of the total methyl bromide used (Thomas, 1999). Based upon the anticipated phaseout of the other uses of methyl bromide, continuing QPS uses would contribute about 0.3 percent to annual stratospheric ozone depletion (assuming no reductions in contributions from CFCs or other ozone-depleting substances). The current QPS uses of methyl bromide are expected to continue until economical alternatives are developed to satisfy the pest elimination requirements. Most of the anticipated new commodities that could require fumigation (other than SWPM) are expected to need only small quantities of methyl bromide which, when vented following fumigation, would not result in any substantial cumulative contribution to ozone depletion. Although the frequency of fumigations of SWPM with methyl bromide would be expected to increase under the No Action alternative commensurately with the anticipated increases in number of shipments associated with the increasing trade, the increases in trade have greatly exceeded the expansion of inspection services and actual increases in fumigations due to pest detection in SWPM have been negligible. The only noteworthy recent increase in fumigations with methyl bromide attributed to SWPM relates to the compliance of China with the interim rule regulating SWPM from there. Based upon review of imports records by the Customs Service of the U.S. Department of the Treasury, a risk analysis of ozone depletion potential was prepared for the proposed interim rule for SWPM from China (USDA, APHIS, 1998b). This analysis applied conservative assumptions that from 70 to 100 percent of the cargo packed in SWPM would be fumigated with methyl bromide and that from 80 to 100 percent of the methyl bromide used in fumigations would be released to the atmosphere. The calculated potential usage of methyl bromide resulting from the interim rule was determined to range from 1,040 to 12,565 MT annually. This was determined to constitute a 1.6 to 19 percent increase in annual industrial release of methyl bromide to the atmosphere. Actual methyl bromide non-QPS usage data from China indicate a decrease from 3,267 MT in 1998 to 2,664 MT in 1999 (EPA, 2002a). Although data are not available for QPS usage in China by year, the decrease in non-QPS usage to comply with the Montreal Protocol would partially cover any increases in QPS usage that have occurred. The actual QPS usage is probably considerably less than anticipated from the risk analysis due to the conservative overestimation of the actual amount of SWPM used in cargo and the assumption that heat treatment and other substitute packing materials would not be used. China has used these other methods for shipments and this has lowered the need for methyl bromide treatments.

(3) Phosphine

Unlike other fumigants, phosphine fumigations are of extended duration (3 to 5 days). Like methyl bromide, gas concentrations must be monitored during the fumigation period and good penetration of the phosphine is needed throughout the commodity being treated. Phosphine generated from metallic phosphides is produced slowly and even exposure to phosphine gas from uneven release makes effective treatment difficult. After fumigation of foods and feeds with aluminum phosphide, aeration of commodities requires 48 hours to ensure that residue tolerances are not exceeded. Decomposition of phosphine gas requires 3 to 5 days. This period is much shorter in moist areas or on acidic soils. Other than the phosphine gas released to the commodities from phosphine solids, there are solid aluminum and magnesium hydroxides left. These solids occur naturally in soil and their environmental degradation is not an issue of concern.

Although phosphine has been used to treat wood products in the past, recent efficacy research indicates that it is ineffective against many wood pests and pathogens. Accordingly, the approved treatments of wood with phosphine have been removed from the PPQ Treatment Manual.

Additional testing is underway to determine whether phosphine treatments can be used effectively for any particular wood or for treatment against specific wood pests from certain parts of the world.

The potential primary hazard to human health from wood applications occurs from inhalation exposure to the phosphine gas. Phosphine is not readily adsorbed by the dermal route and proper aeration eliminates residual phosphine on the treated commodity. Phosphine has been placed in category I (highest toxicity category) because of extreme inhalation toxicity from phosphine gas. Acute toxic effects to humans may include fatigue, weakness, nose bleeds, ringing in the ears, nausea, vomiting, chest pressure, stomach upset, diarrhea, thirst, difficulty breathing, liver damage, kidney damage, nervous disorders, and fluid build-up in the lungs (Hayes and Laws, 1991). The maximum annual exposure to hydrogen phosphide (worst case situation) from fumigations was estimated to be exposure to 0 to 10 ppm over a total of 200 hours (Fumigation Service & Supply Inc., 1986). EPA reviewed potential exposure of applicators and concluded that no adverse effects to humans would be expected if precautionary labeling requirements are observed (EPA, OPP, 1985). This review indicated that no adverse acute effects, chronic effects, carcinogenicity, genotoxicity, mutagenicity, and reproductive and developmental toxicity are anticipated with proper safety precautions. The Occupational Safety and Health Administration standard for an 8-hour workday limits the average concentration (time-weighted average) of phosphine in the working area to 0.3 ppm or less (Sullivan and Krieger, 1992). EPA has set a re-entry level without respiratory protection of 0.1 ppm.

(4) Sulfuryl Fluoride

Sulfuryl fluoride is applied as a gas from pressurized cylinders. It is highly phytotoxic to plants and exposure to living plants should be avoided. The gas dissipates readily in the atmosphere and proper aeration following fumigation is required. The rapid dissipation ensures that all potential exposures are acute. It is a gaseous fluoride that may react with ozone and concerns related to stratospheric ozone depletion should be carefully considered if widespread use of this chemical were anticipated. The limited efficacy relative to insect eggs makes potential use of this fumigant minimal. In addition, sulfuryl fluoride is not registered in many countries (UNEP, MBTOC, 1998) and fumigation with sulfuryl fluoride is more expensive than with methyl bromide (Schmidt, 1996). There are no labeled uses of sulfuryl fluoride on food or feed crops.

Sulfuryl fluoride is a highly toxic fumigant. Contact with the liquid may cause irritation, freezing, and burning of eyes, skin, and mucus membranes. Inhalation may be fatal. Slowed movement, reduced awareness, and slow or garbled speech are possible delayed symptoms of sublethal exposures. Early symptoms of excess exposure are respiratory irritation, pulmonary edema, nausea, central nervous system depression, and abdominal pain (Sine, 1990). Negative test results have been noted for mutagenic and genotoxic testing. Adherence to proper safety precautions and use of proper protective gear preclude any adverse effects to humans from any fumigations with sulfuryl fluoride.

(5) Other Fumigants

A number of other fumigants are either available or being developed for use on wood products. These include, but are not limited to, methyl iodide, chloropicrin, metam sodium, propargyl bromide, iodinate hydrocarbons, and propylene oxide. Some of these chemicals have various adverse effects to commodities, logistical limitations on facility requirements for delivery of fumigant, inadequate efficacy against pests for certain treatments, and other characteristics or properties that limit their usefulness to APHIS programs to treat wood products. None of these fumigants is expected to be ready for implementation within the foreseeable future. A thorough assessment of the environmental consequences of their use in this program at this time would not provide adequate information to assist in a meaningful decision about use potential. Should development of any of these fumigants show promise, their potential will be assessed and environmental documentation prepared to address any potential impacts foreseen from the anticipated use patterns.

4. Wood Preservatives

a. Description

Wood preservative treatments involve the application of chemicals to SWPM to eliminate pests or diseases, to prevent infestation (the most common usage), or to preclude further reinfestation. Although used primarily against wood-decaying fungi, the chemicals and application methods may vary, depending upon the target pests, the wood species, and the length of time the treatment must remain effective. The chemicals are applied through direct treatment of the surface of the wood, through dipping of the wood in a tank, or through the use of pressure treatments to increase penetration into the wood. This method is permitted as part of the recent regulation of SWPM from China, but wood preservatives are not widely used for treating SWPM.

For surface treatments, 7 CFR 319.40–7 authorizes the use of all EPA-registered surface pesticide treatments for regulated articles imported into the United States. Those chemicals that are reported to be commonly used as wood preservatives and have a reasonable likelihood of being used are listed in table 2–2.

Table 2–2. Chemicals Commonly Used as Wood Preservatives or Surface Treatments

Creosote
Waterborne Preservatives: • Acid copper chromate • Chromated zinc chloride • Alkyl ammonium compound • Inorganic boron • Ammoniacal copper quat
Oil-borne Preservatives: • Pentachlorophenol • Copper naphthenate • Solubilized copper-8-quinolinolate • Bis(tri-–butyltin) oxide • Alkyl ammonium compound
Other Surface Active Pesticide Treatments: • Cypermethrin • Fenvalerate • Permethrin

Nonpressure treatment involves brushing, spraying, dipping, or soaking the wood in the chemical preservative to create a thin protective layer at the wood surface. The material may penetrate the wood to some extent by the capillary action of the wood's cellular structure. Preservatives in use include copper-8-quinolinolate, copper naphthenate, 3-iodo-2-propynyl butyl carbamate, didecyldimethyl ammonium chloride, propiconazole, tebuconazole, carbendazim, chlorpyrifos, and boron. Borate has been used to protect lumber from decay, fungi, and beetles during shipments, but it does not appear to be effective against all life stages of insects and against some fungi.

Pressure treatment involves applying a preservative under combinations of vacuum or pressure to force the chemical more deeply into the wood. Such treatments are used for long-term protection because of their advantages of better quality and uniformity of treatment and the creation of a thicker chemical barrier. Water-based preservatives include chromated copper arsenate (CCA), copper azole, ammoniacal copper quaternary, copper citrate, ammoniacal copper zinc arsenate (ACZA), and boron. Oil-based preservatives include creosote, pentachlorophenol, copper naphthenate, and copper-8-quinolinolate. Creosote, which has been one of the more commonly used pressure preservatives, protects against fungi, insects, and bacteria.

b. Anticipated Consequences

The chemicals acceptable for treatment of SWPM are limited to those that are registered by the EPA for this intended use. A large number of pesticide products are registered for use on wood. A complete list may be accessed from EPA's online Pesticide Product Information System at the following Internet address: (http://www.epa.gov/opppmsd1/PPISdata/). The available wood preservative chemicals, however, are subject to change as EPA review of technical information results in changes in the regulations. As of 1993, 73 percent of the use of wood preservatives consisted of inorganic arsenicals and the remaining 27 percent consisted of creosote solutions, oil-borne systems, fire retardants, and limited use of surface treatments (Barnes and Murphy, 1995).

EPA recently (February 12, 2002) announced its decision to eliminate many uses of chromated copper arsenate (CCA), one of the most common wood preservatives applied by pressure treatment (EPA, 2002b). The decision was based primarily upon results of a human health risk assessment and voluntary concurrence of the manufacturer with the early health findings. The health risks associated with other registered wood preservative treatments are anticipated to continue to result in decisions to discontinue various applications in the United States. Many of the SWPM treated with pesticides and preservatives commonly used in other countries but not registered by EPA for use in the United States will not be permitted entry to the United States. The anticipated lack of available preservative treatments for wood is expected to limit this potential treatment option in the near future.

Surface treatments are generally not applied to SWPM to eliminate plant pests, because these applications do not generally penetrate wood deeply enough to affect insects and pathogens in the interior. Surface treatments have been used to protect wood against reinfestation after heat treatment or fumigation, but these surface treatments need to be applied within 48 hours of the initial heat treatment or fumigation. This provides a barrier to infestation, however, the effectiveness of such a chemical barrier often decreases substantially after 30 days without further prophylactic treatment.

Unlike surface applications of pesticides, nonpressure preservative treatments may penetrate 1/8- to 1/4-inch into the wood. Nonpressure treatment consists of brushing, spraying, dipping, or soaking the wood in a treatment solution at atmospheric pressure to create a thin, protective layer at the wood surface (Morrell, 2001a, 2001b). Woods from some tree species such as red oak and many pines are highly permeable, but wood from larch and white oak can not be adequately treated with preservatives (Morrell, 2001a). As with surface treatments, the protective residue dissipates over time and could require additional treatment at 3- to 6-month intervals (Morrell, 1996a).

Pressure treatment involves applying a preservative using combinations of vacuum and pressure to force the chemical more deeply into the wood (Morrell, 2001b). Applying the preservatives by pressure treatments increases the penetration into the wood, but may also negatively alter the wood properties and may decrease commercial value. The pressure treatment of wood is commonly used for products exposed to weather or in contact with the ground (i.e., posts, pilings, poles, and railroad ties). The sapwood of most species is relatively easy to pressure treat, but the heartwood of most species is virtually impossible to penetrate (Morrell, 2001b). Both nonpressure and pressure treatments of wood with greater than 60 percent moisture content result in highly variable penetration and may not provide consistent preservation (Morrell, 2001b).

Pesticides and preservatives are approved by EPA for specific uses on specific wood articles contingent on the ultimate use and destination of the article. Although EPA has great concern for human health risks from residential uses, it is increasing restrictions on industrial uses (including SWPM) of high risk chemicals, such as CCA, previously described. Pesticides and preservatives must be used according to current label instructions. The product label provides exact language detailing application directions, including any use restrictions or special precautions. This includes required protective gear for applications and proper disposal of wastes. Amended label information was published in the Federal Register (51 FR 1334, January 10, 1986) for the three major wood preservative chemicals: pentachlorophenol, creosote, and the inorganic arsenicals. As noted above, most uses of the arsenicals have undergone intense scrutiny and are no longer available.

Creosote is the oldest wood preservative and protects wood against attack by fungi, insects, and bacteria. Wood treated with creosote has a useful life at least five times longer than untreated wood. Pressure treatment with creosote is the application of choice for wood used in railroad ties. Human health issues associated with potential exposure to creosote have resulted in EPA decisions to impose additional exposure reduction measures (EPA, 1984) and to amend label restrictions (EPA, 1986). Several chemical substances present in creosote are known to have moderate carcinogenic potential. Disposal of creosote-treated wood in a lined landfill presents no environmental problems (Morrell, 2001b), but disposal by burning of such wood produces toxic gases and ash that pose a risk of adverse human health effects. The environmental consequences for disposal of other pressure preservative treatments, particularly the oil-borne preservatives are similar.

Boron and borate treatments have been used to protect lumber from decay, fungi, and beetles during shipment (Amburgey, 1996). Unlike most preservative treatments, borate treatments work best when the wood is kept moist during the diffusion period (Barnes and Murphy, 1995). Borate is not able to penetrate less permeable species (Morrell, 1996a). Although borates are effective at protecting wood from beetles, termites, and brown-rot decay fungi, growth of mold fungi and soft-rot decay fungi is not prevented. Treatments of wood with some water-borne preservatives such as borates do not immobilize the chemical and the compound may leach out of the wood, particularly when moist.

The surface treatments are limited primarily to those pests present on the wood surface. As previously mentioned, these applications serve best as a secondary treatment to provide a barrier to reinfestation after heat treatment or fumigation. The residual action of these compounds is of limited duration (perhaps 30 days), so this protection of the wood is temporary. Many of the surface treatments are conventional pesticides associated with various toxicity issues. The three surface treatment chemicals listed in table 2-2 are synthetic pyrethroid insecticides. Their mode of toxic action is through effects on the sodium channel to stimulate nerves to produce repetitive discharges. Muscle contractions are sustained until a block of the contractions occurs. Nerve paralysis occurs at high levels of exposure (Walker and Keith, 1992). Exposure to handlers of SWPM during the period of residual toxicity of such compounds is an issue of concern. Although dermal toxicity of humans to these compounds may be slight, continual or ongoing exposure to these substances can result in elevated exposures. Residual exposures could also be an issue for use of some other preservative treatments such as creosote and pentachlorophenol.

5. Irradiation

There are three types of irradiation treatment that have been studied for use on SWPM. These are gamma irradiation, electron beam irradiation, and microwave irradiation. Irradiation works by exposing organisms to lethal quantities of energy. Insects would be more affected than fungi by irradiation methods. The relative efficacies, costs, and logistics of irradiation treatment have not yet been determined, and there are no regulations that specify the conditions or minimum standards for irradiation treatment of SWPM.

Irradiation is being developed by several organizations for phytosanitary applications. Guidelines have been developed for the use of irradiation as a phytosanitary treatment including information on policies, procedures, and requirements for the proper conduct of treatments and consistent maintenance of operations between agencies and countries (NAPPO, 1997). APHIS proposed the use of irradiation as an additional regulatory treatment method for phytosanitary certification of some agricultural commodities (61 FR 24433, May 15, 1996) and prepared an environmental assessment (EA) to analyze the potential environmental impacts of that proposal (USDA, APHIS, 1997). Although the treatment process is similar to that considered for SWPM, the agricultural commodities considered in the EA required dosages that are considerably lower than would be efficacious for wood. Unlike the exposures considered in the EA, including the unique radiolytic products that could be consumed orally, the only potential source of exposure for SWPM treatments would be from stray radiation at the facilities—primarily a concern for workers. The amount of stray radiation would be expected to increase commensurate with the higher dosages for treating wood and any increase in the number of treatments. There have been no more recent advances in developing treatment facilities that would be logistically and economically feasible for treating SWPM. Until this issue is resolved to the satisfaction of the industry, irradiation treatments are unlikely to be considered seriously by manufacturers of SWPM.

a. Description

(1) Gamma Irradiation

Gamma irradiation as a treatment involves exposing the SWPM in an enclosed chamber to the radiation emitted from a radioactive isotope such as cobalt-60 or cesium-137. It has been used to sterilize or kill certain pest species primarily in commodities other than wood. It is most often used to disinfect or disinfest food products, pharmaceuticals, and medical devices. With irradiation, a target dose and exposure time that will destroy the target organisms are sought. Previous programs have considered irradiation treatment only on a case-by-case basis for each facility or commodity use pattern. Irradiation has not been shown to be effective against a wide range of pests (UNEP, 1998). Fungi are known to be more tolerant of irradiation than insects (Morrell, 1996a). Lethal doses of gamma irradiation to adult ambrosia beetles were determined to range from 73 to 130 krad (USDA, APHIS, 1991). Research was conducted in Russia to support a generic dose for treating logs (Huettel, 1996). This research suggested that a dose of 7 kiloGrays (kGy) is sufficient to cause 100 percent mortality in insects, fungi, and nematodes in logs. A science review panel was established to assess the potential of this work, but these lethal doses are too high to provide an economically practical treatment method (Eichholz *et al.*, 1991; Dwinell, 1996).

(2) Electron Beam Irradiation

Electron beam irradiation is similar to gamma irradiation except that the source of radiation is electrons generated by a machine rather than by radioactive isotopes. Data on the efficacy of this treatment against insect pests and pathogens is quite limited. Agriculture Canada is examining the feasibility of this treatment against the New World pinewood nematode and wood-stain fungi. Obstacles to the use of this method are similar to those for gamma irradiation. Limited information is available about the cost and logistics of setting up treatment facilities. Very little documentation of efficacy against insect pests and pathogens prevent its practical employment for this purpose.

(3) Microwave Irradiation

The use of microwaves as a treatment method involves exposing wood to ultra-high frequency magnetic fields, which elevate the temperature of any material containing moisture. When exposed to microwaves, dry wood has low dielectric properties and remains cool, but insects in the wood are heated to lethal temperatures. Microwave irradiation may be regarded as a future heat treatment technology, but requires further research before it can be considered a feasible or economic method. Microwave studies performed by Burdette (1976) showed that total mortality to anobiid beetles (one type of powderpost beetle) in wood blocks treated with 1500 watts of power at 50 °C. Similar studies with other insects in wood have been efficacious (Thomas and White, 1959; Hightower *et al.*, 1974). However, fungi may not be as susceptible as insects to microwave exposure, especially in wood with a high moisture content such as green wood (USDA, APHIS, 1991).

b. Anticipated Consequences

(1) Gamma Irradiation

Exposures to high levels of gamma irradiation are known to make paper and fiberboard become brittle. The effects of exposure to gamma irradiation on the wood quality of SWPM is uncertain. This issue may not be important for most wood packing materials, but the overall strength of wood is important to protect the cargo being transported. Although there may be structural changes in the wood quality, irradiation does not change the overall appearance of the wood (Morrell, 1996a).

An environmental assessment (EA) prepared by the U.S. Department of Health and Human Services' Food and Drug Administration (FDA) determined that no adverse environmental effects are anticipated at food processing plants that are designed to irradiate fruits and vegetables (FDA, 1982). The Nuclear Regulatory Commission (NRC) has set stringent environmental protection requirements for any facilities that use radionuclide sources (10 CFR Parts 20, 30, 51, and 71). In addition, there are special carrier requirements for transport of radionuclides set by the U.S. Department of Transportation. Any extraneous radiation emitted from radionuclides is required to be contained within facilities by shielding, as required by the NRC and the Bureau of Radiological Health at FDA. Any irradiation equipment would be designed to release radiation to the SWPM only. Monitoring of radiation at quarantine treatment facilities has demonstrated ambient background radiation levels at property boundaries. The treated wood does not retain any radioactivity from the exposure. Irradiation equipment and levels at approved facilities are checked on a regular basis by the USDA Radiation Safety Staff in accordance with standards set by the NRC. No problems have been associated with the use of irradiation equipment under APHIS permits.

(2) Electron Beam Irradiation

There is very little information available on the efficacy and the potential consequences of electron beam irradiation. Most probably, the principal concern would be for the safety of the treatment personnel and those in proximity with the irradiation equipment. Irradiation equipment would need to be properly designed and constructed, with shielding that is adequate to protect personnel from high voltages and incidental radiation.

(3) Microwave Irradiation

Among the unresolved issues regarding the use of microwaves for wood treatment are the ability of the microwaves to penetrate wood, the effectiveness of microwaves against fungi, and the ability to construct adequate treatment facilities given the large electrical power requirements for this method. Although microwaves control pests on the surface of wood, the depth of penetration of microwaves is low and may not reach borers, particularly in dense pieces of SWPM. The external costs involved in producing the high electrical power requirements to attain sufficient microwave energy to kill wood pathogens may exceed the market value of the commodity being transported. Until adequate efficacy data are available and large treatment facilities are built, the use of microwaves as a risk mitigation method for SWPM can only be viewed as experimental.

6. Controlled Atmosphere

a. Description

Controlled atmosphere is a technique that involves changing the relative concentrations of gases (oxygen, nitrogen, and carbon dioxide) in the atmospheres of enclosures to kill pests within commodities. It frequently involves the use of low oxygen levels (anoxia) and elevated carbon dioxide and nitrogen levels to suffocate pests. Controlled atmosphere is a standard technique for the post-harvest treatment of fruits, vegetables, and stored grains; it can be combined with other methods, including cold treatment and heat treatment, to enhance efficacy for those commodities. Controlled atmosphere appears to be a viable method for disinfesting agricultural produce and commodities that are associated with SWPM. However, its efficacy against deep wood borers and pathogens is relatively untested. APHIS has no approved controlled atmosphere treatment schedule for SWPM and is only beginning to research its potential for SWPM. Controlled atmosphere is not known to be approved for quarantine use by any country.

b. Anticipated Consequences

Although controlled atmosphere treatments are very effective for protection of fresh fruit and grains from damage due to surface pests, there are no studies indicating good control of pests of wood either internally or externally. It is theoretically possible that wood borers or other important wood pests could be eliminated by controlled atmosphere treatment, but this would have to involve long-term control. Many of the wood pests are accustomed to living in low oxygen environment and the long time required for sufficient displacement of oxygen in the wood make this an unlikely option for routine commercial treatments. Use of this method to treat wood products needs considerable research before it could be considered. Implementation of controlled atmosphere treatments of wood is not expected for any quarantine applications in the foreseeable future, but development of this technology could provide information to assist in a meaningful decision if methods indicate any promising results.

7. Substitute Packing Materials

a. Description

Substitute packing materials would use other materials (e.g., plywood, oriented strand board, particle board, metal, plastic, rubber, or fiberglass) that are not regulated be used as substitutes for SWPM. For our purposes within this EIS, this component method differs from the previously described broader Alternative 5 in that this component could be implemented as one component of an alternative, as a part of a broader program that included other treatment methods as well. In other words, it would not be implemented as the sole means of mitigating risk from SWPM.

b. Anticipated Consequences

Selectively requiring substitute materials would achieve varying degrees of risk reduction, depending upon how it was applied. Generally, there would be substantially decreased risk from the introduction of pest organisms, diminished use of some resources (wood), and increased use of other resources (ores for metal production and petroleum for plastics)—depending upon the proportional use of this alternative in an overall risk reduction strategy.

The potential environmental consequences of the use of substitute packing materials would vary according to what packing materials are used. Other-than-wood packing materials pose substantially less pest and disease risk than SWPM. Substitute packing materials made of synthetic or highly processed wood such as plywood, oriented strand board, particle board, corrugated paperboard, or plastic and resin composites, generally are not subject to infestation by wood pests or diseases. Although some wood pests may infest plywood and other processed wood packing materials, the frequency of reinfestation of treated or processed wood is known to be low and is unlikely to pose substantial risk of new pest introductions (Dwinell, 2001; Burgess, 2001). Although all packing materials occasionally harbor hitchhiking insects and surface pests, the biologically inert materials used in substitute packing materials are less likely to harbor such pests.

At present, the market for shipping pallets is dominated by SWPM, which constitutes about 95 percent of the total. SWPM are used in association with 6,000,000 containers that are transported annually in international trade. The capability of industry to tool up to manufacture and switch to substitute packing materials for such a shipping volume may limit the feasibility or implementation of a switch over. Substitute packing materials are more expensive than SWPM. Also, although some substitute packing materials show great promise (i.e., corrugated pallets), there may be limitations on their use and they may require a phase-in period to allow the industry to adapt these materials to the shipping processes.

Plastics presently constitute a small percentage of the market share, and their use has been limited by the lack of a standard pallet size and the requirement for a closed loop system that is not yet feasible to the pallet industry. Packing methods such as slipsheets (flat, solid, fibre sheets with load-bearing area used as a platform for unitizing, handling, storing, and shipping of commodities) are inexpensive, but require a special push-pull attachment for forklifts that is expensive and not easily adaptable to present practices. Corrugated pallets constitute about 2 percent of the current market and could be expanded to as much as 10 percent in the foreseeable future. Plywood and oriented strand board pallets make up about 2 percent of the market share and are useful packing for heavy loads, but these materials are heavy and cumbersome for transport of many commodities. Some packing materials such as particle board are limited in their ability to withstand the conditions that routinely occur during transport.

Inspection under this method would be limited to checking paperwork and verifying that no SWPM was being used. In the event that SWPM was found to be used, the decision could be made to treat the SWPM, deny entry of the shipment (re-export), or eliminate pest risk from the SWPM through destruction by incineration or deep landfill (6 feet or deeper). This non-compliance probably would occur infrequently due to the resultant costly delays in deliveries, noncompliance fines, and related complications for the shipper. The substitute packing materials alternative would considerably reduce inspection efforts and would largely eliminate pest risks from wood-feeding insects and diseases.

There are environmental concerns relating to the manufacture of substitute packing materials. Some substitute materials would still require the harvesting of wood, and resins or plastics may be required to seal and protect wood surfaces. The particulates from cutting and drilling wood products are generally limited to manufacturing workplace areas. The curing of these resins and plastics release volatile organic contaminants to the air. These vapors are generally of short duration in the air and of negligible impact, but may contribute to local air quality problems. The manufacture of packing materials made exclusively of metal, plastic, and various other processed materials would result in the use of unreplenishable natural resources (metal ores and petroleum) with resultant adverse environmental consequences, additional demands on energy resources, and problems associated with disposal of manufacturing materials.

In conclusion, the prohibition of SWPM and the requirement to switch to substitute packing materials would result in substantially less pest and disease risk than any of the other components considered in this EIS. The cost of production of substitute materials would be greater than that of SWPM, but many of the substitutes are more durable and more recyclable.

The manufacturing processes and uses of raw resources probably would pose negligible environmental effects, and would be offset by the decrease in pest risk and the substantial environmental benefits resulting from a reduced demand on raw wood products (depending upon the substitute materials that would be utilized; substantial use of processed wood may result in little difference in resource use).

8. Disposal

a. Description

Disposal would involve the destruction of SWPM through approved incineration or burial processes. The great amount of SWPM being imported into the United States would make the disposal of all of it unfeasible, so it is likely that the method could only be implemented in combination with other control methods as part of a combined or comprehensive risk mitigation strategy. Disposal would be costly and probably less effective than many of the other component methods.

b. Anticipated Consequences

Although incineration or burial could substantially reduce pest risk, those processes still could result in the release of pest organisms, from improper handling, before or during the course of transportation, incineration, or burial actions. Any disposal activities would need to be conducted by contractor organizations, because of APHIS' limited resources, and could have limited security, depending upon APHIS' ability to monitor operations.

Incineration poses an array of problems, including the low number of approved incinerator facilities, the prohibitions on certain types of burning, the requirements for permits, and the collateral emission of pollutants like carbon dioxide and hydrocarbons. Burial would also pose a number of problems, including a continued pest risk (many insects that burrow through wood are also capable of burrowing through soil), the lack of approved landfill facilities, and the substantial costs of burying the SWPM. Finally, APHIS considers disposal of SWPM to be the least preferred of all the methods, because the action would take place within the United States and the United States would still incur a substantial pest risk.

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III. Affected Environment

A. The United States

The environment of the United States that could be affected by new regulations for SWPM includes the human population, nontarget species, and the physical environment—land (including forests), air, and water resources. That environment may be affected in two ways by new regulations for SWPM: first, by the degree to which the regulations meet their objective of protecting forest resources; and second, by the degree to which any required control methods impact environmental components.

Humans and human health may be affected by increased or decreased use of forest resources that are used not only for the production of SWPM, but which are important sources of construction materials, are used as buffers, and are used for ornamental and esthetic purposes. An increasing human population (the U.S. Census projects a U.S. population of 282,798,000 by 2003) will result in greater land use and a corresponding demand for forest products in the coming years. Human health could be affected by some of the required control methods, including fumigation with methyl bromide which has been associated with destruction of the atmospheric ozone layer which protects the earth from harmful ultraviolet radiation. Humans also could be affected by other methods as well, including controlled atmosphere, chemical preservatives, or irradiation, if protective measures were not adequate. In addition, manufacturing processes for some packing materials (wood and substitute) could result in exposures to particulates and gases from forming or curing raw materials.

Nontarget species, especially wildlife which use forest resources for food, habitat, and cover, could be affected by changes in forest resources—the availability, diversity, or quantity of those resources. For example, the loss of forest resources and critical habitat has been associated with impacts to endangered species such as the red-cockaded woodpecker, *Picoides (=Dendrocopus) borealis*, and the northern spotted owl, *Strix occidentalis caurina*. Also, nontarget species could be impacted by the establishment of foreign pests or diseases in U.S. forests, or by the reduction of those forests for the production of forest products, including SWPM. The required control methods largely preclude exposures to nontarget species and their habitats are unlikely to be affected by potential treatments.

Land, air, and water also may be affected by the control methods that are employed for SWPM. Although treatments generally would be required to be done outside of the United States, there could be indirect, transboundary effects on the physical environment of the United States from the foreign use of fumigants or wood preservatives, or disruption of United States land resulting from approved disposal methods. Although the IPPC Guidelines would not obligate U.S. manufacturers to treat SWPM, other countries which adopt the IPPC Guidelines would require compliance with the guidelines if the SWPM were to be exported to those countries. Also, to the extent that new regulations may promote the increased harvesting of forest resources, some water contamination and land erosion could result.

B. Other Nations and the Global Commons

The environments (the human population, nontarget species, and the physical environment) of the other nations and the global commons (Antarctica, the high seas and deep seabed, the atmosphere, and outer space) also may be affected by changes in regulations for SWPM. In general, those effects probably would be more pronounced in other nations, because the SWPM treatments are required to be accomplished and certified in the exporting countries, rather than in the United States. Also, the effects may be exacerbated in some underdeveloped countries where forest resources are not plentiful, but where there is substantial economic advantage to the exportation of manufactured products—hence greater incentive to use SWPM.

Human health may be at greater risk in countries where adequate safeguards or protection measures do not exist for treatment methods or manufacturing processes for packing materials. Cultural or educational disadvantages, or problems with communication in some countries also could result in the inability to recognize health risks associated with treatment methods. Government infrastructure may not exist to provide adequate safeguards for workers and the public who may be affected by fumigation, or other kinds of treatments.

Nontarget species, and especially endangered species, could face great risks from the loss of cover and habitat resulting from the exploitation of forest resources. The individual species' status, diminishing forest resources, and lack of adequate government infrastructure to promote the conservation of endangered species, could combine to result in substantial risk to the endangered species of other countries.

Some of the SWPM treatment methods and packing material manufacturing processes would have the potential for contamination and adverse impacts on the physical environment of the other countries and the global commons. In particular, the use of methyl bromide in fumigations could result in damage to the stratospheric ozone layer and contribute to increased ultraviolet radiation received over large areas of the earth. These transboundary effects would not necessarily be felt in the country that employed the treatment methods, but could be manifested on multiple other countries or areas that are not under the specific control of any sovereign nation.

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IV. Environmental Consequences

All of the alternatives have potential consequences to the human environment resulting from their capacities to protect the environment from pest risk (their efficacies) and from the specific effects from use of the component risk abatement methods. This chapter presents the likely direct and indirect environmental consequences of potential program alternatives for regulation of SWPM. There is also a discussion of potential aggregate environmental consequences. This includes environmental effects resulting from the sum of impacts from all methods used in the alternative as well as cumulative impacts of other reasonably foreseeable actions taken by APHIS and by other agencies, individuals, and organizations. The descriptions of direct, indirect, and aggregate effects of each alternative are combined to provide a summary characterization that may be used to readily compare the consequences of the different alternatives. Finally, a concluding part of this chapter discusses special considerations such as compliance with other environmental statutes, logistical considerations, regulatory issues, and other program-specific concerns.

A. Program Alternatives

1. No Action

a. Capacity for Pest Mitigation

The historical justification for the No Action alternative (defined as the existing regulations) has been the demonstrated ability of the regulations to exclude pests of quarantine significance from the United States. Inspections and the ability of inspectors to detect and treat wood infested with pests of quarantine significance have been effective at excluding most invasive species that threaten native trees and forest resources of the United States. With increasing international trade, the number of quarantine pest interceptions has increased dramatically. However, the frequency and number of inspections has not increased commensurate with the increased trade or with the increases in cargo accompanied by SWPM entering the United States. Increased inspection would result in some reduction of pest risk—with the reduction dependent upon the resources that could be brought to bear on the process. The complexity and time required for inspection of the SWPM in large shipments of unwieldy cargo make thorough inspection impractical, if not impossible. Resource and staffing limitations already strain the capability of inspectors to thoroughly monitor cargo for compliance with present regulations.

The unprecedented increase in world trade within the last 15 years has resulted in steadily more frequent detections of quarantine pests in SWPM and more frequent introductions of wood pest species that existing quarantine measures previously had excluded. Between 1995 and 1998, 97 percent of the quarantine pests intercepted at U.S. ports were recognized as potential threats to forest resources. In particular, the Asian longhorned beetle (*Anoplophora glabripennis*), the pine shoot beetle (*Tomicus piniperda*), and the emerald ash borer (*Agrilus planipennis*) are introduced species that have recently spread to the United States through untreated wood. The limitations of inspection alone to exclude quarantine pests from SWPM became evident in 1998 when interceptions of quarantine wood pests from China accounted for 40 percent of all interceptions. After the China Interim Rule, interceptions from China decreased to only about 5 percent of all interceptions by the year 2000. However, interceptions of quarantine pests in SWPM from origins other than China continued to increase with the expansion of trade. Just as phytosanitary regulations prior to the China Interim Rule were not designed to handle the elevated pest risks of SWPM associated with the expansion of trade with China, present phytosanitary regulations are inadequate to exclude quarantine pests of SWPM from other origins.

A draft pest risk assessment for importation of SWPM into the United States was prepared in August 2000 (USDA, APHIS and USDA, FS, 2000). Most of the organisms reviewed in the pest risk assessment were determined to pose high pest risk. Those organisms identified as having high pest risk were described as unlikely to be excluded from the United States solely through inspections and associated interdiction actions at ports of entry. Based upon this, the pest risk assessors concluded that more stringent importation requirements should be applied, regardless of country of origin. In addition, they suggested that effective mitigation measures could greatly reduce the risk of introducing destructive exotic forest pests. In the absence of such measures, pests like Asian longhorned beetle can be expected to pose an ongoing threat to the survival and health of forests in the United States.

The present pest risks from current regulations of SWPM can be expected to continue to increase commensurate with increasing use of SWPM in world trade. Other than regulations of SWPM from specific origins (e.g., China and Hong Kong), program decisions to treat SWPM are made for individual shipments based upon inspection results. The effectiveness of these inspections at detecting pest risk is an important factor in prevention of pest risks under the No Action alternative. It is clear that the regulations made in the China Interim Rule dramatically lowered the potential pest risk from that origin. However, the potential pest risks from SWPM of other origins can be expected to continue to pose increased likelihood of pest introduction and associated damage to forest resources in the United States.

Although all three treatment methods specified under the China Interim Rule mitigate pest risks in SWPM, the efficacy against specific pests varies. Wood preservative treatments involve the application of chemicals to regulated SWPM to prevent plant pest infestation, reinfestation after other treatments, or, in some quarantine cases, to eliminate pests that are present. Some preservatives such as creosote offer continual protection against pest infestation, but other preservatives may lose efficacy over time due to leaching (e.g., boron) or degradation (surface treatment agents such as permethrin). Heat-treated wood (without moisture reduction) that is still green is much more prone to reinfestation than is kiln dried lumber (dry heat), but all heat treated articles must be handled and stored to protect those articles from pest infestation after treatment. Fungal infestations of wood are considered the most difficult to eliminate (Morrell, 1996a), but the use of heat to eliminate pests represents one of the most certain approaches to minimizing the risk of pest introductions from SWPM (Morrell, 1995). Fumigation with methyl bromide has been used for many years to treat logs and other wood articles because of the chemical's high volatility, ability to penetrate most materials, and broad toxicity against a wide variety of plant pests (all life stages of insects, mites, ticks, nematodes including cysts, snails, slugs, and fungi such as oak wilt fungus) (USDA, APHIS, 1991). The ability of methyl bromide to penetrate into wood has been a limitation to efficacy. This is particularly true for wood with high moisture content (e.g., green logs). Cross (1992) found that, in practice, it is difficult to achieve an efficacious insecticidal dose much beyond a depth of 100 millimeters in green materials using conventional tent fumigation techniques. The removal of bark has been found to facilitate the penetration of the fumigant into the wood (Ricard *et al.*, 1968). A test shipment of wood from New Zealand fumigated with methyl bromide in early 1992 was found to be infested with a blue stain fungus (quarantine significant fungus) upon arrival in the United States (USDA, FS, 1992). The efficacy data of methyl bromide for many pests and pathogens does not exist (USDA, APHIS, 2002). Although methyl bromide may not be effective against all organisms in wood, agency review of the efficacy of methyl bromide fumigations against pests and diseases in SWPM has been found acceptable for two treatments listed in the APHIS' Plant Protection and Quarantine (PPQ) Treatment Manual (USDA, APHIS, 1998a). Although each of the three treatment methods has limitations to their efficacy, research indicates that most quarantine pests and diseases of concern are adequately eliminated by these treatments.

b. Consequences of Component Methods

The component methods under the No Action alternative include inspection, heat treatment, fumigation with methyl bromide, and treatment with chemical preservatives. Other than occasional damage to the SWPM being checked, program inspection techniques pose no adverse consequences to the human environment. The environmental consequences of the treatment methods are more substantial and will be presented in greater detail. Treatments are required for pest mitigation of SWPM from China and Hong Kong as specified in the China Interim Rule. Decisions to treat SWPM from other origins are dependent upon detection of quarantine pests in the wood by inspection techniques. These treatment decisions are made on a case-by-case basis at the ports and the number of such treatments per year (427 in 2001) is small compared to the annual number of required treatments under the China Interim Rule (~342,000).

Although the SWPM from China or Hong Kong may be treated by one of three methods specified under the China Interim Rule, the actual practice of shippers has been to favor the more convenient and more economical treatments. This practice has limited the actual environmental effects from the China Interim Rule to those resulting from heat treatment or fumigation. The use of chemical preservatives has been very limited under the China Interim Rule and this is not expected to change. The primary factors contributing to the lack of use of chemical preservatives are the higher cost of these treatments (relative to heat treatments and fumigations), the toxicity and health risks associated with residual chemical in the wood, the decreasing availability of most preservative chemicals (due to voluntary phaseout or lack of reregistration), and issues related to safe handling and disposal of SWPM treated with preservatives. Although there are many environmental and health issues associated with preservative treatment of SWPM, the anticipated continuing lack of use of this method is expected to preclude adverse impacts to human health, nontarget species, and environmental quality.

Heat treatments have been used to treat SWPM by some shippers. The present cost is somewhat higher than fumigation with methyl bromide, but the gradually increasing cost of fumigations may make this a more economical treatment in the future. Heat treatments may be impractical for large volumes of wood or thick pieces of wood without elaborate sensoring (Morrell, 1995; UNEP, 1998). This method is anticipated to be used for smaller loads of SWPM, but with improvements in technology may be adaptable for larger volumes. The generation of heat needed for these treatments may be achieved through electrical units or combustion units. This may involve the local release of hydrocarbons (combustion units) or other energy-related emissions (source of electrical power). Any environmental issues associated with the heat source are expected to be temporary and not substantial. The strict supervision and contained nature of the treatment facilities are expected to preclude adverse effects to human health of workers or the general public. The only organisms expected to have mortality and treatment-related adverse effects are those present within the wood to be treated. Proper disposal of hot water from steam and hot water vats at the facilities is not expected to affect local soil or water quality.

Fumigation with methyl bromide has been the predominant quarantine treatment of SWPM throughout the world. The selection has favored this treatment due to the convenience and economical nature of this method. Methyl bromide is the only fumigant authorized by APHIS for SWPM at ports and in the China Interim Rule. Although APHIS is investigating the use of other potential fumigants, the status of research and development suggest that no other fumigants are likely in the immediate future. Although the frequency of port fumigations of SWPM with methyl bromide would be expected to increase under the No Action alternative commensurately with the anticipated increases in number of shipments associated with the increasing trade, the increases in trade have greatly exceeded the expansion of inspection services and actual increases in fumigations due to pest detection in SWPM have been negligible. As was mentioned in the paragraph on inspection, the greatest use of treatments (i..e., mostly methyl bromide fumigation) under the No Action alternative is for treatments of SWPM under the China Interim Rule. Based upon the fact that the majority of the potential environmental consequences of this treatment under the No Action alternative will relate to increased use of methyl bromide in compliance with the China Interim Rule, any statements about methyl bromide usage under this alternative will relate to present and anticipated usage in compliance with the China Interim Rule.

Human health effects from methyl bromide have been described in detail in a chemical background statement prepared for APHIS (LAI, 1992). That document is incorporated by reference into this EIS and the more important information is summarized here. Methyl bromide is an alkylating agent, a substance that deactivates enzymes and disrupts nucleic acid synthesis. The actual biochemical mechanism remains unclear, but may be related to irreversible inhibition of sulfylhydryl enzymes (Hayes and Laws, 1991). The central nervous system is the primary focus of toxic effects of methyl bromide (Honma *et al.*, 1985). The mechanism of intoxication of methyl bromide targets several organs including liver, kidneys, adrenals, lungs, thymus, heart and brains (Medinsky *et al.*, 1985; Eustis *et al.*, 1988). Methyl bromide is an odorless, acutely toxic vapor that is readily absorbed through the lungs by inhalation. The primary health issue of concern to workers is potential adverse neurotoxic and pulmonary effects. Recorded fatalities to methyl bromide are generally the result of respiratory failure. Contact with the liquid can cause skin burns and skin irritation, but this exposure can be prevented by proper handling of the gas cylinders. Preventing acute exposures to methyl bromide is the primary concern. Access within the stack barrier zone during regulatory fumigations is limited to certified personnel wearing self-contained breathing apparatus. Use of proper protective gear in this zone is required until the ambient air concentrations of methyl bromide decrease to 5 ppm or less during aeration. Adherence to required safety precautions and proper protective clothing as described in the PPQ Treatment Manual (USDA, APHIS, 1998a) preclude any direct acute or chronic adverse health effects to humans.

Fumigants such as methyl bromide used to treat commodities such as wood will kill any exposed organisms present in the treated commodity. Other organisms such as wildlife and domestic animals that do not have access to the fumigation chamber are not expected to be adversely affected by fumigations. The aeration vent from a fumigation stack or chamber may regularly release gas at a specific location, which could affect those organisms immediately below the vent. However, methyl bromide gas is anticipated to disperse quickly and few organisms would be expected to reside in close enough proximity to the off-gassing vent to be adversely affected. Most fumigation facilities and stacks are placed on physically disturbed sites that are not preferred habitat for wildlife.

The primary environmental quality issue related to the potential use of methyl bromide as a fumigant is its capacity to contribute to ozone layer depletion in the global stratosphere. The current best estimate of the ozone depletion potential of methyl bromide is 0.4 (NOAA *et al.*, 1998). However, more recent studies (using n-propyl bromide) would suggest a lower value for ozone depletion potential (0.03 to 0.1) (UNEP/WMO, 2002). Title VI of the Clean Air Act requires that all compounds with an ozone depletion potential of 0.2 or greater be phased out in the United States by the year 2005. Based upon their review of known ozone depletion potential, the U.S. Environmental Protection Agency (EPA) has classified methyl bromide as a class I ozone depleting chemical. Phaseout requirements have been set for methyl bromide by EPA under the Clean Air Act (EPA, 1999) in compliance with agreements made under the Montreal Protocol on Substances that Deplete the Ozone Layer. An exemption to the phaseout requirements on methyl bromide has been maintained for quarantine and preshipment uses (QPS). This exempts phaseout of required fumigation uses against regulated pests of SWPM.

The intent of this Protocol, however, is to phase out these use patterns or promote the development of effective alternative quarantine treatments, where possible.

The primary function of the ozone layer in the stratosphere (a part of the Earth's atmosphere existing between 15 and 35 kilometers above the surface) is to prevent the penetration of ultraviolet (UV) radiation through the atmosphere to the Earth's surface. Recent decreases in the level of atmospheric ozone have resulted in an estimated 8 to 15 percent increase in the amount of UV radiation reaching the surface of the Earth, with other influencing factors like clouds and pollution being constant (Bell *et al.*, 1996). Exposure to UV-B radiation can cause conditions ranging from minor sunburn to more severe effects such as snowblindness (the formation of temporary cataracts resulting from sunburn within the eye) and destruction of DNA within cells. Exposure to UV-B radiation has been identified as a major factor in the incidence of various types of cancers (UNEP, 1998; Bell *et al.*, 1996). The effects vary with the amount of radiation, the exposure duration, and the exposure frequency. In addition to human health effects, the increased UV-B exposure associated with ozone depletion has adverse impacts to the health of plants and animals. The productivity of agriculture, forestry, and fisheries could be expected to diminish with excess exposure to UV-B (Bell *et al.*, 1996). The physical environment can be affected by increased production of pollutants in smog from the increased UV and more rapid degradation of polymers and related materials used in construction (Bell *et al.*, 1996).

To assess the relative impacts from methyl bromide use on ozone depletion, it is necessary to understand the impact of the current usage on stratospheric ozone levels. Methyl bromide is only one of a number of substances that react with ozone in the atmosphere. The sum of all global production of methyl bromide has been determined to contribute 1 percent to the overall annual stratospheric ozone depletion (NOAA *et al.*, 1998). The primary substances responsible for stratospheric ozone depletion are various chlorofluorocarbons (CFCs) and the regulatory phaseout of the use of CFCs is associated with much greater decreases in stratospheric ozone depletion than could occur with the phaseout of methyl bromide.

The calculated annual global consumption (anthropogenic use) of methyl bromide in 1996 amounted to 63,960 metric tons (MT)(UNEP, 1998). Many of the current uses of methyl bromide are being eliminated as part of the mandatory phaseout required to comply with the Montreal Protocol and Clean Air Act. The QPS uses of methyl bromide are not required to be phased out and these usages account for only 28 percent of all uses of methyl bromide worldwide (Thomas, 1999). The comparable QPS usage for consumption in the United States is about 9 percent of the total methyl bromide used (Thomas, 1999). Based upon the anticipated phaseout of the other uses of methyl bromide, continuing QPS uses would contribute about 0.3 percent to annual stratospheric ozone depletion (assuming no reductions in contributions from CFCs or other ozone depleting substances). The current QPS uses of methyl bromide are expected to continue until economical alternatives are developed to satisfy the pest elimination requirements.

A risk analysis of ozone depletion potential was prepared for compliance with regulations of SWPM under the China Interim Rule (USDA, APHIS, 1998b). This analysis applied conservative assumptions that projected potential usage of methyl bromide resulting from the interim rule was determined to range from 1,040 to 12,565 MT annually. This was determined to constitute a 1.6 to 19 percent increase in the annual release of methyl bromide to the atmosphere. Actual methyl bromide non-QPS usage data from China indicate a decrease from 3,267 MT in 1998 to 2,664 MT in 1999 (EPA, 2002). Although data are not available for QPS usage in China by year, the decrease in non-QPS usage to comply with the Montreal Protocol would partially cover any increases in QPS usage that have occurred. The actual QPS usage from the China Interim Rule is known to be considerably less than anticipated from the risk analysis due to the analysis assumption that loaded cargo with SWPM would be fumigated rather than fumigation of SWPM prior to cargo loading. In addition, other treatment methods (heat treatment) and substitute packing materials for shipments have been used by China for some cargo and this has lowered their need for methyl bromide treatments. Based upon the more realistic scenario of fumigation of SWPM prior to cargo loading, the projected potential usage of methyl bromide would not exceed 630 MT annually or a 1 percent increase in the annual release of methyl bromide to the atmosphere. This amount of methyl bromide contributes no more than 0.01 percent to the overall annual stratospheric ozone depletion. This contribution is relatively small compared to other ozone depleting chemicals and to the possible quarantine treatments for SWPM worldwide being considered in some other alternatives.

c. Aggregate Consequences

The most substantial aggregate consequences of the No Action alternative are related to pest risk issues and cumulative effects of methyl bromide. Aggregate consequences include those adverse effects resulting from combined program actions under the alternative, from program actions combined with non-program actions, and from program actions combined with any reasonably foreseeable future actions (Federal or non-Federal).

Continuing the existing regulations for SWPM would ensure that the present pest risks from countries (other than China and Hong Kong) will increase commensurate with increases in trade. The draft pest risk assessment for importation of SWPM into the United States (USDA, APHIS and USDA, FS, 2000) found that most of the organisms reviewed in their pest risk assessment were determined to pose high pest risk and those organisms were described as unlikely to be excluded from the United States solely through inspections and associated interdiction actions at ports of entry. In the absence of more stringent pest mitigation measures, pests like Asian longhorned beetle can be expected to pose an ongoing and increasing threat to the survival and health of forests in the United States. The potential damage to forests and forest resources from these pest species would be much greater than the potential damage from the other alternatives.

Preservative treatments are not expected to occur very frequently under the No Action alternative and the reasonably foreseeable program and non-program use is expected to pose negligible effects. Likewise, heat treatments are only expected to be used moderately for SWPM with negligible cumulative risks from combustion products and disposal of hot water.

The environmental consequences of the cumulative effects of all quarantine uses of methyl bromide were discussed in considerable detail in a previous EIS (USDA, APHIS, 2002). The content and findings of that EIS as related to potential impacts of methyl bromide quarantine use on ozone depletion from this program are incorporated by reference into this document and summarized here. Most of the anticipated new commodities that could require fumigation (other than SWPM) are expected to need only small quantities of methyl bromide which, when vented following fumigation, would not result in any substantial cumulative contribution to ozone depletion. Based upon a total overall annual contribution to stratospheric ozone depletion of no more than 0.01 percent, the aggregate effects would appear inconsequential. The recent dramatic increases in trade with China are the basis for the need to fumigate SWPM and this trade is expected to continue. It is less clear to what extent trade will continue to expand in the future. The increased need for methyl bromide treatments is expected to mirror the increased trade with China under this alternative. Although the amount of trade with China has been steady since the increases in trade prior to the China Interim Rule, it is possible that trade and associated treatments may increase again. It seems unlikely that the cumulative effects of methyl bromide on annual stratospheric ozone depletion under the No Action alternative will increase greatly for the foreseeable future and any increases would be considerably less than the inconsequential depletion (0.01 percent) resulting from the present level of trade. The phaseout of chlorofluorocarbons and other ozone-depleting chemicals is anticipated to result in much more evident effects on recovery of stratospheric ozone than any ongoing inconsequential depletion from the No Action alternative.

2. Extend Treatments in China Interim Rule to All Countries

Extension of the treatments in the China Interim Rule to all countries would ease the burden on inspection or would redirect inspection to checking paperwork and verifying treatments. This alternative continues the same treatments as under the No Action alternative. Some information about these treatments may be repeated as it applies to this alternative, but most statements about treatments will be directed to any changes in context or intensity resulting from the potential extension of the China Interim Rule.

a. Capacity for Pest Mitigation

Unlike the No Action alternative which depended primarily upon inspection to detect and exclude pest risks (except for China and Hong Kong), pest mitigation under the extended treatments of the China Interim Rule depends primarily upon compliance with required treatments and efficacy of the treatment methods. This alternative requires less direct inspection of SWPM and more review of compliance than the No Action alternative.

The ability of inspection to verify compliance with required treatments under this alternative is limited by the available documentation. This alternative would lack the certification markings of wood required under the IPPC Guidelines for SWPM, but would require documentation of treatment. Although some treatments could be verified by specific tests (e.g., kiln dried SWPM can be verified by an electrical conductivity meter), most treatments lack a quick, reliable test for indicating treatment or lack thereof. Therefore, the documentation and spot checking of SWPM is important to verify pest mitigation treatments. Based upon the availability of similar documentation for all SWPM to that provided for cargo manifests from China, one could selectively inspect only those shipments for which the likelihood of quarantine pest infestation in SWPM is elevated. Monitoring of inspections of SWPM from China and Hong Kong within a year following the passage of the interim rule in 1998 revealed that proper compliance with the requirements for SWPM were met approximately 98 percent of the time. Based upon the results of this monitoring study, one could expect live insects in 0.1 to 0.2 percent of the shipments, lack of treatment in 0.7 to 0.9 percent of the shipments, and incorrect treatments for 0.05 to 0.2 percent of the shipments. Closer inspection of shipments from sources with previous inadequate or non-compliance has been shown to increase likelihood to detect cargo with increased pest risks. Using this cargo information, inspection rates for SWPM by inspectors can be set statistically to meet a desired level of compliance that maximizes exclusion and minimizes the likelihood of plant pest introduction. However, excluding the effects of applicable treatment requirements, the frequency of infested SWPM would be anticipated to remain much higher and to pose pest risks that inspection efforts alone could neither contain nor exclude.

The primary intent of inspection is to mitigate pest risk by ensuring compliance with the regulations. The high potential risks from damaging pests associated with noncompliance make it APHIS policy to provide a strong deterrent. Therefore, APHIS keeps importers and shippers informed of the penalties from inadequate compliance. The importer or shipper could be subject to administrative penalties, criminal fines, jail sentences, and loss of revenue due to APHIS' rejection of commodities, permit applications, and/or compliance agreements. A major tool for APHIS is the option to refuse entry, require treatment, or require destruction of the SWPM. All of these options are costly to the shipping line and exporter, who must assume all costs for the delays and any treatments. This offers strong incentive for their full compliance with SWPM regulations.

A thorough discussion of the efficacy of different treatment methods was provided under the No Action alternative as those treatments related to the China Interim Rule and most of that information will not be repeated here. The pest risk potential from the application of the China requirements to all SWPM worldwide would be considerably less than the pest risk potential under the No Action alternative. Although this change in treatment requirements would result in an overall decrease in pest risks for this alternative over the No Action alternative, the inability of these treatment methods to eliminate all wood pests present in SWPM would result in greater pest risk than the alternative use of only substitute packing materials. The primary pest risk issue under this alternative is the extent to which the treatments of SWPM are effective at eliminating pests and diseases.

Although all three treatments are effective at eliminating pest risk in SWPM, each method has limitations as described in the environmental consequences section for the No Action alternative. Despite proven efficacy, the use of chemical preservatives has not been used widely under the China Interim Rule. Likewise, chemical preservatives are not expected to be widely used for SWPM treatments under this alternative due to health and environmental issues related to handling and disposal of treated SWPM. Of the various treatment methods available for SWPM, the heat treatments are the most efficacious of the treatments against potential pest risks. Although heat treatments are very efficient at eliminating pest risk within wood of thin diameters, penetration of heat to core temperatures hot enough to kill pests in thick wood is more problematic. Therefore, heat treatments are expected to be limited to smaller, more easily treated wood articles or high value articles (Morrell, 1996b). Likewise, elimination of some pest and disease risks in thick wood may not be successful (UNEP, 1998; Morrell, 1995). Although reinfestation of heat-treated SWPM is possible, most studies have indicated that this is unlikely, particularly with kiln-dried wood. The primary issue of concern under this alternative is the effectiveness of the heat treatment guidelines. The prescribed heat treatment under this alternative sets a required minimum core temperature of 71.1 °C for at least 75 minutes. Although not all pests are capable of being killed by such treatments, application of these requirements will eliminate most pest risks and provide more thorough treatment than the IPPC Guidelines. Methyl bromide treatments do penetrate wood well, but may not eliminate all pest risks present (USDA, APHIS, 2002). One of the limitation of fumigations with methyl bromide was found to be inability to eliminate risk from bluestain fungi in some wood packing (USDA, FS, 1992). As with heat treatments, fumigation requirements are more stringent under this alternative than under the IPPC Guidelines. The treatments using methods in the China Interim Rule are expected to be just as efficacious as those under the IPPC Guidelines, but thorough research comparing the differences in concentration, time, and temperature have not been completed.

Notwithstanding these treatment limitations, the pest risk assessment of SWPM (USDA, APHIS and USDA, FS, 2000) concluded that more stringent importation requirements should be applied and that effective mitigation measures including effective treatments could greatly reduce the risk of introducing destructive exotic forest pests. The application of the China regulations to all SWPM would make the potential pest risks from SWPM consistent from all origins, that is, comparable pest risks would be eliminated by these treatment requirements. Those pest organisms and disease vectors of wood not effectively treated by fumigation with methyl bromide or heat treatment would continue to pose potential risk of introduction and damage to trees in the United States. In particular, some of the deep wood-borers, fungi, rots, and wilts will continue to be problematic for abatement of pest risk. However, the longer and more intense exposures of SWPM under this alternative compared to the exposures under the IPPC Guidelines would be expected to make treatments under this alternative more effective at eliminating potential pest risks.

b. Consequences of Component Methods

The consequences of the component methods of this alternative have been discussed under the No Action alternative and that information will not be repeated here except as it relates to application of the China regulations to all SWPM. Although the potential consequences of using preservative chemical treatments are considerable, the anticipated health and environmental risks are expected to be minimal due to the lack of use of these treatments. Heat treatments and fumigations with methyl bromide are expected to be the primary treatment methods. The only environmental issues associated with the actual heat treatments relate to the emission from the heat source (combustion products) and disposal of hot water. Effects from these emissions and by-products of heat treatment are expected to be localized, temporary, and not of substantial intensity.

The primary environmental quality issue relates to the greater frequencies and quantities of methyl bromide used in fumigation under this alternative. This alternative extends the treatments of the China Interim Rule to all SWPM worldwide. These treatments are more stringent than those required under the IPPC Guidelines and are projected to involve the greatest usage of methyl bromide of any alternative being considered. The potential contribution from these fumigations of SWPM with methyl bromide to cumulative ozone depletion depends upon how much SWPM is to be fumigated relative to other available alternate methods. For example, if most SWPM is either heat treated or replaced by other packing materials, then the potential contribution from methyl bromide fumigation could be very small.

Applying the same conservative analytical approach described in the No Action alternative to all SWPM worldwide would result in commensurately greater amounts of methyl bromide consumption and release. The additional usage of methyl bromide is expected to range from as low as 427 MT per year to as high as 5,145 MT per year. This annual usage amounts to an increase in anthropogenic release of methyl bromide from 0.7 to 8 percent. Although this is a potentially substantial increase in methyl bromide use, the associated annual ozone depletion would only amount to an additional increase of 0.007 to 0.08 percent. This ultimately could result in a 1.2 percent effect on the restoration of the ozone layer. Although this usage is still a relatively small contribution (relative to chlorofluorocarbons) to overall ozone depletion, this approach does not assist in fulfilling the intent of the Montreal Protocol to gradually phase out these QPS uses of methyl bromide.

A recent approach being developed to mitigate the potential effects of methyl bromide on ozone depletion is through the use of recapture system devices to collect methyl bromide from fumigation chambers before the gas is emitted into the atmosphere. This system can be designed for program fumigations, but there are high setup costs and modest maintenance costs involved.

A conservative estimate of the amount of methyl bromide recovered by the recapture system from each fumigation is 75 to 80 percent of the total fumigant applied (McAllister, 2000). This recovery compares favorably with the average amount of methyl bromide vented to the atmosphere from a fumigation that has been estimated to be from 69 to79 percent of the total applied (UNEP, MBTOC, 1998).

The recapture system is currently being used for some port fumigations of agricultural commodities in California and Texas. Several other ports are considering installation of recapture systems. Any required installation of recapture systems for all domestic fumigation facilities would be costly and is not expected in the immediate future. This recapture technology could be applied to quarantine fumigations of SWPM in other countries, but there are logistical considerations and there may be regulatory restrictions that make this development unlikely within the immediate future.

c. Aggregate Consequences

As was true with the No Action alternative, the most substantial aggregate consequences for this alternative relate to pest risk issues and the cumulative effects of methyl bromide. Preservative treatments are expected to be used infrequently and that limited use is projected to pose negligible adverse effects. The exhaust emissions from heat treatment sources and disposal of excess hot water from heat treatment poses only local effects of negligible impact. The heat from individual heat treatments is released to the atmosphere and dissipates readily with no long-term or cumulative effects on global temperatures. Expansion of the frequency of heat treatments to cover pest risks from other parts of the world is not anticipated to add substantially to the global heat load.

Extension of the China Interim Rule to all SWPM worldwide does ensure long-term exclusion of most wood pests of quarantine concern from the United States. This prevents the potential damage to forest and forest resources likely to occur under the No Action alternative. However, some of the deep wood-borers, fungi, rots, and wilts could continue to be problematic for abatement of pest risk. The only alternative that would ensure protection against these species is the use of substitute packing materials.

As stated previously, the cumulative impacts of methyl bromide usage have been described in considerable detail in a previous EIS designed specifically to address issues related to impacts on the ozone layer (USDA, APHIS, 2002). The sum of all global production of methyl bromide has been determined to contribute 1% to the overall annual stratospheric ozone depletion (NOAA *et al.*, 1998). Most stratospheric ozone depletion is presently contributed by chlorofluorocarbons that are being phased out. The additional methyl bromide usage expected under this alternative ranges from 427 MT to 5,145 MT per year.

Disregarding any phaseout of ozone-depleting chemicals, the additional annual contribution of methyl bromide to ozone depletion from SWPM treatment worldwide at China Interim Rule rates would be expected to range from 0.007 to 0.08 percent (ultimately a 1.2 percent effect on the restoration of the ozone layer). Most anticipated QPS usages of methyl bromide (other than the SWPM rule being considered) are small and contribute negligible potential effects to ozone depletion. The gradual phase-out of non-QPS use patterns of methyl bromide will decrease ozone depletion, but those critical usages that will be allowed under the EPA regulations have yet to be designated. Although QPS usages (such as quarantine treatments of SWPM) are exempted from phaseout under the Montreal Protocol and Clean Air Act, the primary intent of the Montreal Protocol is to phase out uses of ozone-depleting chemicals such as methyl bromide and promote the development of effective alternative materials, where possible. This alternative involves the most usage of methyl bromide and does the least to assist in achieving the goals of the Montreal Protocol.

3. Adoption of IPPC Guidelines (Proposed Alternative)

Adoption of the IPPC Guidelines decreases the need for inspection by providing documentation and evidence of treatments to mitigate pest risks. Unlike the previous two alternatives, the IPPC Guidelines do not include chemical preservative applications to SWPM as an acceptable phytosanitary treatment, so the human health and environmental consequences related to chemical preservatives do not apply to this alternative. In addition, the IPPC Guidelines do not require debarking of SWPM as required under the previous two alternatives. Debarking was determined not to further reduce risk substantially when either methyl bromide or heat treatment was performed consistent with the IPPC Guidelines. Some information about the treatment methods may be repeated as it relates to common issues, but most statements about treatments will be directed to any changes in context or intensity resulting from the adoption of the IPPC Guidelines.

a. Capacity for Pest Mitigation

The ability of inspection to exclude quarantine pests of SWPM could be greatly enhanced by the additional documentation required with each shipment under the IPPC Guidelines. Unlike previous alternatives, the IPPC Guidelines require specific markings on treated wood which would greatly assist with treatment verification. As with the alternative extending the China Interim Rule, this alternative facilitates selective inspection of only those shipments for which the likelihood of quarantine pest infestation in SWPM is elevated. Likewise, it is reasonable to project approximately 98 percent compliance for all countries as was determined by monitoring of the China Interim Rule compliance. Closer inspection of shipments from sources with previous inadequate or noncompliance could be done to increase likelihood of detecting cargo with increased pest risks. Using the expanded documentation, inspection rates for SWPM by inspectors could be set statistically to meet a desired level of compliance that maximizes exclusion and minimizes the likelihood of plant pest introduction. In the absence of any of the required treatments under this alternative, the frequency of infested SWPM would be anticipated to remain high and to pose pest risks that inspection efforts alone could neither contain nor exclude.

The pest risk potential from SWPM from the adoption of the IPPC Guidelines would be considerably less than the pest risk potential under the No Action alternative. The lack of a debarking requirement under the IPPC Guidelines would normally be associated with greater pest risk, but the required treatments (heat or methyl bromide fumigation) should eliminate most potential pests in and under bark. The primary pest risk issue under this alternative is the extent to which the treatments of SWPM are effective at eliminating pests and diseases. Although both treatments are effective at eliminating pest risk in SWPM, each method has limitations as described in the environmental consequences section for the No Action alternative. The primary issue relates to penetration of the heat or fumigant to the site of the pest within the wood. Methyl bromide treatments do penetrate wood well, but may not eliminate all pest risks present (USDA, APHIS, 2002). Although the IPPC Guidelines acknowledge that not all pests are capable of being killed by such treatments, they allow fumigation decisions by the NPPOs to be made on a case-by-case basis, providing a scientifically based pest risk assessment is done. Therefore, current APHIS regulations (as applied in the China Interim Rule) for fumigations at the higher concentrations and longer exposure periods than the IPPC Guidelines could be continued if appropriately justified. The limited efficacy data may require considerable research effort to ensure that the IPPC Guidelines meet the pest risk standards that APHIS currently expects.

The prescribed heat treatment under the IPPC Guidelines involves heating the wood to a minimum core temperature of 56 °C for at least 30 minutes. As with fumigation, these heat treament guidelines are less stringent than the China SWPM regulations that require heat treatments to attain a minimum core temperature of 71.1 °C for at least 75 minutes. Although the IPPC Guidelines acknowledge that not all pests are capable of being killed by such treatments due to a higher thermal tolerance, the guidelines allow heat treatment decisions by the NPPOs to be made on a case by case basis, with appropriate justification. Initial testing of those treatments contained in the IPPC Guidelines indicates that those applications provide adequate mitigation of the pest risks of greatest concern to APHIS.

Notwithstanding these treatment limitations, the pest risk assessment of SWPM (USDA, APHIS and USDA, FS, 2000) concluded that more stringent importation requirements should be applied and that effective mitigation measures including effective treatments could greatly reduce the risk of introducing destructive exotic forest pests. The adoption of the IPPC Guidelines would make the potential pest risks consistent from all origins, that is, comparable pest risks would be eliminated by these treatment requirements. Those pest organisms and disease vectors of wood not effectively treated by fumigation with methyl bromide or heat treatment would continue to pose potential risk of introduction and damage to trees in the United States. As with the extension of the China Interim Rule, some of the deep wood-borers, fungi, rots, and wilts could continue to be problematic for abatement of pest risk under the IPPC Guidelines.

b. Consequences of Component Methods

A thorough discussion of the environmental consequences of heat treatments and fumigations with methyl bromide was provided under the previous alternatives and that information will not be repeated here except as it relates to compliance with the IPPC Guidelines. As with the previous alternatives, the only environmental issues associated with the actual heat treatments relate to the emission from the heat source (combustion products) and disposal of hot water. Effects from these emissions and by-products of heat treatment are expected to be localized, temporary, and not of substantial intensity.

The greater frequencies and quantities of methyl bromide used in fumigation under this alternative would be expected to contribute to ozone depletion more than under the No Action alternative, but duration of intense exposure of SWPM to methyl bromide under this alternative is not as great as under the alternative extending the China Interim Rule. The lower exposures under this alternative compared to the China Interim Rule would allow less use of methyl bromide to meet the IPPC Guidelines. The projected additional annual usage of methyl bromide under adoption of the IPPC Guidelines could range from 384 MT to 4,630 MT per year. This usage pattern would be expected to contribute additional ozone depletion of from 0.006 to 0.072 percent (ultimately a 1 percent effect on the restoration of the ozone layer). Although this usage is a relatively small contribution to overall ozone depletion relative to that posed by CFCs, this approach does not assist in fulfilling the intent of the Montreal Protocol to gradually phase out these QPS uses of methyl bromide. The limitations of effective alternate treatments under the IPPC Guidelines are comparable to those described in the previous sections on environmental effects of other alternatives. Future application of those methods to lower the releases of methyl bromide to the atmosphere are contingent upon improvements in the costs and various logistical issues.

c. Aggregate Consequences

The aggregate consequences of adoption of the IPPC Guidelines are similar to those from the extension of the China Interim Rule to all SWPM worldwide. Emissions and other effects from heat treatments pose negligible local and global risks. The most substantial aggregate consequences relate to potential pest risk and the cumulative effects of methyl bromide.

Adoption of the IPPC Guidelines ensures long-term exclusion of most wood pests of quarantine concern from the United States. The lack of required debarking and the less stringent treatment requirements than those under the extension of the China Interim Rule alternative make the pest risk higher under the IPPC Guidelines, but efficacy testing has not indicated higher risk for those quarantine pests of greatest concern to APHIS. The IPPC Guidelines prevent the potential damage to forest and forest resources most likely to occur under the No Action alternative.

However, as with the extension of the China Interim Rule, some of the deep wood-borers, fungi, rots, and wilts would continue to be problematic for abatement of pest risk.

Using the same approach for calculation of the usage rates in IPPC Guidelines as previous alternatives, a similar pattern emerges. The fumigation rate is slightly lower under the IPPC Guidelines than under the China Interim Rule and therefore, the projected usage is commensurately lower. Based upon actual fumigation of SWPM before loading, the additional methyl bromide usage from the IPPC Guidelines would be expected to result in additional methyl bromide usage from 384 MT to 4,630 MT per year. This usage indicates that the additional annual contribution of methyl bromide to ozone depletion from SWPM treatment at IPPC Guidelines' rates would be expected to range from 0.006 to 0.072 percent (ultimately a 1 percent effect on the restoration of the ozone layer). As was true with China Interim Rule rates, the cumulative impacts associated with the IPPC Guidelines' rates must take into account other uses. The gradual phase-out of non-QPS use patterns will decrease ozone depletion, but the critical usages that will be allowed have yet to be designated. The lower usage of methyl bromide under the IPPC Guidelines does indicate less potential for cumulative impacts than the usage of methyl bromide under the China Interim Rule rates, but the differences are very slight. As with the China Interim Rule cumulative analysis, most anticipated QPS usages (other than the SWPM rule being considered) are small and contribute negligible potential effects to ozone depletion. Although usage under this alternative provides a relatively small contribution to overall cumulative ozone depletion, selection of this alternative does not assist in fulfilling the intent of the Montreal Protocol to gradually phase out these QPS uses of methyl bromide. This alternative involves less use of methyl bromide than the extension of China Interim Rule, but the potential differences in effects on stratospheric ozone between the two alternatives are minimal.

4. Comprehensive Risk Reduction Program

Many of the environmental effects from the methods and treatments used in a comprehensive risk reduction program (e.g., heat treatment and methyl bromide fumigation) have already been described and that information will not be repeated here. Information about potential environmental effects of other methods to reduce pest risk in SWPM will be presented in this section based upon the extent to which research is completed or underway. As with the other alternatives, a brief discussion of potential pest risk and issues related to effectiveness of inspection is included.

a. Capacity for Pest Mitigation

Inspections under a comprehensive risk reduction program would be complicated by a number of factors. Without specific documentation of type of SWPM, origin, and type of treatment, this work could be difficult. Markings in compliance with the IPPC Guidelines and physical evidence of treatment would be useful. Treatments such as irradiation that leave no visible evidence could be difficult to verify. The inspection would be most effective with documentation of the methods used to mitigate pest risk of the SWPM used in each shipment. This would allow the inspector to assess the effectiveness and know what potential risk reduction to expect. However, this approach would require considerable adjustments to current cargo documentation for SWPM and these adjustments may not be readily adaptable to shippers, customs records, and trade regulations. If proposed methods were consistent worldwide for all SWPM, the issue of type of SWPM would not be critical to inspection. However, it has been shown that the pest risk from some types of SWPM and some origins can be effectively eliminated by certain treatment methods that do not have efficacy against pests in other types of SWPM and from other origins due to differences in the type of pest risks present. This could pose many difficulties for inspectors who are working to exclude pest risk from SWPM. None of these logistical issues is insurmountable, but inspection under this alternative would be expected to require more involvement and more attention of the officers to specific details.

The pest risk potential from the application of a comprehensive risk reduction program to all SWPM would be considerably less than the pest risk potential under the No Action alternative. The primary pest risk issue under this alternative is the extent to which the selected methods are effective at eliminating pests and diseases. Although all treatments are effective at eliminating pest risk in SWPM, each method has limitations on efficacy and applicability. The use of substitute packing material eliminates pest risks associated with SWPM., but the logistics of converting over to the use of only these materials is not feasible at present. Notwithstanding the limitations of these methods, the pest risk assessment of SWPM (USDA, APHIS and USDA, FS, 2000) concluded that more stringent importation requirements should be applied and that effective mitigation measures including effective treatments could greatly reduce the risk of introducing destructive exotic forest pests. The consistent application of specific treatments to all SWPM would provide comparable protection from pest risks for all origins. This would ensure that comparable pest risks would be eliminated worldwide, but it would not protect against some of the pests that are more tolerant of the present treatments of SWPM. Those pest organisms and disease vectors of wood not effectively treated by these methods would continue to pose potential risk of introduction and damage to trees in the United States. In particular, some of the deep wood-borers, fungi, rots, and wilts could continue to be problematic for abatement of pest risk. However, the comprehensive risk reduction approach would provide the maximum flexibility to select methods and treatments that are the most effective at eliminating all potential pest risks.

(1) Pest Mitigation from Fumigation Treatments

There are a number of fumigants (other than methyl bromide) available or being developed for use in treatment of wood or wood products. Most of these fumigants are not expected to be ready for implementation within the foreseeable future. These include, but are not limited to, methyl iodide, chloropicrin, metam sodium, propargyl bromide, iodinate hydrocarbons, and propylene oxide. A thorough assessment of the environmental consequences of their use in this program at this time would not provide adequate information to assist in a meaningful decision about use potential. Should future development of any of these fumigants show promise, their potential will be assessed and environmental documentation prepared to address any potential impacts foreseen from the anticipated use patterns. There is, however, adequate information available to discuss the potential use of some fumigants such as phosphine, sulfuryl fluoride, and carbonyl sulphide.

Although phosphine has been used to treat wood products in the past, recent efficacy research indicates that it is ineffective against many wood pests and pathogens. Accordingly, the approved treatments of wood with phosphine have been removed from the PPQ Treatment Manual. Additional testing is underway to determine whether phosphine treatments can be used effectively for any particular wood or for treatment against specific wood pests from certain parts of the world.

Sulfuryl fluoride has been used primarily against termites in wooden structures and could be used effectively against insects that form colonies. Sulfuryl fluoride is considered to have excellent penetrability into wood (USDA, APHIS, 1991), with dosages similar to methyl bromide. Sulfuryl fluoride is less reactive than methyl bromide and produces no objectionable colors or odors to treated commodities. This fumigant is also effective against other major insect pests of timber such as bark beetles, wood-wasps, longhorn beetles, and powderpost beetles (UNEP, 1998). Unfortunately, eggs of many insects are tolerant to even high concentrations of sulfuryl fluoride (USDA, APHIS, 1991). This inability to penetrate eggs of insects has resulted in elimination of the use of sulfuryl fluoride against all wood-boring beetles from the PPQ Treatment Manual. However, sulfuryl fluoride is still authorized for applications to wood for control of hitchhikers, surface-feeders, and any brood-tending species of insects such as termites, bees, wasps, and ants. This limited use pattern for sulfuryl fluoride minimizes the possible applications for SWPM, which is often infested with wood-boring beetles whose egg stages could survive fumigation with sulfuryl fluoride.

Applications of carbonyl sulphide (COS) as a fumigant are applied in a manner similar to methyl bromide or phosphine from gas canisters. Tests have shown that it will control a wide range of pests, such as beetles, fruit flies, moths, mites, termites, molds, and nematodes. It has shown good efficacy in tests of grains, legumes, dried fruit, cut flowers, and both hard and soft timbers. It has, however, not been tested against some insect pests and most fungi of quarantine significance in wood. Any future decisions by APHIS to allow use of COS to treat SWPM for quarantine certification will be based upon its efficacy against these quarantine pests.

(2) Pest Mitigation from Controlled Atmosphere Treatments

Another treatment method with possible future applications is the use of controlled atmospheres. Controlled atmosphere treatments involve modifying the level of oxygen, nitrogen, and carbon dioxide to control pests present within the commodity. The displacement of oxygen results in asphyxiation of the exposed pests. Although controlled atmosphere treatments are very effective for protection of fresh fruit and grains from damage due to surface pests, there are no studies indicating good control of pests of wood either internally or externally. It is theoretically possible that wood borers or other important wood pests could be eliminated by controlled atmosphere treatment, but this would have to involve long-term control. Many of the wood pests are accustomed to living in low oxygen environment and the long time required for sufficient displacement of oxygen in the wood make this an unlikely option for routine commercial treatments. Use of this method to treat wood products needs considerable research before it could be considered. Implementation of controlled atmosphere treatments of wood is not expected for any quarantine applications in the foreseeable future, but development of this technology could provide information to assist in a meaningful decision if methods indicate any promising results.

(3) Pest Mitigation from Irradiation Treatments

Irradiation is a method of treatment that is under ongoing investigation for potential uses. The potential efficacy and potential environmental consequences vary with the source of radiation used. The three types of irradiation methods under consideration include gamma irradiation, electron beam irradiation, and microwave irradiation. None of these methods is considered ready for application to quarantine treatments of SWPM at present.

Gamma irradiation as a treatment involves exposing the SWPM in an enclosed chamber to the radiation emitted from a radioactive isotope such as cobalt-60 or cesium-137. It has been used to sterilize or kill certain pest species primarily in commodities other than wood. It is most often used to disinfect or disinfest food products, pharmaceuticals, and medical devices. With irradiation, a target dose and exposure time that will destroy the target organisms are sought. Previous programs have considered irradiation treatment only on a case-by-case basis for each facility or commodity use pattern. Irradiation has not been shown to be effective against a wide range of pest insects (Morrell, 1996a). Lethal doses of gamma irradiation to adult ambrosia s (UNEP, 1998). Fungi are known to be more tolerant of irradiation than beetles were determined to range from 73 to 130 krad (USDA, APHIS, 1991). Research was conducted in Russia to support a generic dose for treating logs (Huettel, 1996). This research suggested that a dose of 7 kiloGrays (kGy) is sufficient to cause 100 percent mortality in insects, fungi, and nematodes in logs. A science review panel was established to assess the potential of this work, but these lethal doses are considered too high to provide an economically practical treatment method (Eichholz *et al.*, 1991; Dwinell, 1996).

Electron beam irradiation is similar to gamma irradiation except that the source of radiation is electrons generated by a machine rather than by radioactive isotopes. Data on the efficacy of this treatment against insect pests and pathogens is quite limited. Agriculture Canada is examining the feasibility of this treatment against the New World pinewood nematode and wood-stain fungi. Obstacles to the use of this method are similar to those for gamma irradiation. Limited information is available about the cost and logistics of setting up treatment facilities. Very little documentation of efficacy against insect pests and pathogens prevent its practical employment for this purpose.

The use of microwaves as a treatment method involves exposing wood to ultra-high frequency magnetic fields, which elevate the temperature of any material containing moisture. When exposed to microwaves, dry wood has low dielectric properties and remains cool, but insects in the wood are heated to lethal temperatures. Microwave could be regarded as an alternate heat treatment technology. Microwave studies performed by Burdette (1976) showed that total mortality to anobiid beetles in wood blocks treated with 1500 watts of power at 50 °C. Similar studies with other insects in wood have been efficacious (Thomas and White, 1959; Hightower *et al.*, 1974). However, fungi may not be as susceptible as insects to microwave exposure, especially in wood with a high moisture content such as green wood (USDA, APHIS, 1991). Although microwaves control pests on the surface of wood, the depth of penetration of microwaves is low and may not reach borers, particularly in dense pieces of SWPM. Until adequate efficacy data are available and large treatment facilities are built, the use of microwaves as a pest mitigation method for SWPM can only be viewed as experimental.

(4) Pest Mitigation from Disposal of SWPM

There are a number of means of disposal of SWPM. The decision to select a given method of disposal would have to be made on a case-specific and site-specific basis. The greatest difficulty with the use of disposal methods is that any untreated SWPM arriving at a port of entry could still contain the quarantine pests or diseases that were present at the point of origin, and the containment of this pest risk to prevent introduction from the port of entry would be logistically difficult. For wood with pests and diseases that have slow spread or containable spread, disposal through incineration or other processing may pose acceptable pest risk. Disposal through burial may be effective if the depth is sufficient to prevent emergence of any pest or disease organisms.

b. Consequences of Component Methods

Considerable information about the potential consequences of preservative treatments, heat treatments, and fumigations with methyl bromide have been provided under the previous alternatives. Since a comprehensive risk reduction program will use a combination of methods and it is unclear exactly how frequently specific methods will be selected, the potential environmental consequences could vary considerably. The low use of preservative chemicals is expected to remain minimal under this alternative and impacts are anticipated to be negligible. The amount of heat treatment and fumigation with methyl bromide would most likely vary from the amount of each method under the No Action alternative to the amount under the extension of the China Interim Rule worldwide. If economical, alternate treatments to methyl bromide were developed, then the amount of fumigation with methyl bromide could actually decrease. The potential range of environmental consequences for each of these treatment methods is considerable.

(1) Environmental Consequences of Fumigations and Controlled Atmosphere

The consequences of other fumigants and controlled atmospheres that may be used to treat SWPM vary and are described below by individual compound. All require more research or development before their use could be considered adequate for regulatory quarantine treatments of SWPM. The completed research is expected to limit the foreseeable use patterns on SWPM to phosphine, sulfuryl fluoride, and carbonyl sulphide. Therefore, the discussions of fumigants under this alternative will be limited to these compounds.

The potential primary hazard to human health from phosphine applications to wood products occurs from inhalation exposure to the phosphine gas. Phosphine has been placed in category I (highest toxicity category) because of the extreme inhalation toxicity from this route of exposure. EPA has reviewed potential exposure of applicators and concluded that no adverse effects to humans would be expected if precautionary labeling requirements are observed (EPA, OPP, 1985). EPA has set a re-entry level without respiratory protection of 0.1 ppm. Proper application and disposal of phosphine also precludes adverse effects to non-target wildlife and environmental quality.

Sulfuryl fluoride is applied as a gas from pressurized cylinders. It is highly phytotoxic to plants and exposure to living plants should be avoided. The gas dissipates readily in the atmosphere and proper aeration following fumigation is required. It is a gaseous fluoride that may react with ozone and concerns related to stratospheric ozone depletion should be carefully considered if widespread use of this chemical were anticipated. Sulfuryl fluoride is a highly toxic fumigant to humans. Contact with the liquid may cause irritation, freezing, and burning of eyes, skin, and mucus membranes. Inhalation may be fatal. Slowed movement, reduced awareness, and slow or garbled speech are possible delayed symptoms of sublethal exposures. Adherence to proper safety precautions and use of proper protective gear preclude any adverse effects to humans from any fumigations with sulfuryl fluoride.

Carbonyl sulphide breaks down quickly and has extremely low residue levels. The rapid degradation ensures that bioaccumulation will not occur in living organisms or soil. One of the degradation products, hydrogen sulfide, is extremely toxic. The required use of self-contained breathing apparatus for any workers or supervising authorities within the restricted fumigation area prevents potential adverse respiratory and systemic effects. COS can cause depression and damage to the central nervous system with inadequate personal protection (BOC Gases Australia Limited, 2000). A complete evaluation of potential health and environmental risks of COS has not been completed by EPA.

Controlled atmospheres may have some potential use patterns for SWPM, but their limitations have not yet been clarified. The primary concern with using controlled atmospheres is the potential for asphyxiation of humans and non-target wildlife from the gases present that displace oxygen. This treatment method would be expected to require similar safety precautions and protective measures to those applied to fumigations. Aeration of enclosures after completion of controlled atmosphere treatments would be necessary to avoid adverse human health effects.

(2) Environmental Consequences of Irradiation Treatments

Exposures to high levels of gamma irradiation are known to make paper and fiberboard become brittle. The effects of exposure to gamma irradiation on the wood quality of SWPM is less certain. This issue may not be important for most wood packing materials, but the overall strength of wood is important to protect the cargo being transported. Although there may be structural changes in the wood quality, irradiation does not change the overall appearance of the wood (Morrell, 1996a), so there is no visible means to confirm or deny completion of an irradiation treatment.

An environmental assessment (EA) prepared by the U.S. Department of Health and Human Services' Food and Drug Administration (FDA) determined that no adverse environmental effects are anticipated at food processing plants that are designed to irradiate fruits and vegetables (FDA, 1982). The Nuclear Regulatory Commission (NRC) has set stringent environmental protection requirements for any facilities that use radionuclide sources (10 CFR Parts 20, 30, 51, and 71). In addition, there are special carrier requirements for transport of radionuclides set by the U.S. Department of Transportation. Any extraneous radiation emitted from radionuclides is required to be contained within facilities by shielding, as required by the NRC and the Bureau of Radiological Health at FDA. Any irradiation equipment would be designed to release radiation to the SWPM only. Monitoring of radiation at quarantine treatment facilities has demonstrated ambient background radiation levels at property boundaries. The treated wood does not retain any radioactivity form the exposure. Irradiation equipment and levels at approved facilities are checked on a regular basis by the USDA Radiation Safety Staff in accordance with standards set by the NRC. No problems have been associated with the use of irradiation equipment under APHIS permits.

Irradiation is being developed by several organizations for potential phytosanitary applications. Guidelines have been developed for the use of irradiation as a phytosanitary treatment including information on policies, procedures, and requirements for the proper conduct of treatments and consistent maintenance of operations between agencies and countries (NAPPO, 1997). APHIS proposed the use of irradiation as an additional regulatory treatment method for phytosanitary certification of some agricultural commodities (61 FR 24433, May 15, 1996; 65 FR 34113, May 26, 2000; and 67 FR 11610, March 15, 2002) and prepared an environmental assessment (EA) to analyze the potential environmental impacts of this proposal (USDA, APHIS, 1997). Although the treatment process is similar to that considered for SWPM, the agricultural commodities considered in the EA required dosages that are considerably lower than would be efficacious for wood. Unlike the exposures considered in the EA which includes the unique radiolytic products that could be consumed orally, the only potential source of exposure for SWPM treatments would be from stray radiation at the facilities which is primarily a concern for workers. The amount of stray radiation would be expected to increase commensurate with the higher dosages for treating wood. There have been no further advances in developing treatment facilities that would be logistically and economically feasible for treating SWPM. Until this issue is resolved to the satisfaction of the industry, irradiation treatments are unlikely to be considered seriously by manufacturers of SWPM.

There are a number of unresolved issues regarding the use of microwaves for wood treatment. The limited ability of the microwaves to penetrate wood, the effectiveness of microwaves against fungi, and the ability to construct adequate treatment facilities given the large electrical power requirements for this method are all issues of concern. The external costs involved in producing the high electrical power requirements to attain sufficient microwave energy to kill wood pathogens may exceed the market value of the commodity being transported. As with the other irradiation methods, worker protection through adequate shielding from microwaves must be demonstrated before this treatment could be approved.

(3) Environmental Consequences of SWPM Disposal

If the SWPM has undergone chemical treatment with preservatives, there are several hazards to consider. Any residues remaining on the wood will degrade or be released to various environmental media. Small quantities of boron and other water-soluble preservatives that wash off from treated wood are not likely to pose noteworthy problems upon disposal. These substances would not be expected to enter water following disposal and any residual preservative would be expected to degrade or be diluted to innocuous concentrations. The toxicity of some synthetic organic and oil-borne preservatives require more care in the selection of a method of disposal. Disposal of creosote-treated wood in a lined landfill presents no environmental problems (Morrell, 2001b), but disposal by burning of such wood produces toxic gases and ash that pose a risk of adverse human health effects. Many of the oil-borne preservatives on SWPM could pose substantial health hazards from incomplete incineration. Disposal of SWPM treated with some persistent preservatives can result in high concentrations and contamination of landfills.

Hydrocarbon gases released from incineration of small quantities of untreated SWPM would most likely pose minimal environmental risks, but incineration of larger quantities could pose local air quality concerns. This issue would have to be addressed in a site-specific EA.

The environmental consequences of processing SWPM depend upon the condition of the wood (treated or untreated) and what is being done. Any residual processing effluents or contaminated materials could require special handling or detoxification to eliminate potential hazards. This would have to be addressed as part of the review and environmental documentation for the process being contemplated.

c. Aggregate Consequences

The aggregate environmental consequences of a comprehensive risk reduction program are difficult to predict and could vary to the extent different methods are used to treat SWPM. Many of the methods are in various phases of research and development that do not provide adequate basis for any final decisions about program usage. To the extent that a comprehensive risk reduction program could require efficacious treatments of SWPM or substitute packing materials in a manner that eliminates pest risks that currently exist, this approach would be very useful. The logistics of implementing new pest mitigation methods could require a phase-in period with commensurate delays in pest risk reduction. Considerable work remains to be done before organization of a workable comprehensive risk reduction program could be instituted.

Aggregate consequences resulting from the use of specific pest mitigation methods would need to be considered. As with the other alternatives, methods involving heat treatments would not be expected to pose substantial cumulative effects on global warming. The cumulative impacts of methyl bromide usage under a comprehensive risk reduction program are difficult to predict and would depend upon the extent to which fumigation with methyl bromide was selected over other treatment methods and the rates of methyl bromide to be used in those fumigations. It is likely that the amount of methyl bromide usage and cumulative effects on ozone depletion would not exceed those under an extension of the China Interim Rule, but the actual program decisions would set the rates and duration of the fumigations that meet the risk reduction requirements. Likewise, the potential use of sulfuryl fluoride as a regulatory quarantine treatment of SWPM could pose some risk of ozone depletion potential, but applications of sulfuryl fluoride are expected to be more limited and of lesser global impact. Other limited use fumigants such as phosphine and carbonyl sulphide are not expected to pose any notable aggregate environmental consequences. The contained nature of controlled atmospheres and irradiation treatments are not expected to pose adverse environmental consequences other than temporary local effects. Environmental effects from disposal methods may have long-term implications (landfill) or ongoing implications (incineration) commensurate with quantities of SWPM handled. Landfill and incineration disposal of SWPM are best applied on a case-by-case basis to preclude any potential aggregate effects to local air quality or land contamination. To the extent that SWPM can be recycled without risk of reinfestation from quarantine pest, the use of incineration and landfill disposal can be delayed. Use of substitute packing materials could decrease cumulative consequences of other methods such as those anticipated from fumigation of SWPM with methyl bromide. It is, however, less clear what the aggregate environmental effects would be from mass manufacturing of these substitute packing materials.

5. Substitute Packing Materials Only (Prohibition of SWPM)

The logical response to address the issue of methyl bromide use relative to ozone depletion potential is to promote the use of alternate phytosanitary methods (such as substitute packing materials) to deal with SWPM used in international trade. This approach, however, has certain issues that must first be addressed. The World Trade Organization (WTO) has established certain agreements to ensure that all member nations (including the United States) apply trade policies that are harmonious with and equitable to all nations. The WTO's Agreement on the Application of Sanitary and Phytosanitary Measures (SPS) sets out certain provisions for nations to provide protection against disease and pest risks in trade commodities. Paragraph 6 in Article 5 of this agreement stipulates that any phytosanitary measures taken by member nations should not be more trade-restrictive than required to achieve the needed level of protection, taking into account technical and economic feasibility. This stipulation is clarified by identifying a measure as not more trade-restrictive than required if there are no other reasonably available measures that achieve the appropriate level of protection and those available measures are not significantly less restrictive to trade.

Fumigation with methyl bromide is highly efficacious and is the most economical way to treat SWPM for most quarantine pest risks. Unfortunately, other phytosanitary options for addressing pest risks in packing materials either pose greater pest risk (inadequate phytosanitary protection) or their greater cost and logistical problems contribute to restrictions on applicability to world trade. Substitution of other packing materials is an available alternative that eliminates pest risks associated with wood, but the costs of most materials exceed the likely costs of SWPM that is fumigated with methyl bromide. Restrictions placed upon acceptable packing materials would not satisfy the provisions of the SPS Agreement because they would not meet the "not significantly less restrictive to trade" requirement.

a. Capacity for Pest Mitigation

Inspection under this alternative would be limited to checking paperwork and verifying that no SWPM was being used. In the event that SWPM was found to be used, the decision could be made to treat the SWPM, deny entry of the shipment (re-export), or eliminate pest risk from the SWPM through destruction by incineration or deep landfill (6 feet or deeper). This non-compliance probably would occur infrequently due to the resultant costly delays in deliveries, noncompliance fines, and related complications for the shipper. The non-compliance issue was discussed in greater detail in the environmental consequences section for the alternative analyzing application of the China Interim Rule. The substitute packing materials alternative would considerably reduce inspection efforts and would largely eliminate pest risks from wood-feeding insects and diseases.

The potential environmental consequences of the use of substitute packing materials would vary according to what packing materials are used. Other-than-wood packing materials pose substantially less pest and disease risk than SWPM. Substitute packing materials made of synthetic or highly processed wood such as plywood, oriented strand board, particle board, corrugated paperboard, or plastic and resin composites, generally are not subject to infestation by wood pests or diseases. Although some wood pests may infest plywood and other processed wood packing materials, the frequency of reinfestation of treated or processed wood is known to be low and is unlikely to pose substantial risk of new pest introductions (Dwinell, 2001; Burgess, 2001). Although all packing materials occasionally may have hitchhiking insects and surface pests present, the frequency and numbers of those pests are unlikely to pose substantial risks of introduction.

b. Consequences of Component Methods

There are environmental concerns relating to the manufacture of the substitute packing materials. Some substitute materials would still require the harvesting of wood, and resins or plastics may be required to seal and protect wood surfaces. The particulates from cutting and drilling wood products are generally limited to manufacturing workplace areas. The curing of the resins and plastics in some substitute packing materials release volatile organic contaminants to the air. These vapors are generally of short duration in the air and of negligible impact, but may contribute to local or inside air quality problems. Some of these volatile organics, such as formaldehyde, released in enclosed spaces (rooms of buildings) have been associated with allergic and hypersensitivity reactions. The manufacture of packing materials made exclusively of metal, plastic, and various other processed materials could result in the use of unreplenishable natural resources (metal ores and petroleum) with resultant adverse environmental consequences. Some of the industrial manufacturing processes (e.g., metal packing materials) involve heating and associated combustion processes that release hydrocarbons. These consequences of the substitute packing material manufacturing processes are expected to be temporary or localized.

c. Aggregate Consequences

At present, the market for shipping pallets is dominated by SWPM, which constitutes about 95 percent of the total. SWPM are used in association with 6,000,000 containers that are transported annually in international trade. Industry's inability to quickly tool up to manufacture and switch to substitute packing materials for such a shipping volume may impede or limit the implementation of a switchover. Substitute packing materials are more expensive than SWPM. Also, although some substitute packing materials show great promise (i.e., corrugated pallets), there may be limitations on their use and they may require a phase-in period to allow the industry to adapt these materials to the shipping processes.

Plastics presently constitute a small percentage of the market share, and their use has been limited by the lack of a standard pallet size and the requirement for a closed loop system that is not yet feasible to the pallet industry. Packing methods such as slipsheets (flat, solid, fibre sheets with load-bearing area used as a platform for unitizing, handling, storing, and shipping of commodities) are inexpensive, but require a special push-pull attachment for forklifts that is expensive and not easily adaptable to present practices. Corrugated pallets constitute about 2 percent of the current market and could be expanded to as much as 10 percent in the foreseeable future. Plywood and oriented strand board pallets make up about 2 percent of the market share and are useful packing for heavy loads, but these materials are heavy and cumbersome for transport of many commodities. Some packing materials, such as particle board, are limited in their ability to withstand the conditions that routinely occur during transport.

Based upon the present use pattern, the demand for substitute packing materials may increase, but is unlikely to be the predominant packing material for the foreseeable future. Any aggregate effects from changes to substitute packing materials are not expected to be substantial and are expected to be limited to the site of manufacture and the immediately surrounding environs.

From an environmental perspective, any choice between the materials (wood or alternate materials) that can be used as packing materials should consider at least three processes that are associated with the materials: replenishment, re-use, and recycling. Replenishment applies only to wood, which in a sustainable agriculture system, can be replanted and harvested many times from the same locations. Non-wood packing materials are made from materials (e.g., ores) which are not renewable, although some like aluminum (the most abundant metal on earth) are very plentiful. Packing materials of all composition (wood, metal, plastics, fiberglass, etc.) may be re-used. Because metals such as steel and aluminum are stronger than wood and less vulnerable to rot, they potentially can be re-used more times than wood. Recycling involves the intentional breakdown and reformulation of products. All types of packing materials may be recycled, to varying degrees. Solid wood which has been damaged may be recycled and reformulated into products like particleboard, which can be used again as a packing material. There are limitations, however, to the amount of times wood can be recycled before it is no longer usable. Metals such as steel and aluminum may be crushed and resmelted for use almost indefinitely. Industry’s overall recycling rate for steel is estimated to be 64 percent (Steel Recycling Institution, 2002). Plastics (including polyethylenes, polypropylenes, and polyvinyl chlorides) also may be broken down and reformulated for use again as packing materials. The recycling of fiberglass is of considerable interest to the boat industry in the United States, but it appears that there are, at present, substantial barriers to a cost-effective implementation. There are additional characteristics, such as weight, durability, disposal requirements, electrical conductivity, and cost, which make one material more desirable than another for specific purposes, and which may also influence the degree to which they may be replenished, re-used, or recycled

In conclusion, the requirement to switch to substitute packing materials would result in substantially less pest and disease risk than any of the other components considered in this EIS. The cost of production of substitute materials would be greater than that of SWPM, but many of the substitutes are more durable and more recyclable. The manufacturing processes and uses of raw resources probably would pose some environmental effects, which probably would be offset by the environmental benefit resulting from a reduced demand on raw wood products (depending upon the substitute materials that would be utilized; substantial use of processed wood may result in little difference in resource use).

B. Special Considerations

1. Applicable Environmental Statutes

a. APHIS Environmental Compliance

In the planning and implementation of its programs and actions, the Animal and Plant Health Inspection Service (APHIS) complies with a variety of environmental statutes and regulations. Most of those statutes and regulations have the underlying objective of forcing Federal managers to consider comprehensively the environmental consequences of their actions before making any firm decisions. In addition, the statutes and regulations provide guidance in the procedures that must be followed, the analytical process itself, and the ways of obtaining public involvement. This environmental impact statement is prepared specifically to meet the needs of the National Environmental Policy Act of 1969 (NEPA), 42 United States Code (U.S.C.) 4321 *et seq*.

APHIS strives to comply with environmental regulations and statutes as an integral part of the decisionmaking process to identify and consider available alternatives that lead to more successful programs. NEPA is the origin of current APHIS environmental policy. It requires each Federal agency to publish regulations implementing its procedural requirements. APHIS originally published the “APHIS Guidelines Concerning Implementation of NEPA Procedures” (44 FR 50381–50384, August 28, 1979). Subsequently, it published the APHIS “National Environmental Policy Act Implementing Procedures” (7 CFR. 372), which superseded its earlier guidelines. APHIS bases its current procedures on NEPA itself; the Council on Environmental Quality’s “Regulations for Implementing the Procedural Provisions of the National Environmental Policy Act,” 40 CFR 1500, *et seq*.; the U.S. Department of Agriculture’s “NEPA Regulations,” 7 CFR 1b, 3100; and the APHIS "National Environmental Policy Act Implementing Procedures."

b. The National Environmental Policy Act

NEPA requires Federal agencies to consider potential environmental consequences in their planning and decisionmaking processes. It requires them to prepare detailed statements (environmental impact statements (EIS)) for major Federal actions which significantly affect the quality of the human environment. These statements must consider the environmental impact of the proposed action, adverse effects which cannot be avoided should the proposal be implemented, alternatives to the proposed action, the relationship between local and short-term uses of the human environment, and the maintenance and enhancement of long-term productivity, and any irreversible and irretrievable commitments of resources necessary to implement the action. NEPA provided the basis for many other statutes and environmental regulations within the United States.

NEPA established the President's Council on Environmental Quality, which published regulations for the implementation of NEPA that became effective in 1979. Those regulations were designed to standardize the process that Federal agencies must use to analyze their proposed actions. Those regulations have been the models for the NEPA implementing regulations that have been promulgated by Federal agencies.

c. Endangered Species Act

The Endangered Species Act of 1973 (ESA), 16 U.S.C. 4332 *et seq.*, was passed to provide for a Federal mechanism to protect endangered and threatened species. This act provides for an analysis of the impact of Federal programs upon listed species. Under ESA, animal and plant species must be specifically listed in order to gain protection. Federal agencies proposing programs which could have an effect on listed or proposed endangered and threatened species prepare biological assessments for those species. Those biological assessments analyze potential effects and describe any protective measures the agencies will employ to protect the species. A consultation process, section 7 consultation (after that section of the Act), is employed as needed. Such consultation is important to APHIS' environmental process and then becomes an integral part of the proposed program.

d. Executive Order 12114—Environmental Effects Abroad of Major Actions

Executive Order (EO) 12114, "Environmental Effects Abroad of Major Federal Actions," was written to require Federal officials to become informed of pertinent environmental considerations and take them into account, along with other national policy considerations, when making decisions on certain kinds of Federal actions (generally those that would have significant effects outside the jurisdiction of the United States). The executive order specifically covers major Federal actions that significantly affect (1) the global commons (environment outside the jurisdiction of any nation), (2) the environment of nations not participating in or involved in that action, (3) the environment of a foreign nation by providing to that nation a product that is toxic or radioactive and prohibited or regulated in the United States, and (4) natural or ecological resources of global importance designated by the President.

EO 12114 (section 2–4) specifies the kinds of documents to be used for each class of action above. Types of documents include: environmental impact statements (generic, program, or specific), bilateral or multilateral environmental studies, or concise reviews (including environmental assessments, summary environmental analyses, or other appropriate documents). EO 12114, for some actions, stipulates the preparation of NEPA-type documents; however, NEPA procedures do not apply. Although EO 12114 states that nothing contained in it invalidates any existing regulations of an agency under NEPA and other environmental laws, it explicitly states that it ". . . represents the United States government's exclusive and complete determination of the procedural and other actions to be taken by Federal agencies to further the purpose of NEPA, with respect to the environment outside the United States, its territories and possessions" (section 1–1). Because of its specificity on the type of document to be prepared (based on class of action), it should be regarded as the exclusive procedural guidance for that determination.

e. Executive Order 12898—Environmental Justice

EO 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations," focuses Federal attention on the environmental and human health conditions of minority and low-income communities, and promotes community access to public information and public participation in matters relating to human health or the environment. The document requires Federal agencies to conduct their programs, policies, and activities that substantially affect human health or the environment in a manner so as not to exclude persons and populations from participation in or benefitting from such programs. It also enforces existing statutes to prevent minority and low-income communities from being subjected to disproportionately high and adverse human health or environmental effects.

f. Executive Order 13045—Protection of Children from Environmental Health Risks and Safety Risks

EO 13045, "Protection of Children from Environmental Health Risks and Safety Risks," acknowledges that children may suffer disproportionately from environmental health and safety risks because of their developmental stage, greater metabolic activity levels, and behavior patterns, as compared to adults. The EO (to the extent permitted by law and appropriate, and consistent with the agency's mission) requires each Federal agency to identify, assess, and address environmental health risks and safety risks that may disproportionately affect children. It also established a task force, requires the coordination of research and integration of collected data, gives guidelines for the analysis of effects, and directed the establishment of an "Interagency Forum on Child and Family Statistics.

g. Miscellaneous Federal Environmental Statutes

APHIS complies with a number of other environmental acts, statutes, and regulations. These include the Migratory Bird Treaty Act; Bald and Golden Eagle Act; Federal Insecticide, Fungicide, and Rodenticide Act; Toxic Substances Control Act; Resource Conservation and Recovery Act; Comprehensive Environmental Response, Compensation, and Liability Act of 1980; Clean Air Act; Clean Water Act; and the Food Quality Protection Act. Environmental compliance with these statutes is required to be verified before any program rulemaking or action is undertaken.

h. State Environmental Statutes

The States all have various environmental statutes and regulations. Many of the regulations and regulatory organizations that enforce them are direct parallels of the Federal regulations and regulatory organizations. California, for example, has the California Environmental Quality Act and has formed the California Environmental Protection Agency. For parallel programs and initiatives, APHIS works with State and/or other Federal agencies. APHIS will rely on its State cooperators to identify applicable State environmental regulations, take the lead for their procedures, and ensure full compliance with State laws.

2. Special Concerns

A number of special concerns have evolved with regard to this proposed rulemaking. They include the protection of endangered species; the special requirements for analysis in compliance with EO 12114; and the health and safety of minorities, low-income populations, and children.

a. Endangered Species

APHIS has considered the potential effects on endangered species and has concluded that there will be no adverse effects on endangered and threatened species or their critical habitats as a consequence of program treatments. The additional protection provided to forest resources as a result of the exclusion of invasive species, or as a result of reduced harvesting of forest products if substitute packing materials were required, would probably enhance the protection of endangered species.

b. Analysis in Compliance with Executive Order 12114

The actions that would be implemented as a consequence of this rulemaking would occur within the United States and also in foreign countries. Because the treatments that would be required in foreign countries require the use of products (pesticides) that are strictly regulated in the United States, it is apparent that the EO 12114 applies. EO 12114 stipulates the kinds of documents that may be prepared in such a case, and a draft EIS such as this document is appropriate. This EIS, thus, has been prepared in compliance with EO 12114 and constitutes an EO 12114 analysis.

c. Health and Safety of Minorities, Low-income Populations, and Children

Each of the alternatives was analyzed for its ability to affect minority and low-income populations, and children. Although each of the alternatives could have implications for some individuals, none of the alternatives were found to pose disproportionately high or adverse human health or environmental effects to any specific minority or low-income group, or to children. The packing materials are generally at ports of entry or other locations where children are unlikely to be. The potential program quarantine treatments are in secured facilities with access limited to workers with proper protective clothing. The greatest potential for exposures to humans occurs with preservative treatments that are not being used currently because of cost and concern with potential health issues.

3. Logistical Considerations

Implementation of each of the program alternatives involves specific planning to ensure that the pest risk mitigations can be employed in a timely manner and that monitoring of the efficacy and compliance can be readily accomplished. The frequent use of low quality wood for SWPM has resulted in greater likelihood that pests of quarantine significance are present and that some mitigation of that pest risk may be necessary to exclude those pests.

Inspections of SWPM for compliance and efficacy can be difficult with the limited available documentation. The total amount of inspection possible with the current labor force is estimated to be less than 1 percent of the total number of cargo entries. This means that most potentially infested SWPM with associated cargo is unlikely to be inspected. Selecting for inspection only those cargo shipments that are most likely to be infested is difficult. Visual inspections of wood packing, particularly in large containers, may not reveal internal infestation of fungi, wood borers, and termites. Entries on customs manifests may not always indicate the presence of SWPM or documentation of specific quarantine treatments may not be provided. The ability to verify compliance with required quarantine treatments is vital to exclusion of pest risks. Although some treatments (e.g., wood preservative and some heat treatments) may change the appearance of SWPM, other treatment may have no effect on the appearance (e.g., fumigations, irradiation, and controlled atmospheres). Markings on treated wood are helpful, but all treated SWPM must be marked to be of optimal use to inspection. Tests (such as electrical conductivity for kiln-dried SWPM) for verification of treatment are not available for most quarantine methods and may not indicate reinfestation potential. Although adequate initial treatment may make reinfestation less likely to occur, there is generally no residual control (except with some preservative treatments). Each of these issues require inspections to adjust efforts to exclude potential pest risks that may not be evident from available documents.

Emissions of methyl bromide from quarantine fumigations of SWPM may be decreased by the use of recapture systems. However, the use of recapture systems requires adequate availability of the components of the recapture system and the ability to recharge the canisters that collect the residues of methyl bromide. The suppliers of recapture systems and the servicers of used canisters could not readily meet the potential need for a major conversion of all quarantine fumigations to include gas recapture technology. In addition, the present costs of recapture systems are uneconomical for most SWPM manufacturers and shippers.

Although heat treatment and fumigation with methyl bromide control most pests of quarantine concern in SWPM, there are some deep wood-borers, fungi, rots, and wilts that will continue to be problematic for abatement of pest risk. Heat treatment may be impractical for large volumes of wood or thick pieces of wood without elaborate heat sensors. The effectiveness of methyl bromide is less than that of heat treatment for pests that occur deep in wood. None of the treatment methods have been shown to effectively eliminate all pests. The differences in overall efficacy of the heat treatments and fumigations with methyl bromide for the IPPC Guidelines, as compared to the those from extension of the China Interim Rule, are unclear and any important differences may not be elucidated by the limited testing completed prior to any implementation. The use of the more effective and long-residual wood preservatives such as creosote can involve human exposure to undesirably high amounts of chemical. Many of the treatment methods require more research and development of effective methods. In particular, the uses of controlled atmospheres, irradiation treatments, and most fumigation chemicals are not ready for implementation due to inadequate control, incomplete efficacy data, issues of concern related to safety, issues related to lack of adequate facilities or supplies, and the lack of an economical means of fulfilling the treatment requirements.

The disposal of SWPM involves several logistical concerns. The availability of acceptable landfill space or an incineration facility limit this method. Transport of the SWPM to these locations must be designed to preclude escape of any quarantine pests present. The use of chemical preservatives on some SWPM can create landfill contamination concerns and incineration emission concerns.

At present, the market for shipping pallets is dominated by SWPM, which constitutes about 95 percent of the total. The use of substitute packing materials could increase as manufacturers tool up to produce more of these packing materials. However, the current projections indicate that the increase in use of substitute packing materials could constitute no more than 10 to 15 percent of the total market in the next several years. This makes it unlikely that substitute packing materials alone will be used in the packaging of cargo.

4. Harmonization of Regulatory Efforts

In addition to considering the efficacies and environmental consequences of alternative courses of action, APHIS is obligated to work within applicable international agreements and protocols in its effort to develop an appropriate regulatory strategy for imported SWPM. Some of the agreements focus on the environment and protection of resources (e.g., the Montreal Protocol and the International Plant Protection Convention), while others focus on the facilitation of international trade (e.g., the General Agreement on Trade and Tariffs and the North American Free Trade Agreement). Although various agreements may have different primary purposes (environmental protection or trade facilitation), their objectives are not necessarily mutually exclusive.

The overall motivation of a group or organization would tend to influence its perspective on what alternative would be the most appropriate for APHIS' regulatory strategy. Industry and trade organizations that have commented to APHIS appear to favor the preferred alternative, adoption of the IPPC Guidelines, citing the need for effective, logistically possible measures to mitigate the risk from invasive species in SWPM. The Canadian Food Inspection Agency has also urged APHIS to adopt the IPPC Guidelines, citing significant advantages for global trade and pest prevention, and acknowledging cooperation between the United States, Canada, and Mexico. Environmental interest groups and concerned individuals, on the other hand, have acknowledged in their comments the need to mitigate the risk from invasive species in SWPM, but favor alternative 5, substitute packing materials only (prohibition of SWPM), because it has the least adverse environmental impact. All of those perspectives appear correct and everyone seems to agree on the need to do something about SWPM, but differs on what it is that should be done.

Following are concise descriptions of the aforementioned international agreements, and some aspects of how they may affect APHIS' regulatory strategy for SWPM.

a. The Montreal Protocol

The 1987 Montreal Protocol on Substances that Deplete the Ozone Layer was designed to reduce and eventually eliminate emissions of anthropogenic ozone-depleting substances. The agreement was developed in response to evidence that human-made substances, particularly chlorofluorocarbons, were damaging the stratospheric ozone layer that protects life on earth from excessive ultraviolet radiation. The United States has signed the Protocol, which originally came into effect on January 1, 1989, when 29 countries and the European Economic Community (EC) ratified it.

Although the Montreal Protocol exempts phytosanitary uses of methyl bromide for quarantine and preshipment (QPS) purposes, there are valid concerns about methyl bromide's continued availability. The cumulative impacts of methyl bromide use were analyzed previously in APHIS' "Proposed Rule for the Importation of Unmanufactured Wood Articles

From Mexico, With Consideration for Cumulative Impact of Methyl Bromide Use." Although the emissions from the QPS uses of methyl bromide are miniscule in comparison to the emissions of other agents and gases released in natural processes, the United States is subject to the reduction requirements of the Montreal Protocol and phaseout requirements for methyl bromide that have been set by EPA under the Clean Air Act. It is clear that an alternative for methyl bromide is needed for a long-term strategy.

b. The International Plant Protection Convention

The International Plant Protection Convention (IPPC) dates from about 1952, and was designed to promote international cooperation for controlling and preventing the spread of harmful plant pests. In 1995, the WTO's "Agreement on the Application of Sanitary and Phytosanitary Measures" (SPS Agreement) specifically recognized the standards, guidelines, and recommendations developed by the IPPC. The WTO mediates trade-related disputes and seeks international harmonization of SPS measures through the IPPC Secretariat and two other international standards-setting organizations. Thus, the focus of the IPPC is both environmental protection and trade facilitation.

The most recent revision of the IPPC was presented for adoption on November 17, 1997, and was formally adopted by President George W. Bush on September 5, 2001. Under the IPPC, measures imposed by a country against regulated pests are acceptable if such measures are (1) transparent (clear to all signatory nations), (2) technically justified, and (3) no more restrictive than measures imposed domestically. APHIS would be expected to give serious consideration to adopting the IPPC Guidelines that apply to SWPM, or show just cause why a deviation was required.

c. The General Agreement on Tariffs and Trade

The General Agreement on Tariffs and Trade (GATT) was designed to reduce and eliminate barriers to trade, investment and services among its signatory countries. Since its implementation in 1947, GATT has been administered by the International Trade Organization, then the GATT (de facto name organization), and now the WTO. The recent negotiations for the agreement were completed in the 1986–1994 Uruguay Round and led to the creation of the WTO in 1995.

A common complaint among nations is the imposition of unreasonable phytosanitary restrictions that are thought to be nothing more than deliberate barriers to fair trade. GATT has focused on the reduction of trade barriers through the elimination of unjustified sanitary and phytosanitary restrictions on agricultural trade, without imparing the right of individual nations to establish and apply appropriate measures to protect public health and control plant and animal pests and diseases. The IPPC Guidelines appear to conform with the design and objectives of GATT.

d. The North American Free Trade Agreement

The North American Free Trade Agreement (NAFTA) is an agreement among the United States, Canada, and Mexico to create a free trade zone by reducing and eliminating barriers to trade, investment, and services. The U.S. Congress ratified NAFTA in 1993. The requirements for sanitary and phytosanitary regulations under NAFTA are similar to those under GATT, except for requirements imposed by side agreements. One of those side agreements, the North American Agreement on Environmental Cooperation is a trilateral side agreement to NAFTA (also among the United States, Canada, and Mexico) which established the Commission for Environmental Cooperation (CEC), whose primary function is the consideraion and development of recommendations relating to environmental issues. In particular, one of CEC's missions is to develop an Executive Agreement to be signed by the heads of the three countries which would set standards and requirements for transboundary environmental impact assessment (TEIA). Current drafts of that agreement will require notification and assessment for proposed actions that involve the use of pesticides (except for emergency actions to preserve human, animal or plant life) regardless of their proximities to the international borders. In general, the IPPC Guidelines appear to conform with the design and objectives of NAFTA.

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Appendix E. “Guidelines For Regulating Wood Packaging Material in International Trade”

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INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES

GUIDELINES FOR REGULATING WOOD PACKAGING MATERIAL IN INTERNATIONAL TRADE

Secretariat of the International Plant Protection Convention
Food and Agriculture Organization of the United Nations
Rome, 2002

CONTENTS

Endorsement

International standards for phytosanitary measures are prepared by the Secretariat of the International Plant Protection Convention as part of the United Nations Food and Agriculture Organization's global programme of policy and technical assistance in plant quarantine. This programme makes available to FAO Members and other interested parties these standards, guidelines and recommendations to achieve international harmonization of phytosanitary measures, with the aim to facilitate trade and avoid the use of unjustifiable measures as barriers to trade.

This standard was endorsed by the Interim Commission on Phytosanitary Measures in March 2002.

Jacques Diouf
Director-General
Food and Agriculture Organization of the United Nations

Application

International standards for phytosanitary measures (ISPMs) are adopted by contracting parties to the IPPC, and by FAO Members that are not contracting parties, through the Interim Commission on Phytosanitary Measures. ISPMs are the standards, guidelines and recommendations recognized as the basis for phytosanitary measures applied by Members of the World Trade Organization under the Agreement on the Application of Sanitary and Phytosanitary Measures. Non-contracting parties to the IPPC are encouraged to observe these standards.

Review and amendment

International standards for phytosanitary measures are subject to periodic review and amendment. The next review date for this standard is 2004, or such other date as may be agreed upon by the Commission on Phytosanitary Measures.

Standards will be updated and republished as necessary. Standard holders should ensure that the current edition of this standard is being used.

Distribution

International standards for phytosanitary measures are distributed by the Secretariat of the International Plant Protection Convention to all FAO Members, plus the Executive/Technical Secretariats of the Regional Plant Protection Organizations:

- Asia and Pacific Plant Protection Commission
- Caribbean Plant Protection Commission
- Comité Regional de Sanidad Vegetal para el Cono Sur
- Comunidad Andina
- European and Mediterranean Plant Protection Organization
- Inter-African Phytosanitary Council
- North American Plant Protection Organization
- Organismo Internacional Regional de Sanidad Agropecuaria
- Pacific Plant Protection Organization.

INTRODUCTION

SCOPE

This standard describes phytosanitary measures to reduce the risk of introduction and/or spread of quarantine pests associated with wood packaging material (including dunnage), made of coniferous and non-coniferous raw wood, in use in international trade.

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DEFINITIONS AND ABBREVIATIONS

bark-free wood	Wood from which all bark excluding the vascular cambium, ingrown bark around knots, and bark pockets between rings of annual growth has been removed [ISPM Pub. No. 15, 2002]
chemical pressure impregnation	Treatment of wood with a chemical preservative through a process of pressure in accordance with an officially recognized technical specification [ISPM Pub. No. 15, 2002]
certificate	An official document which attests to the phytosanitary status of any consignment affected by phytosanitary regulations [FAO, 1990]
commodity	A type of plant, plant product, or other article being moved for trade or other purpose [FAO, 1990; revised ICPM, 2001]
consignment	A quantity of plants, plant products and/or other articles being moved from one country to another and covered, when required, by a single phytosanitary certificate (a consignment may be composed of one or more commodities or lots) [FAO, 1990; revised ICPM, 2001]
debarking	Removal of bark from round wood (debarking does not necessarily make the wood bark-free) [FAO, 1990]
dunnage	Wood packaging material used to secure or support a commodity but which does not remain associated with the commodity [FAO, 1990; revised ISPM Pub. No. 15, 2002]
emergency action	A prompt phytosanitary action undertaken in a new or unexpected phytosanitary situation [ICPM, 2001]

emergency measure	A phytosanitary regulation or procedure established as a matter of urgency in a new or unexpected phytosanitary situation. An emergency measure may or may not be a provisional measure [ICPM, 2001]
free from (of a consignment, field, or place of production)	Without pests (or a specific pest) in numbers or quantities that can be detected by the application of phytosanitary procedures [FAO, 1990; revised FAO, 1995; CEPM, 1999]
fumigation	Treatment with a chemical agent that reaches the commodity wholly or primarily in a gaseous state [FAO, 1990; revised FAO, 1995]
heat treatment	The process in which a commodity is heated until it reaches a minimum temperature for a minimum period of time according to an officially recognized technical specification [ISPM Pub. No. 15, 2002]
infestation (of a commodity)	Presence in a commodity of a living pest of the plant or plant product concerned. Infestation includes infection [CEPM, 1997; revised CEPM, 1999]
interception (of a pest)	The detection of a pest during inspection or testing of an imported consignment [FAO, 1990; revised CEPM, 1996]
kiln-drying	A process in which wood is dried in a closed chamber using heat and/or humidity control to achieve a required moisture content [ISPM Pub. No. 15, 2002]
mark	An official stamp or brand, internationally recognized, applied to a regulated article to attest its phytosanitary status [ISPM Pub. No. 15, 2002]
NPPO	National Plant Protection Organization [FAO, 1990; ICPM, 2001]
official	Established, authorized or performed by a National Plant Protection Organization [FAO, 1990]
Pest Risk Analysis	The process of evaluating biological or other scientific and economic evidence to determine whether a pest should be regulated and the strength of any phytosanitary measures to be taken against it [FAO, 1990; revised IPPC, 1997]
phytosanitary action	An official operation, such as inspection, testing, surveillance or treatment, undertaken to implement phytosanitary regulations or procedures [ICPM, 2001]
phytosanitary measure (agreed interpretation)	Any legislation, regulation or official procedure having the purpose to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests [FAO, 1995; revised IPPC, 1997; ISC, 2001]

The agreed interpretation of the term phytosanitary measure accounts for the relationship of phytosanitary measures to regulated non-quarantine pests. This relationship is not adequately reflected in the definition found in Article II of the IPPC (1997).

phytosanitary procedure	Any officially prescribed method for implementing phytosanitary regulations including the performance of inspections, tests, surveillance or treatments in connection with regulated pests [FAO, 1990; revised FAO, 1995; CEPM, 1999; ICPM, 2001]
phytosanitary regulation	Official rule to prevent the introduction and/or spread of quarantine pests, or to limit the economic impact of regulated non-quarantine pests, including establishment of procedures for phytosanitary certification [FAO, 1990; revised FAO, 1995; CEPM, 1999; ICPM, 2001]
plant products	Unmanufactured material of plant origin (including grain) and those manufactured products that, by their nature or that of their processing, may create a risk for the introduction and spread of pests [FAO, 1990; revised IPPC, 1997; formerly Plant product]
PRA	Pest risk analysis [FAO, 1995]
processed wood material	Products that are a composite of wood constructed using glue, heat and pressure, or any combination thereof [ISPM Pub. No. 15, 2002]
quarantine pest	A pest of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed and being officially controlled [FAO, 1990; revised FAO, 1995; IPPC, 1997]
raw wood	Wood which has not undergone processing or treatment [ISPM Pub. No. 15, 2002]
regulated article	Any plant, plant product, storage place, packaging, conveyance, container, soil and any other organism, object or material capable of harbouring or spreading pests, deemed to require phytosanitary measures, particularly where international transportation is involved [CEPM, 1996; revised CEPM, 1999; ICPM, 2001]
test	Official examination, other than visual, to determine if pests are present or to identify pests [FAO, 1990]
treatment	Officially authorized procedure for the killing or removal of pests or rendering pests infertile [FAO, 1990; revised FAO, 1995; ISPM Pub. No. 15, 2002]
wood	A commodity class for round wood, sawn wood, wood chips or dunnage, with or without bark [FAO, 1990; revised ICPM, 2001]
wood packaging material	Wood or wood products (excluding paper products) used in supporting, protecting or carrying a commodity (includes dunnage) [ISPM Pub. No. 15, 2002]

OUTLINE OF REQUIREMENTS

Wood packaging material made of unprocessed raw wood is a pathway for the introduction and spread of pests. Because the origin of wood packaging material is often difficult to determine, globally approved measures that significantly reduce the risk of pest spread are described. NPPOs are encouraged to accept wood packaging material that has been subjected to an approved measure without further requirements. Such wood packaging material includes dunnage, but excludes processed wood packaging material.

Procedures to verify that an approved measure, including the application of a globally recognized mark, has been applied should be in place in both exporting and importing countries. Other measures agreed to under a bilateral arrangement are also considered in this standard. Wood packaging material that does not comply with the requirements of this standard should be disposed of in an approved manner.

REGULATORY REQUIREMENTS

1. Basis for Regulating

Wood packaging material is frequently made of raw wood that may not have undergone sufficient processing or treatment to remove or kill pests and therefore becomes a pathway for the introduction and spread of pests. Furthermore, wood packaging material is very often re-used, recycled or re-manufactured (in that packaging received with an imported consignment may be re-used to accompany another consignment for export). The true origin of any piece of wood packaging material is difficult to determine and thus its phytosanitary status cannot be ascertained. Therefore the normal process of undertaking risk analysis to determine if measures are necessary and the strength of such measures is frequently not possible for wood packaging material because its origin and phytosanitary status may not be known. For this reason, this standard describes globally accepted measures that are approved and that may be applied to wood packaging material by all countries to practically eliminate the risk for most quarantine pests and significantly reduce the risk from a number of other pests that may be associated with that material.

Countries should have technical justification for requiring the application of the approved measures as described in this standard for imported wood packaging material. Requiring phytosanitary measures beyond an approved measure as described in this standard also requires technical justification.

2. Regulated Wood Packaging Material

These guidelines are for coniferous and non-coniferous raw wood packaging material that may serve as a pathway for plant pests posing a threat mainly to living trees. They cover wood packaging material such as pallets, dunnage, crating, packing blocks, drums, cases, load boards, pallet collars, and skids which can be present in almost any imported consignment, including consignments which would not normally be the target of phytosanitary inspection.

Wood packaging made wholly of wood-based products such as plywood, particle board, oriented strand board or veneer that have been created using glue, heat and pressure or a combination thereof should be considered sufficiently processed to have eliminated the risk associated with the raw wood. It is unlikely to be infested by raw wood pests during its use and therefore should not be regulated for these pests.

Wood packaging material such as veneer peeler cores[1], sawdust, wood wool, and shavings, and raw wood cut into thin[2] pieces may not be pathways for introduction of quarantine pests and should not be regulated unless technically justified.

3. Measures for Wood Packaging Material

3.1 Approved measures

Any treatment, process, or a combination of these that is significantly effective against most pests should be considered effective in mitigating pest risks associated with

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[1] Veneer peeler cores are a by-product of veneer production involving high temperatures and comprising the center of a log remaining after the peeling process.

[2] Thin wood is considered to be 6mm thickness or less according to the Customs Harmonized Commodity Description and Coding System (the Harmonized System or HS).

wood packaging material used in transport. The choice of a measure for wood packaging material is based on consideration of:

- the range of pests that may be affected
- the efficacy of the measure
- the technical and/or commercial feasibility.

Approved measures should be accepted by all NPPOs as the basis for authorizing the entry of wood packaging material without further requirements except where it is determined through interceptions and/or PRA that specific quarantine pests associated with certain types of wood packaging material from specific sources require more rigorous measures.

Approved measures are specified in Annex I.

Wood packaging material subjected to these approved measures should display a specified mark shown in Annex II.

The use of marks addresses the operational difficulties associated with the verification of compliance with treatment for wood packaging material. A universally recognized, non-language specific mark facilitates verification during inspection at the point of export, at the point of entry or elsewhere.

References for supporting documentation on approved measures are available from the IPPC Secretariat.

3.2 Measures pending approval

Other treatments or processes for wood packaging material will be approved when it can be demonstrated that they provide an appropriate level of phytosanitary protection (Annex III). The currently measures identified in Annex I continue to be under review, and new research may point, for example, to other temperature/time combinations. New measures may also reduce risk by changing the character of the wood packaging material. NPPOs should be aware that measures may be added or changed and should have sufficiently flexible import requirements for wood packaging to accommodate changes as they are approved.

3.3 Other measures

NPPOs may accept any measures other than those listed in Annex I by arrangement with their trading partners, especially in cases where the measures listed in Annex I cannot be applied or verified in the exporting country. Such measures should be technically justified and respect the principles of transparency, non-discrimination and equivalence.

The NPPOs of importing countries should consider other arrangements for wood packaging material associated with exports from any country (or particular source) where evidence is provided which demonstrates that the pest risk is adequately managed or absent (e.g. areas with similar phytosanitary situations or pest free areas).

Certain movements of wood packaging material (e.g. tropical hardwoods associated with exports to temperate countries) may be considered by the importing NPPO not to carry a phytosanitary risk and thus can be exempted from measures.

Subject to technical justification, countries may require that imported wood packaging material subjected to an approved measure be made from debarked wood and display a mark as shown in Annex II.

3.4 Review of measures

The approved measures specified in Annex I and the list of measures under consideration in Annex III should be reviewed based on new information provided to the Secretariat by NPPOs. This standard should be amended appropriately by the ICPM.

OPERATIONAL REQUIREMENTS

To meet the objective of preventing the spread of pests, both exporting and importing countries should verify that the requirements of this standard have been met.

4. Dunnage

Ideally, dunnage should also be marked in accordance with Annex II of this standard as having been subjected to an approved measure. If not, it requires special consideration and should, as a minimum, be made from bark-free wood that is free from pests and signs of live pests. Otherwise it should be refused entry or immediately disposed of in authorized manner (see section 6).

5. Procedures Used Prior to Export

5.1 Compliance checks on procedures applied prior to export

The NPPO of the exporting country has responsibility for ensuring that systems for exports meet the requirements set out in this standard. It includes monitoring certification and marking systems that verify compliance, and establishing inspection procedures (see also ISPM Pub. No. 7: *Export certification system*), registration or accreditation and auditing of commercial companies that apply the measures, etc.

5.2 Transit arrangements

Where consignments moving in transit have exposed wood packaging material that has not met the requirements for approved measures, the NPPOs of the transit countries may require measures in addition to those of the importing country to ensure that wood packaging material does not present an unacceptable risk.

6. Procedures upon Import

The regulation of wood packaging material requires that NPPOs have policies and procedures for other aspects of their responsibilities related to wood packaging material.

Since wood packaging materials are associated with almost all shipments, including those not normally the target of phytosanitary inspections, cooperation with agencies, organizations, etc. not normally involved with meeting phytosanitary export conditions or import requirements is important. For example, cooperation with Customs organizations should be reviewed to ensure effectiveness in detecting potential non-compliance of wood packaging material. Cooperation with the producers of wood packaging material also needs to be developed.

6.1 Measures for non-compliance at point of entry

Where wood packaging material does not carry the required mark, action may be taken unless other bilateral arrangements are in place. This action may take the form of treatment, disposal or refused entry. The NPPO of the exporting country may be notified (see ISPM Pub. No. 13: *Guidelines on notification of non-compliance and emergency action*). Where the wood packaging material does carry the required mark, and evidence of live pests is found, action can be taken. These actions may take the form of treatment, disposal or refused entry. The NPPO of the exporting country should be notified in cases where live pests are found, and may be notified in other cases (see ISPM Pub. No. 13: *Guidelines on notification of non-compliance and emergency action).*

6.2 Disposal

Disposal of wood packaging material is a risk management option that may be used by the NPPO of the importing country upon arrival of the wood packaging material where treatment is not available or desirable. The following methods are recommended for the disposal of wood packaging material where this is required. Wood packaging material that requires emergency action should be appropriately safeguarded prior to treatment or disposal to prevent escape of any pest between the time of the detection of the pest posing the threat and the time of treatment or disposal.

Incineration
Complete burning

Burial
Deep burial in sites approved by appropriate authorities. (Note: not a suitable disposal option for wood infested with termites). The depth of the burial may depend on climatic conditions and the pest, but is recommended to be at least 1 metre. The material should be covered immediately after burial and should remain buried.

Processing
Chipping and further processing in a manner approved by the NPPO of the importing country for the elimination of pests of concern (e.g. manufacture of oriented strand board).

Other methods
Procedures endorsed by the NPPO as effective for the pests of concern.

The methods should be applied with the least possible delay.

ANNEX I

APPROVED MEASURES ASSOCIATED WITH WOOD PACKAGING MATERIAL

Heat treatment (HT)

Wood packaging material should be heated in accordance with a specific time-temperature schedule that achieves a minimum wood core temperature of 56°C for a minimum of 30 minutes[3].

Kiln-drying (KD), chemical pressure impregnation (CPI), or other treatments may be considered HT treatments to the extent that these meet the HT specifications. For example, CPI may meet the HT specification through the use of steam, hot water, or dry heat.

Heat treatment is indicated by the mark HT. (see Annex II)

Methyl bromide (MB) fumigation for wood packaging material

The wood packaging material should be fumigated with methyl bromide. The treatment is indicated by the mark MB. The minimum standard for methyl bromide fumigation treatment for wood packaging material is as follows:

Temperature	Dosage rate	Minimum concentration (g/m^3) at:			
		0.5hrs.	2hrs.	4hrs.	16hrs.
21°C or above	48	36	24	17	14
16°C or above	56	42	28	20	17
11°C or above	64	48	32	22	19

The minimum temperature should not be less than 10°C and the minimum exposure time should be 16 hours.[4]

List of most significant pests targeted by HT and MB

Members of the following pest groups associated with wood packaging material are practically eliminated by HT and MB treatment in accordance with the specifications listed above:

Pest group
Insects
Anobiidae
Bostrichidae
Buprestidae
Cerambycidae
Curculionidae
Isoptera
Lyctidae (with some exceptions for HT)
Oedemeridae
Scolytidae
Siricidae
Nematodes
Bursaphelenchus xylophilus

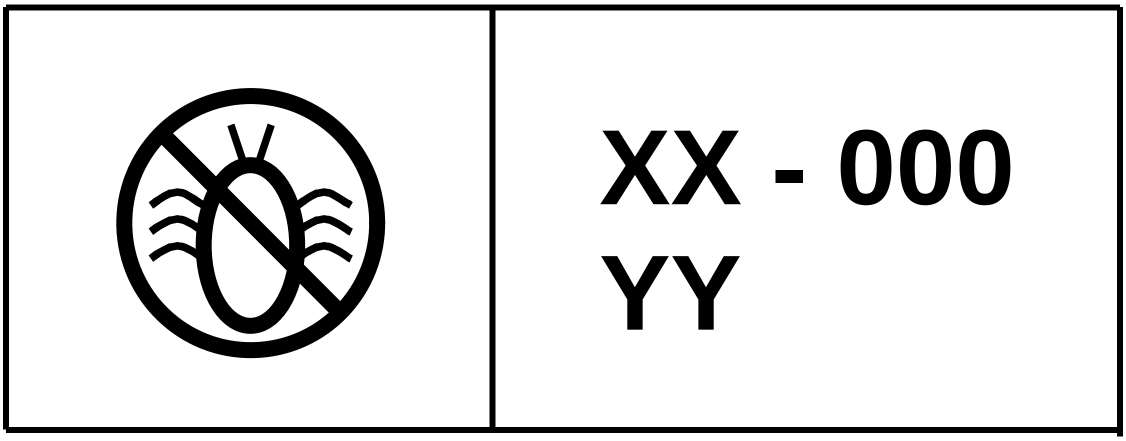
[3] A minimum core temperature of 56° C for a minimum of 30 min. is chosen in consideration of the wide range of pests for which this combination is documented to be lethal and a commercially feasible treatment. Although it is recognized that some pests are known to have a higher thermal tolerance, quarantine pests in this category are managed by NPPOs on a case by case basis.

[4] Certain countries require that the minimum commodity temp should be higher

ANNEX II

MARKING FOR APPROVED MEASURES

The mark shown below is to certify that the wood packaging material that bears the mark has been subjected to an approved measure.



The mark should at minimum include the:

- symbol
- ISO two letter country code followed by a unique number assigned by the NPPO to the producer of the wood packaging material, who is responsible for ensuring appropriate wood is used and properly marked
- IPPC abbreviation according to Annex I for the approved measure used (e.g. HT, MB).

NPPOs, producers or suppliers may at their discretion add control numbers or other information used for identifying specific lots. Where debarking is required the letters DB should be added to the abbreviation of the approved measure. Other information may also be included provided it is not confusing, misleading, or deceptive.

Markings should be:

- according to the model shown here
- legible
- permanent and not transferable
- placed in a visible location, preferably on at least two opposite sides of the article being certified.

The use of red or orange should be avoided since these colors are used in the labeling of dangerous goods.

Recycled, remanufactured or repaired wood packaging material should be re-certified and re-marked. All components of such material should have been treated.

Shippers should be encouraged to use appropriately marked wood for dunnage.

ANNEX III

MEASURES BEING CONSIDERED FOR APPROVAL UNDER THIS STANDARD

Treatments[5] being considered and which may be approved when appropriate data becomes available, include but are not limited to:

Fumigation
Phosphine
Sulfuryl fluoride
Carbonyl sulphide

CPI
High-pressure/vacuum process
Double vacuum process
Hot and cold open tank process
Sap displacement method

Irradiation
Gamma radiation
X-rays
Microwaves
Infra red
Electron beam treatment

Controlled atmosphere

[5] Certain treatments such as phosphine fumigation and some CPI treatments are generally believed to be very effective but at present lack experimental data concerning efficacy which would allow them to be approved measures. This present lack of data is specifically in relation to the elimination of raw wood pests present at the time of application of the treatment.

For further information on international standards, guidelines and recommendations concerning phytosanitary measures, and the complete list of current publications, please contact the:

SECRETARIAT OF THE INTERNATIONAL PLANT PROTECTION CONVENTION

By mail:	IPPC Secretariat Plant Protection Service Food and Agriculture Organization of the United Nations (FAO) Viale delle Terme di Caracalla 00100 Rome, Italy
Fax:	+39-06-570.56347
E-mail:	ippc@fao.org
Website:	http://www.ippc.int

INTERNATIONAL STANDARDS FOR PHYTOSANITARY MEASURES (ISPMS)

New Revised Text of the International Plant Protection Convention, 1997. FAO, Rome.
ISPM Pub. No. 1: *Principles of plant quarantine as related to international trade*, 1995. FAO, Rome.
ISPM Pub. No. 2: *Guidelines for pest risk analysis*, 1996. FAO, Rome.
ISPM Pub. No. 3: *Code of conduct for the import and release of exotic biological control agents*, 1996. FAO, Rome.
ISPM Pub. No. 4: *Requirements for the establishment of pest free areas*, 1996. FAO, Rome.
ISPM Pub. No. 5: *Glossary of phytosanitary terms*, 1999. FAO, Rome.
Glossary Supplement No. 1: *Guidelines on the interpretation and application of the concept of official control for regulated pests*, 2001. FAO, Rome.
ISPM Pub. No. 6: *Guidelines for surveillance*, 1997. FAO, Rome.
ISPM Pub. No. 7: *Export certification system*, 1997. FAO, Rome.
ISPM Pub. No. 8: *Determination of pest status in an area*, 1998. FAO, Rome.
ISPM Pub. No. 9: *Guidelines for pest eradication programmes*, 1998. FAO, Rome.
ISPM Pub. No. 10: *Requirements for the establishment of pest free places of production and pest free production sites*, 1999. FAO, Rome.
ISPM Pub. No. 11: *Pest risk analysis for quarantine pests*, 2001. FAO, Rome.
ISPM Pub. No. 12: *Guidelines for phytosanitary certificates*, 2001. FAO, Rome.
ISPM Pub. No. 13: *Guidelines for the notification of non-compliance and emergency action*, 2001. FAO, Rome.
ISPM Pub. No. 14: *The use of integrated measures in a systems approach for pest risk management*, 2002. FAO, Rome.
ISPM Pub. No. 15: *Guidelines for regulating wood packaging material in international trade*, 2002. FAO, Rome.
ISPM Pub. No. 16: *Regulated non-quarantine pests: concept and application*, 2002. FAO, Rome.
ISPM Pub. No. 17: *Pest reporting*, 2002. FAO, Rome.

Appendix F. Acronyms and Glossary

A

ACGIH American Conference of Governmental Industrial Hygienists

APHIS Animal and Plant Health Inspection Service, United States Department of Agriculture

ARS Agricultural Research Service, United States Department of Agriculture

B

Biodiversity Genetic variability of species and variability of environmental processes within a given geographical area or ecological community.

C

CEC Commission for Environmental Cooperation

CEQ Council on Environmental Quality

CFC's Chlorofluorocarbons

CFR Code of Federal Regulations

Chlorofluorocarbons Organic chemical substances containing chlorine and fluorine.

cm Centimeters

Controlled atmosphere Treatment of commodity to asphyxiate (suffocate) parts by displacement of oxygen.

Cumulative impact or effects ". . . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." (40 CFR 1508.7).

D

Debarking — The process of removing bark from logs and other regulated wood articles, including dunnage.

E

EA — Environmental assessment

Ecosystem — A functioning natural unit including the biological species present, the physical environment (soil, water, air), and relationships among the components present.

EEC — European Economic Community

EIS — Environmental impact statement

Electron beam irradiation — A form of radiation that has experimentally been used to treat wood; the radiation is generated by machine rather than from a radioactive isotope.

Entry — The physical arrival of a pest organism at a particular port or location.

EO — Executive Order

EPA — Environmental Protection Agency

Established — A permanent infestation of a pest organism in a given area.

Establishment — Perpetuation, for the foreseeable future, of a pest within an area after introduction.

EU — European Union

F

FAO — Food and Agriculture Organization, United Nations

FIFRA — Federal Insecticide, Fungicide, and Rodenticide Act

Frass — Excretory products from insects.

FS — USDA, Forest Service

Fumigant	The gaseous state of a toxic chemical which, when released and dispersed to a commodity, is designed to kill any pests found on or within the commodity.
Fumigation	The act of releasing or dispersing a gaseous or aerosol compound (fumigant) to eliminate pest risk.
Fumigation chamber	Enclosed structure where commodities are treated with gaseous or aerosol compound to eliminate pest risk.

G

Gamma irradiation	A nonchemical treatment method that has been used to sterilize or kill certain pest species by exposure to specific wavelengths of light rays and is a method that is most often used to treat commodities other than wood.
GATT	General Agreement on Trade and Tariffs; an international agreement designed to reduce and eliminate barriers to trade, investment, and services among its signatory countries.
Global warming/global climate change	The process by which energy distribution within the atmosphere affects temperature and climate worldwide.
Grams per cubic meter (g/m^3)	Measurement of fumigant concentration in air.
Gray	In irradiation treatments, an amount of energy (1 joule or 1,000 ergs) absorbed from a radiation-producing source per kilogram of matter; 1 Gray equals 100 rads.
Greenhouse gases/effect	Any one of several chemicals present in air that store and retain heat and may cause warming of air temperatures (effect).

H

Harmonization	Process of making Federal regulations consistent and compatible with other Federal regulations, International treaties and agreements, and related trade initiatives.
Heat treatment	Regulatory quarantine action of applying high temperature to a commodity to eliminate pest risk.

Hectare Unit of area measure equal to 2.471 acres.

I

Introduction The intentional or unintentional escape, release, dissemination, or placement of a species into an ecosystem as a result of human activity.

IPM Integrated Pest Management; an approach to pest control that involves consideration to all practical chemical and nonchemical methods.

IPPC International Plant Pest Convention

Irradiation Regulatory treatment which exposes a commodity to light rays resulting in elimination of pest risk.

ITO International Trade Organization

K

Kiln drying A process for heating and drying wood in an enclosed facility. The specific procedures are described in the Dry Kiln Operators Manual.

M

m^3 Cubic meters

MBTOC Methyl Bromide Technical Options Committee

Microwave treatment Exposing wood to ultra-high frequency magnetic fields that elevate the temperature of any material containing moisture.

Mitigation Measures taken to avoid or reduce adverse impacts on the environment; or measures taken to avoid or reduce the likelihood of pest presence or survival in a commodity.

MT Metric tons

N

NAFTA North American Free Trade Agreement

NEPA National Environmental Policy Act

Nonquarantine pest An undesirable organism not officially controlled but of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed.

O

ODP Ozone depleting potential (under stratospheric ozone layer).

ODS Ozone depleting substance; literally, a substance which acts to reduce the amount of ozone in the atmosphere.

Ozone A compound consisting of three connected oxygen atoms found in two layers of the atmosphere, the stratosphere and the troposphere.

P

Phytosanitary measures Any legislation, regulation, or official procedure having the purpose to prevent the introduction and/or spread of pests.

Phytotoxicity The ability of a chemical to adversely affect plant growth or survival.

Plant pest "Any living stage of any insects, mites, nematodes, slugs, snails, protozoa, or other invertebrate animals, bacteria, fungi, other parasitic plants or reproductive parts of parasitic plants, noxious weeds, viruses, or any organism similar to or allied with any of the foregoing, or any infectious substances, which can injure or cause disease or damage in any plants, parts of plants, or any products of plants." (7 CFR 319.40–1).

PPM Parts per million

PPQ Plant Protection and Quarantine, Animal and Plant Health Inspection Service, United States Department of Agriculture

Q

QPS Quarantine and preshipment

Quarantine pest An undesirable organism, officially controlled and of potential economic importance to the area endangered thereby and not yet present there, or present but not widely distributed.

R

Rad	In irradiation treatments, an amount of energy absorbed from a radiation producing source per kilogram of matter; one rad equals 1/100 Gray.
Recapture system	The part of fumigation equipment designed to remove methyl bromide when treatment is completed. Equipment consists of an intake from fumigation chamber, an extraction unit, and an outflow for the purified air.
Regeneration facility	An industrial plant designed to remove bromine residues from carbon absorption modules to allow future use in recapture systems of methyl bromide.
Regulated article	"The following articles, if they are unprocessed or have received only primary processing: logs; lumber; any whole tree; any cut tree or any portion of a tree, not solely consisting of leaves, flowers, fruits, buds, or seeds; bark; cork; laths; hog fuel; sawdust; painted raw wood products; excelsior (wood wool); wood chips; wood mulch; wood shavings; pickets; stakes; shingles; solid wood packing materials; humus; compost; and litter." (7 CFR 319.40–1).
Regulated non-quarantine pest	A nonquarantine pest whose presence in plants for planting affects the intended use of those plants with an economically unacceptable impact and which is therefore regulated within the territory of the importing contracting party.
Regulated pest	A quarantine pest and/or a regulated nonquarantine pest.
RfC	Reference concentration

S

Solid wood packing material (SWPM)	Wood packing materials other than loose wood packing materials, used or for use with cargo to prevent damage, including, but not limited to, dunnage, crating, pallets, packing blocks, drums, crating, and skids.
Sessile	Animals that are slow moving or sedentary.
SPS	Sanitary and phytosanitary regulations/standards.
Stratosphere	The upper portion of the atmosphere, in which temperature varies very little with changing altitude and clouds are rare.

Substitute packing materials Cargo packing materials other than SWPM, including, but not limited to plywood, oriented strand board, particle board, corrugated paperboard, plastic and resin composites, plastic, and metal.

SWPM Solid wood packing materials

T

TEIA Transboundary environmental impact assessments

Trace gas An aerosol present at low concentration that is barely detectable.

U

UN United Nations

UNEP United Nations Environment Programme

USDA United States Department of Agriculture

UV Ultraviolet radiation

V

Volatilizer Heating unit to convert methyl bromide liquid to a gaseous form.

W

WHO World Health Organization

WMO World Meteorological Organization

Wood preservative treatment Application of liquid chemicals by surface coating, dipping, or pressure treatment of wood to prevent or eliminate pest infestation.

Wood packaging material IPPC term that is interchangeable with APHIS' solid wood packing material (SWPM).

WTO World Trade Organization

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Appendix G. Index

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