SB

173

<TARGET><BILL>SB 173</BILL><SUBJECT>SB 173</SUBJECT><COMM>SRES30</COMM></TARGET>

Senator Peter A. Micciche
Alaska State Legislature

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SB173

Sponsor Statement

The bottom-line purpose of my choice to bring SB173 forward is the financial protection of nearly every Alaskan ratepayer who depends upon a utility to deliver electricity to their home, business or facility. SB173 conforms Alaska law to federal law with respect to wood poles treated with pesticides registered with the Environmental Protection Agency. The legislation is drafted narrowly to apply only to a "wood utility pole installed, removed or used by public utilities in connection with providing a utility service in the state."

In the State of Alaska, every wooden utility pole is factory-treated with a preservative/pesticide which prolongs the service life of the pole by protecting it from organisms that compromise structural integrity. It is logical to assume that soil coming in direct contact with treated utility poles for 30 or more years would include traces of that preservative.

The provisions of AS 46.03.822(a) are interpreted to assume public utility liability and indirectly, Alaskan ratepayers for remediating residual preservative when replacing or removing treated wooden utility poles. This liability does not exist under federal law because the companion federal statute to AS 46.03.822 contains a specific exemption for "the application of a pesticide product registered under the Federal Insecticide, Fungicide, and Rodenticide Act [7 U.S.C. 136 et seq.]."

SB173 clarifies and eliminates the assumption of liability and remediation costs for trace elements by including the federal exemption within Alaska's statutes.

Staff Contact: Rachel Hanke 465-2828

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ALASKA STATE LEGISLATURE

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CS for Senate Bill 173
CORRECTED Explanation of Changes from Version A to Version D

1. Page 1, Lines 1-2: Amends the title to read "An Act relating to the liability of a person for the release of certain pesticides on a wood utility pole." [The title in the previous version read *"An Act relating to the liability of a person or the state for the release of certain pesticides during application on a utility pole."*]

2. Page 1, Line Six: Amends Section. 1 (the proposed newly created AS 09.65.243) by removing the words "neither the state nor" [The Committee Substitute, in Change 4, add the definition of person given in AS 46.03.900. Because the state is considered a person under AS 46.03.900, the references to the state in Section. 1 were redundant and removed.]

3. Page 1, Lines 10-11: Amends Section. 1 (the proposed newly created AS 09.65.243), by rewriting paragraph (1) to read "the release resulted during the installation, use, or removal of a wood utility pole treated with a registered pesticide;" [The previous paragraph (1) read *" the release resulted from the application of the pesticide on a wood utility pole during the installation, use, or removal of the utility pole;]*

4. Page 1, Lines 14-15: Amends Section. 1 (the proposed newly created AS 09.65.243) by adding a new subsection (b) to read: "For the purposes of this section, "person" has the meaning given in AS 46.03.900"

Prepared by Senate Resources Committee Staff

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SB173

Sectional Analysis

Section 1

Adds new section to Title 9 under Actions, Immunities, Defenses, and Duties that releases the state and persons from liability for costs and damages for the release of a pesticide under the Federal Insecticide, Fungicide, and Rodenticide Act that is used to treat wood utility poles.

Section 2

Adds cross-references to new section in Title 46.

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February 8, 2018

The Honorable Peter Micciche
Senator
State Capitol Room 508
Juneau, AK 99801

Dear Senator Micciche:

Alaska Power Association is the statewide association for electric utilities in Alaska. Our members provide power to a half-million Alaskans, from Utqiagvik to Unalaska, through the Interior and Southcentral, and down the Inside Passage.

Thank you for introducing Senate Bill 173, which will codify that neither the state nor a person is subject to liability for costs or damages for the release of a pesticide registered under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) if:

- the release resulted from the application of the pesticide on a wood utility pole during the installation, use, or removal of the utility pole; and
- the use of the utility pole is or was intended to provide a utility service in the state.

Alaska Power Association strongly supports this bill. There are thousands of utility poles throughout Alaska using pentachlorophenol to prevent damage to the poles from termites and decay fungi. The U.S Environmental Protection Agency, through FIFRA regulations, re-registered penta after determining its use will not present risks inconsistent with FIFRA and that the benefits of penta to society outweigh the remaining risks. [i]

The Federal Insecticide, Fungicide and Rodenticide Act provides significant oversight of pesticide distribution, sale and use, ensuring through federal regulations that using a pesticide according to specifications will not cause unreasonable adverse effects on the environment.

Senate Bill 173 ensures that Alaska's public utilities will not incur significant regulatory expenses from the use of federally regulated pesticides on wood utility poles. This bill benefits Alaska consumers, who would eventually end up paying for these expenses through their utility bills.

Sincerely,

Crystal Enkvist
Executive Director

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[i] Registration Eligibility Denison for Pentachlorophenol, Section IV Reregistration Eligibility and Risk Management Decisions, Page 37. https://www3.epa.gov/pesticides/chem_search/reg_actions/reregistration/red_PC-063001_25-Sep-08.pdf

Fiscal Note

State of Alaska
2018 Legislative Session

Bill Version: SB 173
Fiscal Note Number:
() Publish Date:

Identifier: SB173-DEC-SPAR-02-09-2018
Title: LIABILITY: PESTICIDES & UTILITY POLES
Sponsor: MICCICHE
Requester: Senate Resources Committee

Department: Department of Environmental Conservation
Appropriation: Spill Prevention and Response
Allocation: Spill Prevention and Response
OMB Component Number: 3094

Expenditures/Revenues

Note: Amounts do not include inflation unless otherwise noted below. (Thousands of Dollars)

	FY2019 Appropriation Requested	Included in Governor's FY2019 Request	Out-Year Cost Estimates				
OPERATING EXPENDITURES	**FY 2019**	**FY 2019**	**FY 2020**	**FY 2021**	**FY 2022**	**FY 2023**	**FY 2024**
Personal Services							
Travel							
Services							
Commodities							
Capital Outlay							
Grants & Benefits							
Miscellaneous							
Total Operating	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Fund Source (Operating Only)

None							
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Positions

Full-time							
Part-time							
Temporary							

Change in Revenues

None							
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**

Estimated SUPPLEMENTAL (FY2018) cost: 0.0 *(separate supplemental appropriation required)*
(discuss reasons and fund source(s) in analysis section)

Estimated CAPITAL (FY2019) cost: 0.0 *(separate capital appropriation required)*
(discuss reasons and fund source(s) in analysis section)

ASSOCIATED REGULATIONS

Does the bill direct, or will the bill result in, regulation changes adopted by your agency? No
If yes, by what date are the regulations to be adopted, amended or repealed?

Why this fiscal note differs from previous version/comments:

Not applicable, initial version.

Prepared By:	Kristin Ryan, Director	Phone:	(907)269-7604
Division:	Spill Prevention and Response	Date:	02/09/2018 12:00 PM
Approved By:	Alice Edwards, Deputy Commissioner	Date:	02/09/18
Agency:	Department of Environmental Conservation		

FISCAL NOTE ANALYSIS

STATE OF ALASKA
2018 LEGISLATIVE SESSION

BILL NO. SB 173

Analysis

The legislation exempts the installation, use, or removal of a utility pole treated with pesticides from State liability laws. There are no additional required regulation or monitoring efforts by the Department of Environmental Conservation to support this exemption. There is no fiscal impact to the Department.

Pentachlorophenol Report

Response to PSB Docket #8310

January 11, 2016

Pentachlorophenol Workgroup Participants

Chuck Schwer:	Group Facilitator, Agency of Natural Resources (ANR)
Ashley Desmond: Michael B. Smith	Agency of Natural Resources (ANR), Sites Management Section
Sarah Vose:	Department of Health (VDH)
Bill Jordan:	Public Service Department (PSD)
Cary Giguere: Jeff Comstock Linda Boccuzzo	Agency of Agriculture Food and Markets (AAFM)
Deb Gaynor: Wendy Sue Harper	Town of Monkton
Kim Greenwood:	Vermont Natural Resources Council (VNRC)
Tim Upton:	Green Mountain Power (GMP)
Tim Follensbee:	Vermont Electric Power Company (VELCO)
Scott Allocca: Jeff Austin	Fairpoint Communications
Dan Weston: Scott Martino	Washington Electric Cooperative (WEC)
Jeff Miller:	Treated Wood Council (TWC)
Roger Donegan: Jeffrey Wimette	International Brotherhood of Electrical Workers (IBEW) Local 300

Acronyms

AAFM	Agency of Agriculture, Food & Markets (Vermont)
ACZA	Ammoniacal copper zinc arsenate
ANR	Agency of Natural Resources (Vermont)
ATSDR	Agency for Toxic Substances and Disease Registry (federal)
AWPA	American Wood Protection Association
BMP	Best Management Practices
BTEX	Benzene, toluene, ethylbenzene, xylenes
CCA	Chromated copper arsenate
CFR	Code of Federal Register
CIS	Consumer Information Sheet
CuNap	Copper napthenate
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
g/L	grams per liter
GHS	Global Harmonization System
GIDMO	Gravitational induced Downward Migration of Oil
HCB	hexachlorobenzene
HHE	Health hazard evaluation
IBEW	International Brotherhood of Electrical Workers
IRIS	Integrated Risk Information System
IROCPP	Investigation and Remediation of Contaminated Properties Procedure
L/kg	liters per kilogram
MCL	Maximum Contaminant Level
mg/kg/day	milligrams per kilogram per day
mmHg	millimeter of mercury
MSDS/SDS	Material Safet Data Sheet/Safety Data Sheet
NIOSH	National Institute for Occupational Safety and Health
NTP	National Toxicology Program
PAHs	Polycyclic aromatic hydrocarbons
PCP	abbreviation for pentachlorophenol
PD4	Position Document 4 for the Wood Preservative Pesticides: Creosote, Pentachlorophenol and Inorganic Arsenicals
Penta	abbreviation for pentachlorophenol
POET	Point of entry treatment
POP	Persistent Organic Pollutant
ppb	parts per billion (also micrograms per liter or micrograms per kilogram)
ppm	parts per million (also milligrams per liter or milligrams per kilogram)
PSB	Public Service Board (Vermont)
PSD	Public Service Department (Vermont)
RED	Reregistration Eligibility Document
SIM	Selected Ion Monitoring
SMAC	Site Management Activity Complete
SMS	Sites Management Section (within the Vermont Department of Environmental Conservation)

SOM	Superfund Organics Method
TCLP	Toxicity characteristic leaching procedure
UCS	Use Category System
US EPA	United State Environmental Protection Agency
USDA	United States Department of Agriculture
V.S.A.	Vermont Statutes Annotated
VDH	Vermont Department of Health
VGES	Vermont Groundwater Enforcement Standards
VT DEC	Vermont Department of Environmental Conservation

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Appendices

Executive Summary

Pentachlorophenol is defined by the US EPA as a heavy duty wood preservative. It is used primarily to treat wooden utility structures including poles, crossarms and log anchors. The migration of pentachlorophenol beyond the immediate vicinity of treated utility poles has been documented nationally. It is typical to observe and measure pentachlorophenol in soil immediately adjacent to utility poles. In Vermont, there have been three documented instances of shallow drinking water contamination identified in the last six years. Also elevated levels of pentachlorophenol have been detected in soil near utility pole storage yards and utility lines; however, these releases did not result in contamination to drinking water. There have been no documented cases of bedrock aquifer contamination by pentachlorophenol in Vermont. With hundreds of thousands of utility poles in use and stored in the state, these few documented cases of contaminated drinking water suggest that these are rare events, although all environmental releases in the state may not have been identified and documented. As pentachlorophenol is toxic to human health and the environment, statewide efforts should be made to ensure that these events are avoided to the extent possible and that they are properly addressed when or if they do occur.

The documented environmental releases of pentachlorophenol prompted the opening of Public Service Board (PSB) docket #8310, at the request of state agencies, which authorized the establishment of a workgroup to undertake a general review into the practice of Vermont utilities using poles treated with pentachlorophenol. The workgroup consisted of 12 member organizations– Agency of Agriculture Food and Markets (AAFM), Agency of Natural Resources (ANR), Vermont Department of Health (VDH) and Public Service Department (PSD), four representatives from utility companies, and four other stakeholders. The workgroup reviewed the current practices involving the use of pentachlorophenol treated utility poles and evaluated the literature regarding the practice. This information was used to develop Best Management Practices (BMPs) for the Board's consideration. The workgroup did not conduct primary research, but rather relied on available studies and experience of workgroup members.

The workgroup held 8 meetings over the course of 8 months.

To develop the BMPs, the workgroup considered many aspects of utility pole life cycle in both transmission and distribution systems. Aspects evaluated were procurement, storage, siting, installation, decommissioning/removal, reuse of wood poles and the feasibility of alternative pole materials. The topic of undergrounding *vs.* overhead power lines was determined to be beyond the scope of this workgroup.

The workgroup also summarized background information on pentachlorophenol (registration history, use, potential health effects, environmental fate and transport) and identified current risks and benefits associated with pentachlorophenol-treated utility poles, available alternatives and revised the state public outreach materials.

Discussions regarding quality of pole treatment, pole siting and subsequent pole decommissioning and removal in or near sensitive environments were identified as areas of highest concern for the workgroup and the BMPs address these situations. Additionally, the state entities agreed on the appropriate response agency and general protocols to be used to assess and remediate environmental releases. Fact sheets for public information on response to suspected contamination and appropriate reuse for decommissioned poles are included.

This report represents the workgroup members' perspectives and opinions, as well as the group's conclusions, recommendations and the proposed BMPs. Workgroup members used recognized authoritative sources related to their individual fields of expertise, as such this report is not intended as a literature review, but rather represents the concerns, opinions, and perspectives of the workgroup members.

Statement of Purpose

In response to three known incidences of pentachlorophenol, which is also referred to as Penta or PCP, released from utility poles resulting in drinking water contamination in the past six years, and at state agencies' request, the Vermont Public Service Board (PSB) opened docket #8310. This docket authorized a stakeholder group to review current use practices associated with utility poles treated with pentachlorophenol. This review has resulted in conclusions and recommendations from the workgroup as well as the development of a set of Best Management Practices (BMPs) for Vermont utilities to proactively prevent environmental releases.

Below are the conclusions and recommendations of the workgroup, as a well as a review of many of the issues, concerns and science related to the use of pentachlorophenol. This investigation included background information on wood treatment, pentachlorophenol (registration history, use, potential health effects, and environmental fate and transport), an evaluation of other available non-pentachlorophenol options, the state policy for the reuse of pentachlorophenol-treated poles and the state agency framework for response to environmental releases of pentachlorophenol.

The proposed BMPs are presented in Appendix 1 as well as in a descriptive table at the end of this document.

Vermont Background

Since 2007, the Vermont Agency of Natural Resources (ANR) has managed the investigation and remediation of seven separate environmental releases of pentachlorophenol. In three of these instances, pentachlorophenol migrated from a treated utility pole and contaminated nearby shallow drinking water sources. In the four remaining cases, pentachlorophenol migrated through soil from pole storage yards and utility poles, but did not result in drinking water contamination. With consideration for the hundreds of thousands of pentachlorophenol-treated utility poles in use and stored throughout the state, the limited number of documented cases of contaminated drinking water and environmental releases suggest that these are rare events. It is appropriate to note that the extent of environmental releases is not fully characterized in Vermont.

Although pentachlorophenol is a cost-effective and reliable treatment option for utility poles in Vermont, its use presents potential risk to human health and the environment. The recent Vermont environmental releases demonstrate the need for heightened awareness of the risks and BMPs for the use of pentachlorophenol-treated utility poles. These environmental releases of pentachlorophenol have also provided valuable lessons to Vermont state agencies to better manage and mitigate contaminated areas.

In response to pentachlorophenol releases many Vermont utilities, including all the utilities represented in this workgroup, have implemented practices designed to better protect water sources and minimize environmental contamination from pentachlorophenol-treated poles.

Conclusions of the Workgroup

The rural nature of most Vermont service territories, along with economic, environmental, and safety considerations, suggest that wood will remain the dominant pole material for the foreseeable future. The service life and reliability of wood poles is greatly extended by wood preservation that is done in accordance with industry standards. When considering the options for wood preservation, Vermont utilities evaluate the reliability of the preservative, utility worker safety, public safety, system reliability and the human health and environmental impacts. According to the Vermont utilities, pentachlorophenol remains the best overall option for most utilities; however, they continue to assess responsible and cost-effective alternatives as they are developed and approved for use by regulatory agencies.

Exposure to pentachlorophenol and its contaminants has the potential to result in adverse human health effects, both cancer and non-cancer. The contaminants in pentachlorophenol may also cause adverse human health effects and persist and bioaccumulate in the environment.

The pentachlorophenol that is likely to be released into the environment from properly treated poles will likely be retarded by soil and naturally degrade without significant migration of the pentachlorophenol away from the immediate vicinity of the pole. However, if the soil conditions surrounding the pole are not conducive to natural degradation or adsorption, or if the pole is improperly treated and releases excessive amounts of pentachlorophenol, there is an increased risk to public health and the environment.

As pentachlorophenol is relatively immobile in the environment, migration of pentachlorophenol beyond the immediate area of a pole is unlikely when properly treated poles are installed. However, pentachlorophenol adsorbed to soil or organic particles can migrate with the soil if it is disturbed and mobilized (*e.g.,* excavation, pole removal, erosion). Pentachlorophenol dissolved in carrier oil from improperly treated poles can migrate with the oil as it will preferentially dissolve in the oil and not readily interact with and be retarded by organic matter in the soil.

In Vermont, and in other New England states, shallow groundwater wells serve as a domestic water supply for many homes and businesses, so proactively protecting those wells from contamination by pentachlorophenol and contaminants is necessary.

When state agencies and utilities assess environmental releases of pentachlorophenol solutions from utility poles, there are many factors to consider in determining when a release is 'excessive': topography, site conditions, soil type, proximity to sensitive areas, and total quantity of contamination. In some instances, this will be a difficult determination and professional judgment will be used. The ANR prefers that potential releases be reported to them, rather than waiting for confirmation by the utility or other sources.

The potential for leaching of pentachlorophenol-treated poles to soil and groundwater which results in adverse human health and environmental impacts exists in Vermont. Management practices that ensure high quality poles, appropriate siting, and proper decommissioning of poles will further decrease the potential for adverse effects. The members of the working group agree that proactive steps, such as instituting the BMPs and the proper reuse of treated poles minimizes environmental contamination and limits potential adverse effects.

This report is based on a significant amount of information and data which was reviewed by the working group and although only a small subset of that data was specific to Vermont, the working group determined the relied upon data and associated findings to be applicable for the group's charge of developing BMP's to limit the potential of future contamination of shallow groundwater supplies.

These proposed BMPs should be implemented by Vermont utilities when using (procurement, storing, siting, decommissioning) pentachlorophenol-treated poles. When there are utility-specific and time-sensitive (emergency) situations which prevent these BMPs from being implemented, deviation from the BMPs should be noted and explained. Utilities may also have more restrictive BMPs than those presented here.

As the AAFM lacks regulatory authority over pentachlorophenol-treated poles, it will continue to assist the ANR to manage environmental contamination events under ANR's state statutory authority.

Responsible and appropriate reuse of pentachlorophenol-treated poles will help to protect human and animal health, as well as help to protect the environment. Responsible and appropriate reuse of pentachlorophenol-treated poles will also reduce the amount of waste in Vermont landfills.

Recommendations from the Workgroup

To help to protect human health and the environment, Vermont utilities, and their contracted entities, should implement the BMPs developed by this group to minimize environmental releases of pentachlorophenol. These proposed BMPs are not intended to replace any more stringent utility requirements.

Vermont utilities should continually evaluate other cost-effective and reliable utility pole materials and treatments that are less toxic to human health and the environment, while maintaining the safety of utility workers and the public. As wood provides a cost-effective and reliable source of pole material its continued use in Vermont is supported, with considerations of the results of these on-going evaluations.

As additional scientific data becomes available from the US EPA's pesticide reevaluation process, Vermont should monitor and evaluate and the use and reuse of pentachlorophenol-treated wood in the state.

This report is based on a significant amount of information and data which was reviewed by the working group and although only a small subset of that data was specific to Vermont, the working group determined the relied upon data and associated findings to be applicable for the group's charge of developing BMP's to limit the potential of future contamination of shallow groundwater supplies. Given that the working group had a limited amount of confirmed shallow water supply contamination events in Vermont and minimal follow-up data to review, utilities in Vermont could collaborate with state partners at ANR, AAFM, PSD, and VDH to develop an organized study focused on the potential impact on potable water quality, if any, existing poles may have on a shallow drinking water supplies located in close proximity to pentachlorophenol treated utility poles. The scope of the investigation would take into account existing Vermont data that has been collected over the years by Vermont utilities.

Wood Utility Poles

Wood poles are a sustainable source of material for utility support structures. They are the best option in areas inaccessible to line trucks as they can be easily climbed and are generally considered to be the most aesthetically-acceptable overhead systems. Wood poles, however, are subject to deterioration. Conditions that promote the growth of decay fungi, wood destroying insects and bacteria result in an increased likelihood of the deterioration of the wood pole. Deterioration of the pole presents both reliability issues (replacement) and safety (breakage) issues. Nationally, geographical zones have been delineated, showing estimated deterioration pressures based on environmental conditions (*e.g.*, temperature, soil moisture, pest pressure). (Figure 1). The zones indicate what level of wood treatment is needed to resist premature deterioration. Vermont is located in Deterioration Zone 2 (moderate). As such, wood poles used in Vermont must be able to resist the environmental stresses associated with Zone 2, if they are to be considered reliable.

Figure 1.

Wood Preservation

To delay and prevent deterioration by wood-decaying organisms, wood utility poles are treated with a chemical preservative. The US Environmental Protection Agency (US EPA) estimates the life span of treated wood is five or more times that of untreated wood. When properly treated with wood preservatives, utility poles can have useful service lives of 60 years or more. Treating utility poles prolongs the service life of the pole and increases worker and public safety by maintaining the structural integrity of the pole; however, the chemical preservative may result in environmental impacts.

The level of protection achieved by the treatment is related to the chemical preservative used, the penetration, the retention and the uniformity of the preservative in the wood, as well as the environment in which the pole is sited. The penetration and the retention of the chemical preservative in the wood pole are affected by many factors: preservative type (and carrier), species of wood, pre-conditioning of wood, and the application treatment method. Industry standards that account for these wood treatment factors are promulgated by the American Wood Protection Association (AWPA). The AWPA has created the Use Category System (UCS) to guide user specifications for treated wood commodities, specifying the preservative systems (treatment methods and compounds) and effective preservative retention rates for protecting wood products under specific use and exposure conditions. The major use categories are divided into sub-categories that address the degree of deterioration hazard and service life expectations for treated wood products. Generally, the more environmental stressors, the more critical the structural need for the wood, and the more difficult to replace, the higher the requirement for retention of the chemical preservative in the wood.

Treated wood poles that are used by Vermont utilities meet or exceed the AWPA category for service conditions that are in contact with the ground or fresh water under normal to extreme decay conditions. The majority of poles used in distribution systems in Vermont are Southern Pine species, whereas Douglas Fir species are preferred for transmission structures. These species have favorable form, length and strength properties: they also have properties that make them favorable to retain chemical preservatives which increase the pole service life.

Utility Worker Safety Communication

In 1986 US EPA concluded an eight-year study of the major wood preservatives under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). It evaluated the risks and benefits from the use of the wood preservatives, and cancelled the registration of wood preservatives that did not exhibit a positive risk/benefit relationship. In order to minimize exposure to the end users of treated wood, the industry agreed to undertake a Consumer Awareness Program to disseminate information concerning the proper use and handling of treated wood. One method of providing this information was through a Consumer Information Sheet (CIS). In addition to the CIS, since August of 1994 the manufacturers of treated wood have been distributing material safety data sheets (MSDS) for treated wood.

The OSHA Hazard Communication Standard requires annual worker refresher training of work place chemical hazards and safe work practices. The annual review includes the information provided on the MSDS (now called SDS under the Global Harmonization System [GHS]). The mandatory format of today's GHS Safety Data Sheets includes human protection measures and controls such as personal protective equipment. Utility safety manuals require personnel to wear the recommended personal protective equipment.

Wood Preservation Options

Utilities consider many factors when choosing a wood preservative for a utility pole: effectiveness to preserve wood (expected lifespan in environment), exposure of workers to the preservative (installation, line work), impact on line workers' safety (ability to climb, structural integrity), environmental impacts, use type (transmission/distribution), site, cost, and aesthetics.

There are limited heavy duty wood preservative options available for treating wood utility poles. Current options are creosote, pentachlorophenol, chromated copper arsenate (CCA), ammoniacal copper zinc arsenate (ACZA), and copper naphthenate (CuNap).

Creosote

Creosote is a derivative of coal tar and is used primarily to treat railroad ties. Vermont utilities have not typically used creosote-treated wood poles, and completely discontinued its use in 2003. There are still a few that remain in service in the state. Creosote is an effective wood preservative and relatively immobile in the environment. However, it does pose human health and environmental risks as well as safety risks for utility workers. Creosote is a very sticky substance that may leak from poles, particularly in warm weather, making poles slippery to climb and is difficult to keep off utility worker clothing and personal protective equipment during maintenance activities. Its use has been discontinued in Vermont to protect utility field personnel.

Chromated copper arsenate (CCA)

CCA is a water-borne preservative. It has been used as a wood preservative since the early 1940's when Bell Telephone installed about 20,000 CCA-treated utility poles on the East Coast. CCA was also extensively used for lumber in outdoor residential and playground settings. Up until 2004, most pressure-treated lumber available for retail sale was treated with CCA. At that time, concerns over human health impacts, particularly exposures to children, led to its voluntary withdrawal from the marketplace except for industrial uses. CCA is still widely used to treat wood utility poles in the United States, but these poles are not used by Vermont utilities. CCA, like other water-borne preservatives, makes the surface of the poles harder, and requires more effort when climbed. Treatment additives have been developed to "soften" CCA poles, but the effectiveness of this treatment in Vermont is undetermined. Vermont utilities have avoided the use of CCA-treated poles at the request of line workers.

Ammoniacal copper zinc arsenate/Copper naphthenate (ACZA/CuNap)

ACZA and CuNap are copper-based preservatives, used on a very small portion of utility poles nationwide. ACZA, like CCA, is a water-borne preservative. It is not considered a viable alternative in Vermont, where maintenance and restoration activities require frequent pole climbing. CuNap is an oil-borne product, and produces a pole with physical characteristics essentially identical to those of a pentachlorophenol-treated pole. CuNap has a lower human toxicity than pentachlorophenol and has been an effective wood preservative for over 100 years. Its use in utility poles is much more recent and its effectiveness has had mixed results. In the 1990s a significant number of CuNap-treated poles experienced premature failure. Many poles deteriorated and broke well above the ground line, some only 2 years post-installation. After these failures, most utilities discontinued or avoided using CuNap-treated poles. Subsequent investigations into the failures suggested that the premature failure was caused by high water content in the wood from improper drying and/or the use of non-standard naphthenic acids at particular treatment facilities. More recent applications, and more comprehensive surveys of the pole failures, have shown CuNap-treated poles to have failure rates similar to other chemical treatments. Drawbacks of this treatment include higher toxicity for aquatic organisms and limited availability. Some Vermont utilities stock small numbers of CuNap-treated poles, specifically for use in close proximity to shallow drinking water sources. Cooperative utilities do not generally use CuNap poles.

Pentachlorophenol

Pentachlorophenol has been used as a wood preservative for nearly 80 years, and as of 2008 was estimated to be used on 36 million poles in the United States. In the United States it is used almost exclusively to treat utility poles and crossarms. Pentachlorophenol, as an oil-borne wood preservative, does not cause poles to harden or become brittle, as some of the other chemical options do, thereby extending the service life of the pole as well as improving the climbing surface for line workers. The surface of pentachlorophenol-treated poles is drier than creosote-treated surfaces, and does not easily contaminate clothing or contact the skin. Unlike creosote, pentachlorophenol is not sticky and can be easily rinsed from skin. However, if pentachlorophenol comes in contact with skin, it is quickly absorbed. Chronic exposure to low levels of pentachlorophenol and some of its by-products can cause health problems. In the environment, properly treated pentachlorophenol poles are expected to have minimal migration from the pole to the environment directly surrounding the pole. Pentachlorophenol-treated poles have demonstrated extended lifespans in Vermont's weather conditions.

Alternative Material Options

Steel, fiberglass, and concrete poles are all available for purchase. All are substantially more expensive than wood poles. For example, a typical wood distribution pole used in Vermont costs roughly \$350; an equivalent steel pole costs approximately \$1,100; an equivalent fiberglass structure costs over \$1,000. The most common alternative material is steel, which has been used for high-voltage transmission structures in select locations in Vermont. Steel poles have a long service life (up to 80 years in some applications) and can be recycled; however, a properly treated wood pole has a comparable service life with a lower initial cost, and can often have a secondary use (reuse) in exterior structural settings. Steel poles cannot be climbed, making them inappropriate for use, especially on distribution lines, in locations that cannot be directly accessed from a line truck. Climbing steps can be added, but they further increase cost and logistical challenges.

PSB Docket 6763

In a previous PSB Docket (#6763) October 2002, safety concerns related to creosote treated poles were identified. This PSB docket followed a National Institute for Occupational Safety and Health (NIOSH) Health Hazard Evaluation [NIOSH HHE-HETA 2001-0307]. The NIOSH report found "the transition to (new) creosote poles reintroduced an occupational hazard that was a major factor in the switch to pentachlorophenol treated poles." Creosote is the preferred pole treatment for marine environments; however, the NIOSH report found the creosote poles arriving in Vermont introduced new hazards "including degradation of natural rubber insulating gloves, electrical shock due to tracking through wet creosote, and ignition of creosote during work on creosote wet poles."

The NIOSH HHE was posted for a mandatory 30-day period in all Vermont utility work places. The International Brotherhood of Electrical Workers (IBEW) Local 300, representing Union workers in both Vermont electric and communication line worker communities, participated in the deliberations of Docket 6763. A final stipulation was introduced July 22, 2003, and following a one year wait period was closed July 13, 2004. The installation of new creosote treated poles in Vermont was discontinued.

When all of these considerations have been evaluated, most Vermont utilities have concluded that the use of pentachlorophenol-treated wood poles is the best overall option available. Based on demonstrated reliability, cost, environmental impacts, and utility worker and public safety, pentachlorophenol-treated wood poles are and historically have been the most widely used utility poles in Vermont.

Pentachlorophenol Registration History & Treated Article Exemption

In 1970, the US EPA was created and authorized to regulate pesticide registration, use and labeling. The current federal law which regulates the registration, use and labeling of pesticides is FIFRA. Section 3 of FIFRA requires that pesticides be registered by US EPA before they are eligible for initial distribution, sale or use. The pesticide registration process evaluates human and environmental health risks of pesticides. Section 4 of FIFRA requires the periodic review and re-registration of pesticide products to ensure they continue to not present *"unreasonable adverse effects to human health or the environment."*

FIFRA is unique among federal laws as it designates the primary responsibility for enforcement of pesticide use violations to the states. Section 26 of FIFRA describes this division of responsibilities for various aspects of the law between US EPA and the designated State Lead Agencies for pesticide regulation. In Vermont, the Agency of Agriculture Food, and Markets is the state lead agency for pesticide use, regulation and enforcement.

Registration of Pentachlorophenol

Pentachlorophenol is a chlorinated phenol that has been used as a general biocide (*e.g.*, fungicide, herbicide, insecticide, molluscide) by many industries since the early 1900s. Pentachlorophenol was first registered in 1950 by the USDA. The pentachlorophenol registration was transferred to US EPA in 1970, upon creation of that agency. In 1984, and again in 2008, pentachlorophenol was reviewed for re-registration under Section 4 of FIFRA. Based on the 1984 review of health risks associated with pentachlorophenol, all non-wood uses were discontinued in the mid-1980s.

The *2008 Reregistration Eligibility Decision for Pentachlorophenol* (2008 RED) identified six pentachlorophenol products eligible for reregistration, provided that risk mitigation measures associated with the *use* of pentachlorophenol were adopted by the registrant(s) and the products labeled accordingly. The 2008 RED defined the *use* of pentachlorophenol as occurring only at the wood treatment facility. Therefore, the risk mitigation measures targeted reducing inhalation and dermal exposure to the workers at the wood treatment facility. The only non-occupational risk and mitigation measure addressed by the 2008 RED is for aquatic organisms where treated wood comes in direct contact with water.

Based on the 2008 RED, the use of pentachlorophenol is currently limited to a heavy duty wood preservative for application in commercial facilities capable of pressure treating the wood and mostly for exterior use. There are a few exceptions for interior use as structural support posts and poles which are in contact with soil and are subject to insect decay and infestations (*e.g.*, barns, stables). When used in the interior, treated wood must be sealed in accordance with label specifications.

Currently, pentachlorophenol is registered by the US EPA as a restricted use pesticide. Restricted use pesticides can only be applied by certified applicators. However, wood treated with pentachlorophenol is available for purchase and use by the public. Formulated products that are used to treat wood utility poles contain about 5-9% of technical-grade pentachlorophenol. Technical-grade pentachlorophenol (approximately 86% pure) is diluted in a petroleum-based carrier: fuel oils (P-9, #2), kerosene or mineral spirits for application to wood products.

In the United States, pentachlorophenol is currently undergoing another re-registration review by the US EPA. Pentachlorophenol is also the subject of international review. In 2015 parties of the Stockholm-Basel-Rotterdam Convention on Persistent Organic Pollutants voted to adopt recommendations to ban pentachlorophenol (and its salts) within 5 years from the date of enactment. This decision was made based on health and environmental reasons and adds these chemicals to the list of persistent organic pollutants (POPs) in Annex A of the Stockholm Convention. This adopted recommendation, specifically exempted (*i.e.,* continues to allow) the use of pentachlorophenol on utility poles and crossarms but banned reuse for any non-exempt use. This decision has no impact on regulated use in the United States, as it is not a ratifier.

The Treated Article exemption

Section 25 of FIFRA provides US EPA authority to exempt by regulation any pesticide determined to be: 1) Adequately regulated by another federal agency; or 2) Of a character which is unnecessary to be subject to the requirements of FIFRA. 40 CFR Part 152.25 defines the exemption for classes of pesticides the US EPA determines to be of a character not requiring regulation by FIFRA. Among this list are treated articles.

Treated Articles are defined as *"an article or substance treated with, or containing, a pesticide to protect the article or substance itself (for example, paint treated with a pesticide to protect the paint coating, or wood products treated to protect the wood against insect or fungus infestations), if the pesticide is registered for such use."*

Utility poles are treated with pentachlorophenol to protect them against pests that cause the wood to decay and are treated articles, exempt from FIFRA regulation. As treated articles, the Agency of Agriculture, Food and Markets does not have regulatory authority over pentachlorophenol-treated utility poles. So although the utility poles contain pesticidal material, they are not considered pesticides. Therefore, the installation/placement, distribution and storage of treated poles do not constitute the *use* of a pesticide as defined by FIFRA or Vermont State Law.

As described in the registration section above, the regulated *use* of pentachlorophenol occurs only at the facility where utility poles and other wood products (lumber) are treated.

Pentachlorophenol Wood Treatment Process

Heavy duty wood preservatives, such as pentachlorophenol, are applied to wood in specialized high pressure treatment cylinders at wood treatment facilities. There are no pentachlorophenol-treatment facilities in Vermont. An overview of pentachlorophenol-treatment process is presented in Figure 2. To ensure good and uniform penetration of the pentachlorophenol, de-barking and drying of the wood is important. Moisture in the wood limits the penetration of pentachlorophenol into the sapwood. With oil-borne preservatives such as pentachlorophenol, bleeding and oozing of the pentachlorophenol after application can occur. To reduce this, poles are vacuum-treated. Vacuum-treating the pole extracts excess treatment solution that has not been fixed in the wood. Performing a double vacuum treatment, or doubling the length of the vacuum treatment, is a standard practice for pentachlorophenol-treated wood intended for use in sensitive environments, such as open water locations. These vacuuming procedures reduce the chance that the pentachlorophenol and carrier solution will migrate into the environment.

Figure 2.

Overview of Wood Pole Treatment with Pentachlorophenol

Step 1 – Untreated, debarked wood poles are conditioned to remove water from the interior of the wood pole. Depending on the wood species, conditioning may be accomplished by one of several procedures: (1) kiln-drying, (2) air-drying, (3) steam conditioning, or (4) boiling under vacuum.

Step 2 – If conditioning is done outside the cylinder, the poles are then placed on small rail cars and rolled into a steel pressure cylinder.

Step 3 – The cylinder is filled to capacity with 5-9% pentachlorophenol-oil solution.

Step 4 – The cylinder is then placed under pressure to inject the pentachlorophenol-oil solution into the cells of the wood pole. After a specified time, the pressure is released.

Step 5 – The cylinder is then placed under a vacuum to remove any excess solution from the poles. After a specified time, the vacuum is removed, the cylinder is opened and the poles are rolled out of the cylinder onto a drip pad.

Step 6 – The poles remain on the drip pad until surface-dry, then removed to a storage yard awaiting shipment to customer. For Vermont, treaters meet American Wood Protection Association (AWPA) retention standard for poles in Deterioration Zone 2.

Photo from US EPA 2008 RED

Contaminants of Technical Grade Pentachlorophenol

During the manufacture of technical grade pentachlorophenol, several microcontaminants are formed including hexachlorobenzene (HCB), chlorinated dibenzodioxins and chlorinated dibenzofurans (commonly called dioxins and furans, respectively). These contaminants are toxic and environmentally persistent. In the 1980s, when the US EPA initially discontinued non-wood preservative uses of pentachlorophenol, the permissible amounts of contaminants in the technical grade product were also established: hexachlorodibenzodioxin to 2 parts per million (ppm), hexachlorobenzene to 75 parts per million (ppm), and 2,3,7,8-tetrachlorodibenzodioxin to below the analytical method detection limit of 1.0 parts per billion (ppb).

In 1989, the National Toxicology Program (NTP) analyzed technical pentachlorophenol from three manufacturers and found that the technical grade pentachlorophenol was of approximately 90.4% purity, with the impurities being a mixture of ethers, furans, chlorophenols, and 0.1% dioxins, primarily octachlorodibenzo-p-dioxin. In 1989, the amount of hexachlorodibenzodioxin in the composite of the technical grade mixtures was 10 times greater than the levels allowed.

In December 2014 the US EPA published the pentachlorophenol Preliminary Work Plan, and reported the levels detected in monthly samples from 2013 contained 0.55 parts per million (ppm) of hexachlorodibenzodioxin, 19.3 parts per million (ppm) of hexachlorobenzene, and non-detected results for 2,3,7,8-tetrachlorodibenzodioxin (at less than 1 parts per billion (ppb)). These results were an order of magnitude lower than levels previously reported, showing the decline in contaminant level over the past 20 years. Due to the presence of contaminants in pentachlorophenol, it is prudent to consider them in the assessment and mitigation process in the event of an environmental release of pentachlorophenol.

Health Risks of Pentachlorophenol

Cancer

Using a weight-of-evidence characterization, the US EPA determined pentachlorophenol is "likely to be carcinogenic to humans." The cancer weight of evidence determination is based on evidence from studies in mice showing increases in various types of cancers in treated animals, and strong evidence from human epidemiological studies showing increased risks of non-Hodgkin's lymphoma and multiple myeloma, some evidence of soft tissue sarcoma, and limited evidence of liver cancer associated with pentachlorophenol exposure. According to the US EPA's 2010 updated Integrated Risk Information System (IRIS) assessment, an additional cancer risk of 1 in 1,000,000 would be seen at a level of .09 parts per billion pentachlorophenol in drinking water, which is based on a lifetime exposure scenario of a 70 kilogram person ingesting 2 liters of water per day.

In 2014, the National Toxicology Program, within the Department of Health and Human Services, issued the thirteenth edition of the Report on Carcinogens. The Report classified pentachlorophenol and its contaminants as "reasonably anticipated to be a human carcinogen." This determination is based on limited evidence of carcinogenicity in humans and sufficient evidence of carcinogenicity in experimental animals. The determination is supported by mechanistic studies that support the biological plausibility of carcinogenicity in humans.

Non-cancer

For non-cancer effects, the US EPA determined the primary target for chronic pentachlorophenol exposure is the liver. Liver toxicity after chronic exposure to pentachlorophenol is observed in rats, mice and dogs, and is manifested as lesions and increased liver weight. A reproductive study showed that technical grade pentachlorophenol is associated with decreased fertility, delayed puberty, testicular effects, decreased litter size, decreased viability, and decreased pup weight.

Health risk assessments: occupational exposure

As summarized in the 2008 RED, the US EPA determined that the primary health risk was to workers treating the lumber with pentachlorophenol. The US EPA determined that there was potential cancer and non-cancer risk from dermal exposure to workers, as well as environmental risk from exposure to dioxin and furan contaminants. The US EPA stated that additional protective measures to reduce worker exposure to pentachlorophenol and its contaminants were required for pentachlorophenol pesticides to meet the "no unreasonable adverse effects" criteria of FIFRA.

Health risk assessments: residential exposure

In the 2008 RED for pentachlorophenol, the US EPA indicated that residential exposure was not a concern, and that occupational exposure presented the greatest risk. The RED presented a risk management decision that considered the results of both human health and ecological risk assessments conducted as specified by the Office of Pesticide Programs.

Information considered in the development of the decision to authorize pentachlorophenol for continued registration included an evaluation of the toxicity of pentachlorophenol and modeled estimates of the level of pentachlorophenol that could be present in groundwater and surface water based on certain use patterns under certain assumptions. Modeled estimates of pentachlorophenol concentrations in water were combined with estimates of toxicity and potential human exposure, again based on certain assumptions, in order to estimate the level of risk that may be associated with exposure. The modeling efforts conducted by US EPA estimated that there would be limited amounts of pentachlorophenol in water due to the use patterns considered and that human exposure, and thus risk, via ingestion of drinking water would be limited.

The US EPA's generic modeling assumptions did not adequately represent the acute exposure scenarios that were documented in Vermont. Also the health risk from the US EPA's 2008 RED relied on a cancer slope factor of 0.07 mg/kg/day, a factor that was subsequently updated in the 2010 IRIS document to 0.4 mg/kg/day. Thus, not only the exposure, but the risk was underestimated in the 2008 RED modeling. This is of concern because many Vermont homes and businesses have shallow drinking water sources as the domestic water supply.

Health advisory levels of pentachlorophenol in drinking water

The US EPA has set the federal maximum contaminant level (MCL) for pentachlorophenol in drinking water at 1 part per billion. The US EPA considers cost when setting the regulatory MCL. The MCL Goal, also established by the US EPA, is 0 parts per billion. The MCL goal is set based on the best science to prevent potential health problems. The Vermont Department of Health has established a Vermont Action Level in drinking water for pentachlorophenol at 0.1 parts per billion.

Given that the odor threshold of pentachlorophenol is 857 parts per billion, in warm water, pentachlorophenol may be present in drinking water above both the Vermont Action Level and the MCL, without any detectable odor. The odor thresholds of the petroleum carriers are similar to pentachlorophenol: fuel oil #2 0.7 parts per million, and light petroleum derivatives at about 1 part per million. In the Vermont cases, the oil-based carrier in the contaminated drinking water sources exhibited a very strong odor when pentachlorophenol levels were less than 10 parts per billion.

Health effects due to contaminants

Pentachlorophenol contains various amounts of contaminants described above that may be of concern for chronic exposure. However, not all toxicity observed in studies with technical grade pentachlorophenol can be attributed to contaminants. The US EPA concluded that the possibility of carcinogenic effects of pentachlorophenol resulting solely from the presence of contaminants was unlikely. In the epidemiological studies, the contaminants were not present in high levels in the blood from the study subjects, and the cancers reported in the studies were more strongly associated with pentachlorophenol than with the dioxin or chlorophenol exposures.

Overview of the Environmental Fate & Transport of Pentachlorophenol

The fate and transport of pentachlorophenol in the environment are primarily influenced by the pH of the media and exposure to sunlight. At pHs at or below 6.5, pentachlorophenol exists primarily as a phenol. At pHs above 6.5 it exists as phenolate anion. Generally, degradation and mobility of pentachlorophenol are more rapid at higher pHs, in its phenolate anion state.

In surface water, pentachlorophenol is hydrolytically stable from pH 4 to pH 9 and will not be a significant source of degradation products in the environment. Chemical degradation in surface water occurs mainly through photo-degradation. When exposed to direct sunlight, the degradation process may be rapid. Photo-degradation rates decrease with increasing depths of the water. The pH of the water also affects the photo-degradation rate. Half-lives in surface waters have been shown to range from less than an hour (20 minutes) to days, in part dependent on the exposure to sunlight. In aerobic aquatic environments pentachlorophenol may also be degraded by microbes.

The solubility of pentachlorophenol in water (at the standard value of 20°C) is 0.014 g/L indicating that pentachlorophenol is only slightly soluble in water. This low water solubility value is supported by the K_{ow} of 5.12 (Octanol/Water Partitioning Coefficient). In comparison, pentachlorophenol is very soluble in organic solvents or media: methanol solubility is 1800 g/L and benzene solubility is 150 g/L. Therefore, if organic compounds, such as oil, with relatively high solubility for pentachlorophenol are present in soil or groundwater, the pentachlorophenol can preferentially dissolve into the compound instead of groundwater.

Pentachlorophenol has a high affinity for organic media. At lower pH, the organic partitioning coefficient K_{oc} (Soil/Organic Carbon Partitioning Coefficient, L/kg) for pentachlorophenol can range from a low of 706 in sandy soil to a high of 3420 for clay soil. Research done by Banerji and Bajpai in the early 1990's, showed that due to high K_{oc} values in soil with low pH and high organic content, degradation of the pentachlorophenol is retarded in these soil types.

The soil texture and pH also influence mobility of pentachlorophenol in the subsurface and the amount of adsorption to soil particles. In general, pentachlorophenol is more mobile in higher pH and low carbon content sandy soil, moderately mobile in sandy/silt loam soil, and relatively immobile in low pH and high carbon clay loam soil. Maximum soil adsorption occurs at pH values of 4.6 - 5.1, with minimal adsorption reported in soil with pH above 6.8 depending on soil type.

The presence of other organic contaminants in soil or groundwater can increase the mobility of pentachlorophenol by acting as cosolvents. Pentachlorophenol dissolved in an organic fluid such as oil will migrate with the oil and less will be retarded by the organic carbon in the soil.

Soil can contain organic and clayey colloidal particles. Pentachlorophenol can sorb to the colloids depending on the pH and organic carbon content of the colloids. As colloidal particles can migrate in groundwater (dependent on the soil texture and hydraulic conductivity), if pentachlorophenol is adsorbed to the colloidal particles, this can be an important transport mechanism in higher organic content soil where pentachlorophenol is expected to adsorb to the organic material. The presence of other organic contaminants can also enhance the creation of soil/organic matter colloids, further enhancing transport of pentachlorophenol by these particles.

In soil, the major degradation pathway for pentachlorophenol occurs by microbial degradation, with half-lives as low as fourteen (14) days under optimal (generally aerobic) conditions. Under saturated anaerobic soil conditions, the degradation of pentachlorophenol is slowed with observed half-lives of one to two months or longer. Photo-degradation of pentachlorophenol can readily occur at the soil surface of a mineral soil, but is not significant at depths greater than the top 1 mm. In the absence of light, such as in deep groundwater, the main degradation products are 2,3,4,6-tetrachlorophenol and carbon dioxide (CO_2).

In air, pentachlorophenol is a semi-volatile compound, with a vapor pressure of 0.00011 mmHg at 25° C. In air, pentachlorophenol photo-degrades with a half-life of about 1.5 months. Atmospheric pentachlorophenol associated with particulate matter or moisture will be re-deposited on the ground. Based on pentachlorophenol's relatively low Henry's law constant for volatility ($2.45 * 10^{-8}$ atm-m^3/mole at 22 °C); it is unlikely to volatize from water.
These data indicate that pentachlorophenol degrades in the subsurface most quickly when exposed to light, oxygen, and microbes such as may be present in the shallow surface soil. It will degrade more slowly in deeper portions of the soil where there is less light to act on the compound and where there may be less oxygen than at the surface of the soil. Pentachlorophenol is readily adsorbed to organic carbon in the soil, which can retard its transport. It is most mobile in the subsurface in high pH, low carbon content soil.

Movement of Pentachlorophenol in the Utility Pole & Releases to the Environment

Pentachlorophenol may be released from the treated utility pole into the environment by three processes: surface flushing, volatilization and internal leaching. All three of these processes are affected by the oil-based carriers used in the original treatment. Surface flushing, the release of pentachlorophenol in aqueous solution by rainwater, is a less significant transport mechanism as the pentachlorophenol replenishment rate is limited at the outer pole surface. Volatilization from the pole surface is also unlikely to contaminate the soil. Movement down the pole is the primary transport mechanism to the soil. Studies show that oil-borne pentachlorophenol is more rapidly transported from the upper portion of the poles to the underground portion for the first few years of use, and then becomes relatively constant with time.

There are two sites that pentachlorophenol may move down the pole. It can move either at the surface or in the interior of the pole. This downward migration of the oil carrier along the vertical axis of the pole is referred to as Gravitational Induced Downward Migration of Oil (GIDMO). Experimental data show that GIDMO is the primary transport mechanism of pentachlorophenol in the pole and the primary path for migration to soil. Contamination of soil in the vicinity of treated utility poles may result from this downward movement of pentachlorophenol.

Once leached into the soil as a result of to GIDMO, pentachlorophenol can partition from the carrier oil into the soil, soil moisture, or groundwater, if it is present. The soil in the vicinity of treated utility poles may become contaminated either within the subsoil near the underground portion of the pole, or at the surface of the soil. When pentachlorophenol is released from treated poles, the simultaneous release of the carrier oil may affect the mobility of the pentachlorophenol as oil may be more mobile in the soil. Generally, concentrations of pentachlorophenol in soil decrease significantly within the first 20 centimeters from the pole. However, variability has been observed based on localized site and pole conditions.

Based on the tendency for pentachlorophenol to adsorb to soil and, under suitable aerobic conditions, the moderately rapid degradation of the compound in the environment, contamination of groundwater caused by migration of pentachlorophenol from treated utility poles is not likely to occur in most situations. The 2008 RED states a potential low risk may occur in situations where the bottoms of treated utility poles are in direct contact with the water table or come in contact with a fluctuating/seasonal water table. This condition creates a transport pathway from the pole to the groundwater and increases the risk for shallow groundwater contamination. Additionally, contaminated soil particles may migrate when contaminated areas around the poles are disturbed and exposed to wind or water.

If enough carrier oil is present in a pole to allow GIDMO to be significant, it is possible the carrier oil can migrate downwards through the pole under gravity, and potentially be released into the soil at the bottom of the pole. As pentachlorophenol is dissolved in the carrier oil for pole treatment, this can promote rapid movement of the pentachlorophenol through the pole into the soil at depth. If the soil at the bottom of the pole are sandy or coarse grained, and if enough pentachlorophenol-containing carrier oil is released, it may promote rapid movement of the pentachlorophenol dissolved in the carrier oil to the water table. If clayey, fine silt, or other fine grained soils are present in the soil at the bottom of the pole, the carrier oils may not be able to migrate quickly through these soil types. Some clay soil may also adsorb a portion of the pentachlorophenol. This mechanism may serve to slow migration of pentachlorophenol.

Overview of the Ecological Toxicity and Risk of Pentachlorophenol & Contaminants

Ecological toxicity data for pentachlorophenol have been collected from toxicity tests performed as required for the pesticide's registration. Toxicity tests are conducted by exposing indicator species to the chemical. These are conducted in laboratory settings and usually involve high percentages of the pesticide. Additional laboratory tests have been done by US EPA, USDA and US Fish and Wildlife Services. All toxicity test data are reviewed by the US EPA before they are used in the risk assessment process.

As the contaminants in pentachlorophenol are not registered pesticides there is less available toxicity data than if they were registered.

Ecotoxicity of pentachlorophenol

Ecological toxicity data is summarized the *Pentachlorophenol Final Work Plan*, published by the US EPA in June 2015. From these laboratory tests, pentachlorophenol is classified in both acute and chronic studies as highly toxic to very highly toxic to cold and warm water fish and moderately toxic to other freshwater and marine organisms. In bird dietary studies, pentachlorophenol is classified as practically nontoxic to slightly toxic. Administered acutely to birds it is rated as slightly to moderately toxic. Pentachlorophenol has been shown to bioaccumulate in fish, invertebrates and algae. Upon uptake, fish rapidly excrete a pentachlorophenol metabolite with a biological half-life of only 10 hours. Biomagnification in the food chain is not expected because of pentachlorophenol's rapid breakdown in living organisms. Sediments usually contain higher concentrations of pentachlorophenol than overlying waters.

Pentachlorophenol in surface waters

In its 1986 development of Ambient Water Quality Criteria for pentachlorophenol, the US EPA noted that the toxicity of pentachlorophenol is pH-dependent, the lower the pH, the more toxic it is. As such, the US EPA's and Vermont Water Quality Standards are calculated based on pH of the water. For example, at pH 7.8 the Vermont standards for pentachlorophenol are 19 parts per billion (ppb) and 15 parts per billion (ppb) for acute and chronic criteria, respectively. Data compiled in the 2001 *Toxicological Profile for Pentachlorophenol* by the Agency of Toxic Substances and Disease Registry (ATSDR) noted pentachlorophenol concentrations detected in rivers, streams, or surface water systems are generally very low. In June 2015, the US EPA released updated human health ambient water quality values, which may be to evaluate future Vermont standards. Nationally, acute lethal levels have been exceeded only during accidental spills. ATSDR also noted that most water data available was from the 1970s and 80s and with the cancellation of all non-wood preservative uses in the 1980s, they were likely to decrease. In June 2015

Ecotoxicity of contaminants

In the supporting ecological assessments of the 2008 RED and the Final Work Plan, the dioxin/furan contaminants of pentachlorophenol were identified as highly toxic to birds, mammals, and aquatic organisms. They also posed potential acute and chronic risks to birds, and chronic risks to mammals. The persistence and bioaccumulation potential of the compounds pose additional acute and chronic risks to aquatic and terrestrial organisms. The 2008 RED noted that hexachlorobenzene may also persist and bioaccumulate in the environment posing risks to aquatic and terrestrial organisms. Contaminants may bind to and accumulate in the sediment and result in toxic levels.

Ecological risk assessment of pentachlorophenol & contaminants

As the laboratory studies demonstrate, pentachlorophenol and its contaminants pose both acute and chronic toxic risks to aquatic and terrestrial organisms. Literature has shown that pentachlorophenol and its contaminants can leach from utility poles into the environment. Estimating the risk in the environment from utility poles can be challenging as there are many factors, including the amount of leachate from the pole, the amount of contaminants present in the leachate, environmental conditions around the pole, and the potential exposure pathways of plant and animal species. Another confounding factor is that data obtained in environmental studies done before the use pattern was restricted in the United States, or shortly thereafter, may not appropriately represent the current environmental levels.

Modeling exposures, estimating risk, and evaluating biota has been done to attempt to understand the potential impacts of treated wood in the environment. In 2001, the New York State Department of Environmental Conservation published a risk assessment on the use of pressure treated wood in water and concluded that the use of the pentachlorophenol-treated wood in freshwater environments was unlikely to present any long-lasting impacts to an ecosystem. The author cited the small amount of leaching from the pole decreases rapidly, in comparison to its degradation in the freshwater environment. The report also estimated the potential impacts associated with the use of pentachlorophenol-treated poles specifically in wetlands. The paper concluded that even in a worst case scenario, levels of pentachlorophenol in the water of an open water wetland would not exceed the State of New York's ambient water quality standards. Both Vermont and New York have the same ambient water quality standard. In the 2008 RED, the US EPA based on models and available data stated that typical pentachlorophenol concentrations from wood treatment uses were not expected to be of sufficient quantity or duration to have adverse impacts on the aquatic and terrestrial organisms. In 2000, The US Forest Service assessed the effects of treated wood bridges over sensitive ecosystems. Both chemical and biological assessments were done. The author concluded that there were no adverse biological effects related to the pentachlorophenol-treated bridges. However, both the New York State Department of Environmental Conservation and US Forest Service recommend BMPs for the use of treated wood in these environments.

There are toxic risks to terrestrial and aquatic species from the contaminants. However, their persistence and bioaccumulation in the environment poses additional risks. There is little way to determine the amount of hexachlorobenzene, dioxins and furans in the environment related to pentachlorophenol-treated poles, as these compounds are a result of many different sources (such as combustion and other chlorinated chemicals).

In its final work plan for pentachlorophenol, the US EPA stated that it had not received any information which would alter its 2008 environmental risk assessment for pentachlorophenol. It will however, be requesting additional toxicity studies and re-revaluating it with updated scientific framework and risk assessment. It will also reassess the ecological risk from the contaminants.

Livestock Exposure Assessment

The potential for livestock exposure to pentachlorophenol and contaminants through contact with, or access to, treated wood products in pastures, barnyards, animal housing, feeding areas or water sources was considered and investigated.

There are numerous citations and references to the toxicity and adverse effects of pentachlorophenol and its contaminants to livestock and other farm animals. Studies have looked at various species of livestock but most often focused on dairy and beef cattle, poultry and pork. The majority of these toxicity studies evaluated technical grade pentachlorophenol. In addition, there are reports, mostly from the late 1970s, of acute adverse health effects to livestock from direct exposure to treated wood used as sources of bedding (wood chips and sawdust), contaminated feed, and as construction materials in housing and feeding structures.

The most significant shift with respect to potential livestock exposure to pentachlorophenol and its contaminants occurred in 1984 when the US EPA issued its final *Position Document 4 for the Wood Preservative Pesticides: Creosote, Pentachlorophenol and Inorganic Arsenicals (PD4)*. The pentachlorophenol-related regulatory actions taken as a result of PD4, effectively eliminated the potential for direct exposure to livestock. All previously allowed uses for pentachlorophenol except for commercial pressure wood treatment were cancelled, including the herbicidal, antimicrobial and low concentration use retail products. This removed the potential for do-it-yourself (DIY) applications by homeowners and farm operators for post-manufacture (maintenance and retreatment) applications. These types of post-manufacture applications, using retail products, were common on farms and in agricultural settings prior to the mid-1980s.

Also as a result of PD4, pentachlorophenol-treated wood could not be used in in building interiors or for use in direct contact with animals, food, feed or drinking water. These conditions are described in the Consumer Information Sheet and also included in the ANR Reuse fact sheet. Specifically, pentachlorophenol-treated wood is not allowed for use where it will come into contact with human or domestic animal drinking water and is only permitted for use in the construction of animal housing and feeding structures below ground level to prevent exposure from wood chewing behavior (cribbing). The current US EPA registration does allow for the use of treated wood for the construction of docks and bridges where incidental contact with human or animal drinking water may occur.

Practical experience at the AAFM indicates that on-farm water systems are predominantly dual use (human and animal) systems. Farm operators are reluctant to construct groundwater-based watering systems only for animals; they more frequently use surface water systems for single use (animal). The proposed BMPs targeted for the protection of human drinking water sources provides protection for livestock watering operations. The PD4 regulatory actions have eliminated the direct exposure through chewing and contaminated water and feed, however incidental contact with poles in fields is possible. AAFM feels that the risk from incidental contact with poles in pastures is consistent with the risk from incidental contact with animal drinking water (docks/bridges in surface water).

State Authority for Investigation & Cleanup of Pentachlorophenol Environmental Releases

Although pentachlorophenol is a pesticide, as described earlier in this document, utility poles are exempt from AAFM oversight as they are treated articles. However in Vermont, ANR's Sites Management Section (SMS) of the Waste Management and Prevention Division is responsible for the review and approval of site investigations and response actions required when a release of hazardous materials has occurred. Environmental contamination from pentachlorophenol-treated utility poles is managed under state statutory authority.

Authority for hazardous materials releases and response is designated to ANR in 10 V.S.A. 159 §6617, "Any person who has knowledge of a release or a suspected release and who may be subject to liability for a release, as detailed in §6615 (*e.g.,* owners or operators of a facility), shall immediately notify the Agency." Releases of hazardous materials into the surface or groundwater or onto the land of the State are prohibited, according to 10 V.S.A. 159 §6616. The responsible party is required to take necessary response actions to address the release according to 10 V.S.A., 159, §6615b Corrective Action Procedures, which include determining the degree and extent of contamination present, assessing the need for corrective action, implementing the site remediation and monitoring to its completion. This may include sampling of various environmental media, monitoring over time, and/or more complex cleanup methods involving implementing remedial systems. The purpose of corrective action is to reduce or remove contaminants to the extent required by State and Federal regulations and to protect against adverse environmental and human health effects.

In the situations where pentachlorophenol-treated utility poles have resulted in environmental contamination (*e.g.,* contamination of shallow groundwater or extensive soil contamination beyond the immediate vicinity of the pole) the SMS has worked with the utilities and the AAFM, to implement ANR's *Investigation and Remediation of Contaminated Properties Procedure* (IROCPP: *effective 4/2012*). This procedure outlines the regulatory authorities and definitions, as well as the site investigation and remediation process, including relevant Vermont levels/standards used for comparison of contaminants measured in water, soil, sediment and other environmental media.

Vermont Environmental Releases

Vermont utilities first became aware of the potential for the contamination of shallow drinking water sources by pentachlorophenol-treated poles during the summer of 2009 when two shallow drinking water sources were impacted by newly installed poles. Both poles, along with several others that exhibited excessive sweating, were subsequently identified as isolated to a single treatment batch at a treatment facility. In 2010, after completing construction of a new utility line, another utility pole from a separate utility was also identified as exhibiting excessive sweating. Although this pole did not impact any drinking water sources, there were elevated concentrations of pentachlorophenol solution in the soil and within a small wetland located adjacent to the utility structure.

In 2014, a Vermont utility was performing a routine structure replacement. Prior to initiating the work, the utility had contacted the landowners. One of the landowners informed the utility they had a shallow groundwater supply, which was located downhill and adjacent to one of the structures to be replaced. The utility, being aware of the potential of new poles to exhibit excessive sweating (based on the incidents that occurred in 2009-2010), worked with the landowners and took numerous proactive steps to limit the risk of potential contamination from the new poles. Despite the actions taken by the utility during the replacement, the landowners identified an irregular odor coming from their tap water. Laboratory results confirmed that this shallow groundwater supply had been contaminated. After several rounds of soil and water testing, and in consultation with the ANR, it was determined that this source of contamination likely did not occur from the newly installed poles, but rather from contaminated soil that was excavated from around the old poles. These and the other environmental releases are described in more detail in Appendix 6.

Based on experience gained from these Vermont events and literature available, pentachlorophenol releases to the environment are most likely to occur as a result of poor pole treatment (poor penetration, low retention, over-treatment), the localized environmental site conditions (soil type, soil chemistry, distance to water table), and disturbance of the soil when removing existing utility poles.

Reuse

Vermont utility poles are generally removed after 40+ years of service life. Utility poles when removed and determined to not be a hazardous waste, may be disposed of in a landfill or be put to a secondary use. The ANR, which has authority over both household and hazardous waste management in Vermont, does not consider treated wood to be a waste when reused in a manner that does not pose an increased risk to human health or the environment. In general, appropriate reuse of treated wood is consistent with the same use restrictions of the original product. The ANR has identified that reuse of treated woods as support beams in open-air construction or as part of general landscaping such as terracing, fence posts, or property line demarcation is an appropriate reuse.

The ANR discourages reuse of creosote or pentachlorophenol-treated wood unless by the original owner. If ownership is transferred for reuse ANR strongly recommends that the original owner obtain a signed consent form indicating that the recipient understands the risk associated with the product, and provide the ANR fact sheet (Appendix 2). The ANR fact sheet advises that pentachlorophenol-treated wood should not be reused in a vegetable garden or in any location that children are likely to come in contact with the wood. For reuse that may occur in agricultural settings, AAFM recommends that reuse should occur in accordance with the restrictions described in the Consumer Information Sheet (Appendix 3).

Business-generated treated wood waste that is not reused by the original owner, or reused in accordance with the ANR policy must be evaluated to determine if it is hazardous waste under standard ANR procedures. Waste that is determined to be hazardous must be managed in accordance with the Vermont Hazardous Waste Management Regulations.

Development of the Best Management Practices

The utility members of this stakeholder group compiled a list of existing BMPs, and distilled them into a single set of practices, organized by the stages of the typical utility pole's life cycle: treatment/procurement, storage, installation/use, and retirement/disposal. These practices served as a starting point for the final set of recommendations issued by the working group, which are the end result of the collaborative effort and reflect many of the topics covered in this report. The final BMPs reflect a desire to provide safe, reliable, and affordable electric and communication services to Vermonters while protecting vulnerable drinking water sources, and are part of a continuously evolving examination of available alternative materials and practices.

Adoption and implementation of the BMPs will allow the continued responsible use of pentachlorophenol-treated poles, while Vermont utilities continue to research and field-test alternative products where allowed and appropriate. The table at the end of this document outlines the pentachlorophenol BMPs, the rationale behind each of the BMPs, and how the BMPs limit the risk of pentachlorophenol impacts to Vermonters and the environment. The BMPs are also outlined in a concise version in Appendix 1.

Proposed Best Management Practice and Rationale

Pentachlorophenol Proposed Best Management Practice Procurement, Delivery & Storage	Rationale for BMP
1. Require Traceable ID brand with plant location and year produced, which can be traced to the batch of treated poles.	If a pole is identified as exhibiting excessive sweating, it can be traced back to a specific batch of poles. This will allow for further evaluation of other poles from the same batch and provide additional information to the pole supplier for investigation.
2. Require all poles used in VT to be treated to AWPA specifications for use in deterioration zone 2.	All utility poles used in Vermont should meet industry standard for preservation, regardless of preservative type.
3. Require all poles used in VT to be double vacuum treated or extend vacuum cycle to twice the standard length prior to delivery to VT. In some cases, utilities may require immediate delivery of poles for emergency restoration activities, and that such poles may deviate from normal specifications.	Vacuum treatment of pressure treated wood is a standard practice throughout the wood treatment industry. Vacuum treating newly pressure treated wood, helps to extract excess treatment solution that has not fixed in the wood. Performing a double vacuum treatment or double length vacuum treatment, is a standard practice for pentachlorophenol-treated wood intended for use in sensitive environments, such as open water locations. This simple and cost effective step reduces the possibility of pentachlorophenol solution leaching from the pole.
4. Inspect poles on delivery – Retain the right to reject any pole that exhibits excessive sweating of preservative solution.	Ensuring that a potentially problematic pole does not get put into service is the most efficient way to ensure that there are no adverse impacts to human health and the environment. Inspecting poles upon delivery is the first step in this process. Ensuring that sufficient legal language is included in the contract will assist utilities by having defensible contract terms in order to reject non-conforming poles. Additionally, having clear pole specifications regarding treatment and retention requirements will add to the utilities commitment to limit non-conforming and potentially problematic poles.
Permanent Pole Storage Areas – Use for design of new construction or substantial reconstruction of existing pole storage areas.	
1. Locate 100 feet from drinking water sources and as far away as possible from residences.	Locating permanent pole storage areas at least 100 feet away from drinking water sources is a precaution to limit potential impact to water sources.
a. Design considerations should include:	
i. A low permeability surface material (compacted soil or asphalt) with absorbent/organic material; or	Low permeability surface material limits the pentachlorophenol from migrating into the surface soil and beyond. The addition of absorbent or organic materials provides a binding matrix for pentachlorophenol until the material can be collected and disposed of appropriately
ii. Other containment/migration prevention measures	Other containment and migration prevention measures may be just as appropriate. As such, other approaches which may be just as effective and/or cost efficient should also be considered as viable options.

Proposed Best Management Practice and Rationale

2. Poles should be elevated off ground surface.	Storing poles off the ground keeps moisture off of the poles and limits precipitation runoff from coming in contact with poles, thus limiting the potential for such runoff to result in migration.
3. Ground surface should consist of a low erosion potential substance	Limiting erosion from the site will limit the potential for soil or substrate that has come in contact with potential contaminants from migrating to other areas of the site and/or offsite.
4. Maintain a yard slope of less than 10% throughout the pole storage area.	A yard slope of less than 10% throughout the area will limit precipitation runoff velocities and thus further limit erosion and potential contaminant migration.
5. Pole storage yards should be sited to limit odor impact to the public.	Off-gassing of preservative solutions can result in odors. Public exposure should be limited to the extent feasible.
6. Pole storage areas should be visually inspected when work is being done at a pole yard for excessively sweating poles, unusual staining, or other evidence of unusual releases of pentachlorophenol.	Routine inspections of all pole storage areas (temporary, permanent, new, or existing) by utility workers or contractors will identify any evidence of unusual releases of pentachlorophenol or problematic poles.
Pole Siting & Construction	
1. Onsite utility personnel and contractors should inspect all poles prior to installation to ensure no excessive release of preservative solution is occurring.	In addition to the inspection of poles upon delivery from the vendor, field crews should inspect all poles prior to installation for any evidence that the pole may lead to excessive release of preservative solution. As different times of year and weather conditions are related to the migration of the preservative solution, a pole that has been in storage for several weeks or months may exhibit different visual indicators at the time of installation than it did upon delivery. This step is an additional opportunity to inspect the poles for evidence of unusual release of preservative solution prior to installation.

2. Before installing any new pole, determine if there are any shallow drinking water sources within 50 feet of the pole location. Wherever feasible, poles should be located at least 50 feet away from shallow water sources; if this is not feasible utilities should in the following order:	Based on the information gathered from the recent incidents of unusual pentachlorophenol releases from newly installed poles and from migration of pentachlorophenol from disturbed soil around existing poles that have occurred in VT, it is reasonable to assume that pentachlorophenol could travel overland up to 50 feet away from a pole in certain conditions. Given that shallow water sources are the most vulnerable receptors and that most Right-of-Way corridors, which are the areas within the utilities control, are generally 30 to 150 feet wide (with certain exceptions), it is recommended that utilities inspect areas within 50 feet of placement of new poles or replacement of existing poles for the presence of shallow groundwater sources. If such a water supply is identified than it is recommended, that utilities maintain a minimum setback distance of 50 feet away from the shallow water sources. If the water supply is directly down gradient, additional separation distances may be warranted.
a. Use an alternative type of treated pole;	The use of an alternative type of treated pole would eliminate the potential for pentachlorophenol contamination of the shallow water supply; however care should be

	taken to review the treatment preservatives for any alternatively treated wood poles, as well as, any potential effects associated with alternative pole materials that may be used.
b. Use a containment structure or barrier (*e.g.*, pole sleeve);	The use of containment structures around pentachlorophenol-treated poles has shown to be effective in certain scenarios in VT. This option is specifically intended for use associated with the installation of new or replacement poles, to contain pentachlorophenol and to limit the possibility of pentachlorophenol impacting the shallow water supply. In the case of replacement structures this option would address the installation of the new replacement pole; however the additional work of decommissioning of the old pole should also be closely considered as discussed in the Decommissioning, Retirement, and Disposal section. Certain pole barriers claim to limit the migration of pole treatment solutions away from the pole. These barriers are intended to be installed on the pole immediately prior to pole installation. They are installed in the field over the bottom end of the pole, sealed to the pole just above the ground, and backfilled with native or select aggregate material. These barriers are subject to potential damage during the installation process and given that the barrier is intended to be sealed to the pole, it is unclear how the barrier would limit the migration of any pole treatment solution that moves down the outside of the pole, which is of particular concern with regard to shallow drinking water sources in close proximity to utility poles. There is currently no scientifically based information readily available on the effectiveness of these barriers; as such it is recommended that utilities and the regulatory community review the use of these barriers with discretion. In the meantime, the pole siting BMPs attached to this report – specifically, avoidance of vulnerable drinking water sources, use of non-pentachlorophenol poles, and other remedial actions – are all preferable to the use of pole barriers.
c. Work with landowner(s) to develop proactive plan to prevent contamination to the drinking water supply. Provide ANR response fact sheet.	In the event that the options listed above are not operationally feasible, are cost prohibitive, or if there are other benefits to the utility and/or the landowner, a site specific action plan developed in collaboration with the landowner to ensure compliance with the groundwater enforcement standards could provide alternative and effective options for all parties involved.
Decommissioning, Retirement, and Disposal	
1. Removal of poles (based on specific site characteristics)	Pentachlorophenol-treated poles leach preservative solution to the soil adjacent to the pole. Concentration of pentachlorophenol in soil immediately adjacent to poles (within a couple inches), can be relatively high, however these concentration levels decrease rapidly by several orders of magnitude with increased distance from the pole. Generally, these levels have been well within acceptable limits within approximately one foot away from the pole. Additionally, pentachlorophenol typically photodegrades by exposure to UV rays from sunlight and/or degrades by microbes relatively quickly. Given these characteristics and the fact the pentachlorophenol binds to organics in the soil and is relatively immobile once this occurs, unless the organic matter or the soil in general are disturbed, migration of

	pentachlorophenol beyond the average one foot diameter mark is not anticipated. However, disturbing the soil around these areas and creating the potential for erosion increases the risk of migration beyond the area immediately adjacent to the pole.
a. Cut pole and leave butt in ground: appropriate in remote locations & sensitive areas (*e.g.*, wetlands) where access by construction vehicles is difficult, unsafe, or poses significant environmental risk, including soil erosion.	Where site conditions are appropriate, and full pole removal is undesirable, it is acceptable for poles to be cut off at or slightly below ground surface and left in place. This practice limits soil disturbance and thus reduces the potential for migration from around the pole.
b. Pull pole butt and replace with clean fill, where appropriate: appropriate in locations accessible by construction equipment or where the utility or landowner determines that cutting the pole would pose an unacceptable risk of injury after the pole butt decays.	Pole butts in this scenario should be pulled directly out of the ground utilizing onsite equipment, if possible. Care should be taken to limit soil disturbance around the pole and areas of soil disturbance should be stabilized with seed and mulch or other approved erosion control measures, to limit the potential of soil migration.
c. If excavation is required to remove the pole, limit soil disturbance to the extent possible and implement soil management, and erosion and sediment control measures. Excavation should be delayed when there are extreme weather conditions which may lead to erosion (high sustained wind, heavy precipitation) and are within 50 feet of a sensitive area.	Certain situations require excavation of soil around the pole butts in order to free them for removal. In these situations, it is recommended the utilities limit the amount of soil disturbance to only what is needed to extract the pole butt. In addition, soil excavated from around the pole butt should be stockpiled or side cast as close to the excavation location as possible. Once the pole butt is extracted, the excavated soil should be replaced back in the excavation as backfill, with additional clean backfilled used to fill any additional void space created from the excavation and/or the hole left from the pole butt.
d. For work within 50 feet of a shallow drinking water source, excavated soil should be removed and disposed of in accordance with Vermont solid waste regulations.	
e. Grossly contaminated soil should be removed and disposed of in accordance with Vermont solid waste regulations.	
2. Reuse pentachlorophenol-treated wood poles in accordance with ANR Fact Sheet titled "Managing Treated Wood Waste (Appendix 2).	The reuse of pentachlorophenol-treated wood products in accordance with the ANR Fact Sheet provides recipients of the material with acceptable reuse benefits and risks.

Proposed Best Management Practice and Rationale

3. If reuse is not feasible, dispose of pentachlorophenol-treated poles in accordance with all applicable regulations.	In certain cases such as large replacement projects, not all decommissioned treated wood products can be reused. Some may be so deteriorated that it may not be safe or appropriate for reuse or utilities may simply produce more than can be donated in a given duration. In such cases, utilities shall follow all applicable disposal regulations.
Training & Education	
1. In order to ensure compliance with these BMPs train appropriate personnel to:	Training of applicable personnel is imperative for the successful execution of these BMPs. It is recommended that applicable personnel receive training, including a comprehensive review of the BMPs and specific training related to the section(s) of the BMPs that are applicable to each individual or group.
a. Locate and identify shallow water sources.	
b. Identify environmentally-sensitive areas.	
c. Identify poles that are excessively sweating preservative solution.	
d. Ensure familiarity with proper handling and safety precautions.	
e. Identify & report potential releases from poles.	

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Appendices

Appendix 1 *Best Management Practices (BMPs) Associated with the Use of Pentachlorophenol-treated Utility Poles in Vermont*

Appendix 2 *ANR Reuse Fact Sheet*

Appendix 3 *US EPA Example Consumer Information Sheet*

Appendix 4 *State Response for Environmental Releases*

Appendix 5 *Public Response Sheet What to Do If You Suspect Drinking Water Contamination from Utility Poles*

Appendix 6 *Sites Management's Case Summaries*

Appendix 1

Best Management Practices (BMPs) Associated with the Use of Pentachlorophenol-treated Utility Poles in Vermont

Procurement, Delivery & Storage

1. Require Traceable ID brand with plant location and year produced, which can be traced to the batch of treated poles.
2. Require all poles used in VT to be treated to AWPA specifications for deterioration zone 2.
3. Require all poles used in VT to be double vacuum treated or extend vacuum cycle to twice the standard length prior to delivery to VT. In some cases, utilities may require immediate delivery of poles for emergency restoration activities, and that such poles may deviate from normal specifications. However, in all cases, reasonable efforts will be made to install poles in accordance with these BMPs.
4. Inspect poles on delivery – Retain the right to reject any pole that exhibits excessive sweating of preservative solution. This is more readily accomplished during the warmer months.

Permanent Pole Storage Areas *Use for design of new construction or substantial reconstruction of existing pole storage areas*

1. Locate 100 feet from drinking water sources and as far away as possible from residences.
    a. Design considerations should include:
        i. A low permeability surface material (compacted soil or asphalt) with absorbent/organic material; or
        ii. Other containment/migration prevention measures
2. Poles should be elevated off ground surface
3. Ground surface should consist of a low erosion potential substance
4. Maintain a yard slope of less than 10% throughout the pole storage area
5. Pole storage areas should be sited to limit odor impact to the public
6. Pole storage areas should be visually inspected when work is being done at a pole yard for excessively sweating poles, unusual staining, or other evidence of unusual releases of pentachlorophenol.

Pole Siting & Construction

1. Onsite utility personnel and contractors should inspect all poles prior to installation to ensure no excessive release of preservative solution is occurring
2. Before installing any new pole, determine if there are any shallow drinking water sources within 50 feet of the pole location. Wherever feasible poles should be located at least 50 feet away from shallow drinking water sources; if this is not feasible utilities should, in the following order;
    a. Use an alternative type of treated pole
    b. Use a containment structure or barrier (*e.g.* ,– pole sleeve)
    c. Work with landowner(s) to develop a proactive plan to prevent contamination to the drinking water supply. Also provide landowner ANR fact sheet, *What to Do If You Suspect Drinking Water Contamination from Utility Poles*

Decommissioning, Retirement, and Disposal of Pentachlorophenol-treated Poles

1. Removal of poles (based on specific site characteristics)
    a. Cut pole and leave butt in ground: appropriate in remote locations and sensitive areas (*e.g.*, wetlands) where access by construction vehicles is difficult or unsafe, or poses significant environmental risk, including soil erosion
    b. Pull pole butt and replace with clean fill, where appropriate: appropriate in locations accessible by construction equipment or where the utility or landowner determines that cutting the pole would pose an unacceptable risk of injury after the pole butt decays
    c. If excavation is required to remove the pole, limit soil disturbance to the extent possible and implement soil management, and erosion and sediment control measures. Excavation should be delayed when

   there are extreme weather conditions which may lead to erosion (high sustained wind, heavy precipitation) and are within 50 feet of a drinking water well.
   d. For work within 50 feet of a shallow drinking water source, excavated soil should be removed and disposed of in accordance with Vermont solid waste regulations.
   e. Grossly contaminated soil should be removed and disposed of in accordance with Vermont solid waste regulations.

2. Reuse pentachlorophenol-treated wood poles consistently with the restrictions placed on the original product.
   a. Provide ANR fact sheet "Managing Treated Wood Waste" to all private parties that accept decommissioned poles for reuse.
   b. If reuse is not feasible, dispose of treated poles in accordance with all applicable ANR regulations

Training/Education

1. In order to ensure compliance with these BMPs train appropriate personnel to:
   a. Locate and identify shallow drinking water sources
   b. Identify environmentally-sensitive areas
   c. Identify poles that are excessively sweating preservative solution
   d. Ensure familiarity with proper handling and safety precautions
   e. Identify and report potential contaminant releases from utility poles

Appendix 2 ANR Reuse Fact Sheet

Environmental Fact Sheet

VERMONT

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

. Managing Treated Wood Waste

Wood products such as utility poles, railroad ties, and lumber for outdoor exposures are treated with chemical preservatives that create a barrier against insect attack and decay. These wood products can contain toxic constituents in sufficient concentrations to constitute a threat to public health and the environment if improperly reused, or cause the products to be regulated as hazardous waste when discarded. This Fact Sheet is intended to describe best management practices for treated wood reuse and allowable disposal options. As described below, treated wood waste disposal by businesses may be subject to regulation as a hazardous waste.

Wood preservatives fall into three broad categories which, in turn, dictate how the treated wood should be managed when removed from its original use. The categories are:

Water-borne preservatives:	The most common water-borne preservatives used to treat wood include *Chromated Copper Arsenate* (CCA), *Ammoniacal Copper Quat* (ACQ), *Ammoniacal Copper Zinc Arsenate* (ACZA), as well as the less-toxic, inorganic borate compounds. The copper containing treated wood tends to be green in color and can weather to gray. Borate treated wood is colorless, but may be dyed blue. Wood treated with waterborne preservatives is used in a variety of outdoor residential, commercial, and industrial products and applications, such as decking and walkways, fences, gazebos, docks, playground equipment, highway noise barriers, utility poles and retaining walls. CCA treated wood is no longer available for residential use.
Creosote-treated wood:	Wood treated with creosote is used mainly for bridge timbers, railroad tires, retaining walls, and docks. This wood has a dark brown color and may have a strong odor.
Oil-borne preservatives:	Common varieties of oil-borne preservatives include chlorophenolic compounds, e.g., pentachlorophenol, or "penta," and copper naphthenate. "Penta" is the most widely used oil-borne preservative, used to preserve utility poles and cross arms, railroad ties, and fence posts. Neither penta-containing products nor wood treated with penta are available for residential use. Pentachlorophenol-treated wood is dark in color and may have an odor, while copper naphthenate is green and weathers to brownish gray over time.

How can treated wood be reused?

The Waste Management and Prevention Division (WMPD) does not consider wood treated with a preservative to be waste when reused appropriately, i.e., reused in a manner that does not pose an increased risk to human health or the environment. In general, "appropriate reuse" of these types of treated woods does not increase the amount of surface area available to leaching, involve placement in or near environmentally sensitive areas, or involve combustion of any type.

Because of the greater toxicity of the preservative, and increased potential for environmental harm if misused, the WMPD discourages the reuse of chlorophenolic and creosote treated wood, except by the original owner. If these products are considered for reuse, the WMPD strongly recommends that the original owner provide the recipient with this Fact Sheet, and obtain a signed consent form indicating that the recipient understands the risk associated with the product, best management practices for the product's reuse, and end-of-life disposal options.

Examples of inappropriate and appropriate reuses of treated wood

Inappropriate	Appropriate
× Should not be reused in interiors of residential structures × Should not be reused in interiors of farm structures where livestock or animals are present or in farrowing or brooding facilities	✓ Use as support beams in open-air/outdoor construction
× Should not be reused in areas of farm structures that may come in contact with food or feed. × Should not be reused in bee hives	✓ Use for general landscaping in areas that are not in the vicinity of vegetable gardens. For example, terracing
× Do not burn × Should not be reused in areas where there is potential for frequent contact with skin (chairs, playgrounds, patios, decking)	✓ Use as fence posts or property line demarcation
× Should not be reused near vegetable gardens × Should not be reused in areas that may come into indirect or direct contact with drinking water sources, except in incidental contact (docks, bridges)	

How can treated wood waste be disposed of when it is <u>not</u> reused?

Household-generated waste is categorically exempt from regulation as hazardous waste; therefore, treated wood waste generated from a household may be disposed of at a lined, solid waste landfill.

Business-generated treated wood waste that is <u>not reused by the original owner,</u> must be evaluated to determine if it is hazardous waste. Waste that is determined to be hazardous must be managed in accordance with the Vermont Hazardous Waste Management Regulations. The owner or operator of a business can determine whether or not treated wood is hazardous waste based on either "generator knowledge" about the wood, or laboratory analysis.

Business-generated treated wood waste is considered hazardous waste when certain contaminants are present at or above specified limits. The test method used to make this determination (when the determination is not based on "generator knowledge") is the Toxicity Characteristic Leaching Procedure, or TCLP. The regulatory levels for the contaminants generally associated with treated wood are specified in the following chart:

Types of Treated Wood / Distinguishing Characteristics	Hazardous Waste Number	Contaminant	Regulatory Level (mg/L)
Inorganic Preservatives: "greenish" in color.	D004	Arsenic	5.0
	D007	Chromium	5.0
Creosote Formulation: brown to dark brown in color; may be coated with tar; has a "smoky", chemical odor.	D023	o-Cresol	200.0[1]
	D024	m-Cresol	200.0[1]
	D025	p-Cresol	200.0[1]
	D026	Cresol	200.0[1]
Chlorophenolic Formulations: Similar characteristics to creosote.	D037	Pentachlorophenol	100.0

1 If o-, m-, and p-Cresol concentrations cannot be differentiated, the total cresol (D026) concentration is used. The regulatory level of total cresol is 200.0 mg/l.

Treated wood that is not subject to regulation as a hazardous waste, i.e., treated wood from businesses that does not exhibit the toxicity characteristic and is therefore non-hazardous, may be disposed of in certified, lined landfills. (Analogous to household-generated treated wood.) Treated wood should not be shredded or ground prior to disposal.

Note that treated wood (hazardous waste or not) cannot be burned for either energy recovery or disposal unless it is burned in a device that has been permitted by the Agency for that purpose.

For Addition Information About...

...burning wastes, contact the **Air Pollution Control Division** at (802) 828-1288.

...this fact sheet, or other solid or hazardous waste management issues, contact the **Waste Management And Prevention Division** at (802) 828-1138, or visit the Division web site http://www.anr.state.vt.us/dec/wastediv/index.htm

...reducing the amount, and the toxicity, of waste produced, contact Vermont's non-regulatory **Environmental Assistance Office** toll-free (in Vermont) at 1-800-974-9559.

Appendix 3 US EPA Example Consumer Information Sheet

Consumer Information Sheet

PENTACHLOROPHENOL PRESSURE-TREATED WOOD

CONSUMER INFORMATION

This wood has been preserved by pressure-treatment with an EPA registered pesticide containing pentachlorophenol to protect it from insect attack and decay. Wood treated with pentachlorophenol should be used only where such protection is important.

Pentachlorophenol penetrates deeply into and remains in the pressure-treated wood for a long time. Exposure to pentachlorophenol may present certain hazards. Therefore, the following precautions should be taken both when handling the treated wood and in determining where to use and dispose of the treated wood.

USE SITE PRECAUTIONS

Logs treated with pentachlorophenol should not be used for log homes.

Wood treated with pentachlorophenol should not be used where it will be in frequent or prolonged contact with bare skin (for example, chairs and other outdoor furniture), unless an effective sealer has been applied.

Pentachlorophenol-treated wood should not be used in residential, industrial, or commercial interiors except for laminated beams or building components which are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site.

Wood treated with pentachlorophenol should not be used in the interiors of farm buildings where there may be direct contact with livestock which may crib (bite) or lick the wood.

In interiors of farm buildings where domestic animals or livestock are unlikely to crib (bite) or lick the wood, pentachlorophenol-treated wood may be used for building components which are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Sealers may be applied at the installation site.

Do not use pentachlorophenol-treated wood for farrowing or brooding facilities.

Do not use treated wood under circumstances where the preservative may become a component of food or animal feed. Examples of such sites would be structures or containers for storing silage or food.

Do not use treated wood for cutting-boards or countertops.

Only treated wood that is visibly clean and free of surface residue should be used for patios, decks and walk-ways.

Do not use treated wood for construction of those portions of beehives which may come into contact with the honey.

Pentachlorophenol-treated wood should not be used where it may come into direct or indirect contact with public drinking water, except for uses involving incidental contact such as docks and bridges.

Do not use Pentachlorophenol-treated wood where it may come into direct or indirect contact with drinking water for domestic animals or livestock, except for uses involving incidental contact such as docks and bridges.

HANDLING PRECAUTIONS

Dispose of treated wood by ordinary trash collection or burial. Treated wood should not be burned in open fires or in stoves, fireplaces, or residential boilers because toxic chemicals may be produced as part of the smoke and ashes. Treated wood from commercial or industrial use (e.g. construction sites) may be burned only in commercial or industrial incinerators or boilers rated at 20 million BTU/hour or greater heat input or its equivalent in accordance with state and Federal regulations.

Avoid frequent or prolonged inhalation of sawdust from treated wood. When sawing and machining treated wood, wear a dust mask. Whenever possible, these operations should be performed outdoors to avoid indoor accumulations of airborne sawdust from treated wood.

Avoid frequent or prolonged skin contact with pentachlorophenol-treated wood; when handling the treated wood, wear long-sleeved shirts and long pants and use gloves impervious to the chemicals (for example, gloves that are vinyl-coated).

When power-sawing and machining, wear goggles to protect eyes from flying particles.

After working with the wood, and before eating, drinking, and use of tobacco products, wash exposed areas thoroughly.

If oily preservatives or sawdust accumulated on clothes, launder before reuse. Wash work clothes separately from other household clothing.

Urethane, shellac latex epoxy enamel and varnish are acceptable sealers for pentachlorophenol-treated wood.

Appendix 4 State Response for Environmental Releases

The ANR requires a response to environmental releases that impacts ground or surface water. These environmental releases are determined by visual observations, instrument readings, laboratory analyses, and/or visual/olfactory inspection of the water. The first step in the site assessment of a potential an environmental release from a utility pole is to identify the type of chemical preservative used, known contaminants of the preservative, and the carrier used to apply the preservative. Poles in Vermont are primarily treated with pentachlorophenol, but there may be creosote, Cu-Nap, or even un-treated poles in use. For pentachlorophenol-treated poles, levels of pentachlorophenol, its carrier and contaminants may be tested. During the site investigation it is important to note that there are many anthropogenic sources of the contaminants associated with pentachlorophenol: hexachlorobenzene and the dioxins/furans. Analytical methods for these, by matrix, are provided below. Equivalent environmental methods may be used at the discretion of the Sites Management Section, though drinking water samples should be analyzed only by drinking water methods.

Matrix	Compounds of Interest	Analytical Method
Drinking water	Pentachlorophenol	515 or 525
	Hexachlorobenzene	525
	Dioxins	1613 or 8290
	BTEX	524.2
	Naphthalene	524.2
	PAHs	525
Ground, Surface water	Pentachlorophenol	8151, SOM01.2 with SIM
	Hexachlorobenzene	8270
	Dioxins	8290
	BTEX	8260
	Naphthalene	8260, 8270
	PAHs	8270 ± SIM
Soil/sediment	Pentachlorophenol	8151, SOM01.2 with SIM
	Hexachlorobenzene	8270
	Dioxins	8290
	BTEX	8260
	Naphthalene	8260, 8270
	PAHs	8270 ± SIM
	Total Organic Carbon (TOC) for sediments	Lloyd Kahn

Environmental and drinking water samples should be collected, stored and shipped in accordance with the sampling, extraction and analytical method requirements and in compliance with the IROCPP. Testing of samples should be done at an appropriately certified laboratory. That is, drinking water samples should be tested at laboratories that are certified as such by the Vermont Department of Health. Other media should be tested at laboratories that can demonstrate appropriate quality systems based on the media type. For environmental samples this is generally, at a minimum, done by participation in the National Environmental Laboratory Accreditation Program with compound and matrix specific accreditations. The ANR as a policy does allow for other comparable performance based measures in its review of environmental media data.

If during the site assessment process, it is determined that hazardous compounds in water or soil exceed, or are likely to exceed, Vermont standards or requires mitigation to protect sensitive receptors (human/animal/environments) from the hazardous material, remediation will be required.

Environmental remediation measures may include:

— removal of the suspected pole(s),
— replacement with a new pentachlorophenol-treated pole,
— replacement with another type of pole, and/or

— relocation of the pole to a less sensitive area
— excavation and disposal of soil

The remediation measures will be determined based on the groundwater conditions, topography near the structure, level of contamination, and the condition of the suspect pole(s).

If pentachlorophenol is detected in a private drinking water supply, the ANR may require that the water supply be treated using an activated carbon treatment system to remove pentachlorophenol from the water supply at the point of entry into the residence. Depending on the extent of contamination in the water distribution system, replacement of the water source and/or plumbing fixtures may also be required.

Storage Yards

Upon closure or conversion of a pole storage yard, a site assessment should be conducted in conjunction with the SMS of ANR. It is expected that contaminated soil will be generated in the decommissioning of a pole storage yard, or at any time that a significant release of pentachlorophenol is observed in a pole storage yard. The typical cleanup at pole storage yards involves laboratory analyses to assess extent of contamination and then the subsequent removal of contaminated soil. Groundwater monitoring wells may be installed in areas where there is an interface with contaminated areas, or other strategic locations to protect off-site migration. SMS will make recommendations for groundwater monitoring based on the specific geographic location of the pole yard and on the findings of the cleanup reports. Again, the IROCPP will be used to guide the assessment and remediation process.

Appendix 5 Public Response Sheet

VERMONT

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

What to Do If You Suspect Drinking Water Contamination from Utility Poles

This document is intended as a guide for Vermonters to follow in the event you suspect that your drinking water has been contaminated by utility pole preservatives. ***It is important to note that this is very rare occurrence and only a few cases have ever been documented in Vermont.*** Additionally, poles that have been in service for several years and have had no recent excavation are less likely to create any issues. However, if you suspect there is an issue with your water supply or if there has been recent installation or replacement of utilities poles or excavation of soil within a few feet of existing utility poles near your water supply, please follow the steps outlined below.

What kinds of water sources are most at risk? Shallow drinking water sources, such as springs and dug wells, are most likely to be influenced by contaminants moving from utility poles, and other contaminants.

What are signs to look out for?

- Look for a utility pole that appears to be "sweating," or there is more than 12 inches of stained soil around the base of the pole on the soil, especially if it is very close to your water supply
- Gas or diesel-like odors coming from your water
- Note that health and environmental limits are lower than our ability to smell it: you may not be able to smell the contamination in your drinking water.

What should you do? If you suspect your water may be contaminated, do not drink or bathe in it until the situation can be assessed. Use a known safe source of water for these activities. Boiling the water will not remove these contaminants.

Who should you contact? Call the Vermont Department of Environmental Conservation Spill Response hotline during **office hours 1-802-828-1138** or **24 hour at 1-800-641-5005.** Staff members are trained to respond and will work with you to identify the next steps, which will include identifying and notifying the utility that owns the pole. Provide all parties with your name, address and the pole number located on the pole.

What will they test for? If it is determined to be necessary, state agencies and your utility will arrange for collection and testing of water samples for contaminants related to the wood preservatives in the pole. Based on the location and other characteristics of your water supply, the Department of Health may advise you to test for other contaminants as well.

Who will test the water? Only certified laboratories can test drinking water. A list of the Vermont-certified laboratories can be found here: http://healthvermont.gov/enviro/ph_lab/documents/certified_labs.pdf or ask the state agency that you are working with for a list of certified laboratories near you.

What will happen if the water is contaminated? The staff at the state agencies and your utility will work with you to come up with a remediation plan to fix the situation.

Appendix 6 Sites Management's Case Summaries[1]

Summary of specific pentachlorophenol releases in Vermont which led to contamination of drinking water sources

Clarendon Residence

A utility pole approximately 40 feet from the onsite drinking water spring was replaced in early 2009. Soon after the pole replacement, the residents of the property began to notice odors in the water supply similar to the utility pole odor. Under the directive of the Site Management Section (SMS), the utility oversaw the replacement of the pole (with a cedar pole), removal of soil surrounding the pole, and a new bedrock water supply well was installed approximately 80 feet from the original dug well. Monitoring wells were installed to measure any lingering impacts of pentachlorophenol on the property, but it was found that after the initial impact and replacement of the pole that the pentachlorophenol concentrations declined rapidly as verified by samples taken by both the utility's consultant and the Vermont Agency of Agriculture, Food & Markets (VAAFM). The utility elected to replace all of the piping and several appliances in the residence during the cleanup effort. This property received a Site Management Activity Completed (SMAC) designation after meeting regulatory requirements for soil, groundwater and drinking water.

Bennington Residence

Similar to the Clarendon Residence, a pole was replaced near a drinking water spring in 2009, and again an odor was detected in the spring water shortly thereafter. This was a very wet location with a surface water feature directly below the pole and very shallow groundwater conditions. Under the directive of the SMS, the utility oversaw the replacement of the pole (with a cedar pole), removal of soil surrounding the pole, and a carbon-based point of entry (POET) treatment system was installed to remove pentachlorophenol from the spring water influent. Pentachlorophenol concentrations were also found to drop rapidly at this site following removal of soil and pole replacement. The utility installed a new bedrock water supply well to give the owner more assurance about the safety of their water source. However, the new bedrock well was found to have levels of radium exceeding the Vermont Groundwater Enforcement Standards (VGES), so the homeowner decided to revert back to their use of the treated spring source. This spring treatment source was maintained for some time until several rounds of sampling confirmed that there were no detections of pentachlorophenol. The treatment system was eventually removed. At the time of the soil removal and pole replacement, elevated pentachlorophenol concentrations were noted at the bedrock interface at approximately 8 feet below grade. Additional supplemental subsurface investigations between the former utility pole and the spring are required by the DEC before issuing a SMAC designation. This has been delayed as the current property owner is not allowing site access.

Monkton Residence

A utility structure was replaced near a shallow water supply spring in Monkton in March of 2014. The spring was located approximately 45 feet down-gradient of the utility structure and within a seasonal surface water feature. The utility had conducted baseline water sampling prior to the replacement of the structure, and no pentachlorophenol was detected in the spring. During the replacement of the utility structure, odors were detected in the residence water. Upon this discovery the utility returned to the property and collected another sample from the water source. Pentachlorophenol was recorded in this sample in excess of the VGES. The utility had initiated the installation of a replacement bedrock water source be provided and SMS requested that an investigation of soil and groundwater be conducted in the areas surrounding the pole and the spring. Several soil borings and monitoring wells were established at this location and one area near the residences' leach field. No pentachlorophenol was detected in any of the shallow groundwater samples from the monitoring wells. Sheens were initially observed on the surface water near the spring, which was believed to related to the carrier oil compounds that are also present in the utility pole treatment (used as a 'binder' for pentachlorophenol in the

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[1] As described in VTDEC Sites Management Section memo dated December 16, 2014.

preservative solution). Surface water samples collected from an area adjacent to the spring showed elevated levels of pentachlorophenol, though these concentrations were below the VGES and the concentrations for protection of aquatic biota. This is relevant as a large wetland complex is located to the west and down gradient of the utility pole structure. A new bedrock water supply well was installed over 150 yards from the former spring on the property and was found to be free of pentachlorophenol contamination. Several water system components within the residence were also replaced by the utility.

Summary of other confirmed or suspected pentachlorophenol releases in VT, which did not result in drinking water contamination

Middlesex Residence

In 2010, shortly after installation of new utility poles by a local utility near a residence, the owners began to notice odors in their water supply. No pentachlorophenol was ever detected in confirmatory samples from the water source, though pentachlorophenol was encountered in soil a short distance from the pole. Poles were replaced with cedar and impacted soil was removed from the vicinity of the poles in question.

Waterbury

A release from a newly installed utility pole was reported to VT DEC in 2010 by someone who spotted black liquid migrating from the pole on nearby I-89. Remedial actions included soil removal and installation of a containment vessel around the pole.

Pole Storage Yard, Bellows Falls

A pole storage yard was investigated in 2009 and found to have elevated levels of pentachlorophenol and other contaminants in soil in a former pole storage area. Over 1,000 tons of impacted soil was removed and transported for disposal. It appears that the bulk of contamination was effectively removed and there were no documented groundwater impacts.

Pole Storage Yard, Dummerston

A pole storage yard was investigated in 2007 and found to have elevated levels of pentachlorophenol and other contaminants in soil in a pole storage area. Over 2,000 tons of impacted soil was removed and transported for disposal. It appears that the bulk of contamination was effectively removed and there were no documented groundwater impacts.

Testimony of Bradley P. Janorschke, Homer Electric Association, Inc. General Manager
Subject: SB173 | Date: February, 12, 2018

Good Afternoon, Madam Chair and Members of the Committee,

Thank you for the opportunity to testify today. My name is Brad Janorschke. I am the General Manager for Homer Electric Association. Also with me today via teleconference is Homer Electric's Environmental Compliance Officer, Bruce Linton, and our Environmental Attorney, Eric Fjelstad. Bruce and Eric are available to answer any questions of technical or legal nature.

As many of you are aware Homer Electric is a generation, transmission, and distribution electric cooperative providing service to over 33,000 electric meters over a roughly a 3,200 square mile area on the Kenai Peninsula.

The topic at hand today affects all public utilities in Alaska....telephone and electric. The issue comes from the lack of statutory clarity regarding the treatment of wood utility poles. Recent events on the Kenai Peninsula have raised the potential for soils surrounding each wood pole to be treated as a contaminated site when a pole is removed from service.

Just a little background information, over 250,000 treated wood utility poles are installed throughout the state of Alaska and have been used widely across the country for over the last century. Wood poles are less expensive than alternatives such as steel, fiberglass, and concrete, are a renewable resource, and blend in with the environment more readily than previously mentioned options. Today wood poles are factory-treated with a pesticide/wood preservative in order to prolong the life of the pole.

In the last few decades and very common today, most wood poles installed have been treated with pentachlorophenol (penta), an EPA registered pesticide. Environmental studies demonstrate that properly treated poles are expected to have minimal pesticide migration from the pole to the environment directly surrounding the pole. It is this minimal migration that makes the site potentially qualify as a contaminated site under current Alaska law. If it were characterized as a contaminated site, Homer Electric has been informed the estimated cost to remove a single utility pole from service and comply with a lengthy site clean-up process would be about $30,000.

The provisions of AS 46.03.822(a) if strictly read, can be interpreted as making a public utility that installs treated wooden poles liable for cleaning up any residual preservative around an existing or retired utility pole. This liability does not exist under federal law and as far as we are aware, any other state.

The purpose of the proposed legislation is to bring Alaska in alignment with the rest of the country. The legislation is drafted narrowly, intended to apply to potential liability stemming from installing or removing a treated wood utility pole.

In closing, I just want to state that HEA has been actively engaged with the Alaska Department of Environmental Conservation (ADEC) over the past almost two years and we appreciate the professionalism with which they have approached this subject. Our concerns are not with ADEC, rather it is with language of the law that they are obligated to operate under.

As an aside, kudos to ADEC as they have recently taken a positive step forward by inviting members of our state-wide organization (Alaska Power Association) to participate in the development and implementation of best management practices for the handling, storage, use, and retirement of treated utility poles….something that has been successfully been done in at least one other state.

Thank you again for the opportunity to testify today.

United States
Environmental Protection
Agency

Prevention, Pesticides
and Toxic Substances
(7510P)

EPA 739-R-08-008
September 25, 2008

Reregistration Eligibility Decision for Pentachlorophenol

REREGISTRATION ELIGIBILITY DECISION
for
Pentachlorophenol
List B
CASE 2505

Approved By:

Frank T. Sanders
Director, Antimicrobials Division
September 25, 2008

Attachment

Pentachlorophenol Reregistration Team

Office of Pesticide Programs

Health Effects Risk Assessment
Jonathan Chen
Timothy McMahon
Timothy Leighton
Najm Shamim
Timothy Dole

Ecological Risk Assessment
Rick Petrie

Environmental Fate Risk Assessment
Siroos Mostaghimi

Biological and Economics Assessment Division
Jonathan Becker
Steve Hopkins
Timothy Kiely

Risk Management
Sherrie Kinard
Diane Isbell

Office of General Counsel:

Pesticides and Toxic Substances Law Office
Philip Ross

Office of Enforcement and Compliance Assistance:

David Stangel

Office of Solid Waste:

Ross Elliot

GLOSSARY OF TERMS AND ABBREVIATIONS

a.i.	Active Ingredient
aPAD	Acute Population Adjusted Dose
APHIS	Animal and Plant Health Inspection Service
ARTF	Agricultural Re-entry Task Force
BCF	Bioconcentration Factor
CDC	Centers for Disease Control
CDPR	California Department of Pesticide Regulation
CFR	Code of Federal Regulations
ChEI	Cholinesterase Inhibition
CMBS	Carbamate Market Basket Survey
cPAD	Chronic Population Adjusted Dose
CSFII	USDA Continuing Surveys for Food Intake by Individuals
CWS	Community Water System
DCI	Data Call-In
DEEM	Dietary Exposure Evaluation Model
DL	Double layer clothing {i.e., coveralls over SL}
DWLOC	Drinking Water Level of Comparison
EC	Emulsifiable Concentrate Formulation
EDSP	Endocrine Disruptor Screening Program
EDSTAC	Endocrine Disruptor Screening and Testing Advisory Committee
EEC	Estimated Environmental Concentration. The estimated pesticide concentration in an environment, such as a terrestrial ecosystem.
EP	End-Use Product
EPA	U.S. Environmental Protection Agency
EXAMS	Tier II Surface Water Computer Model
FDA	Food and Drug Administration
FFDCA	Federal Food, Drug, and Cosmetic Act
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FOB	Functional Observation Battery
FQPA	Food Quality Protection Act
FR	Federal Register
GL	With gloves
GPS	Global Positioning System
HIARC	Hazard Identification Assessment Review Committee
IDFS	Incident Data System
IGR	Insect Growth Regulator
IPM	Integrated Pest Management
RED	Reregistration Eligibility Decision
LADD	Lifetime Average Daily Dose
LC_{50}	Median Lethal Concentration. Statistically derived concentration of a substance expected to cause death in 50% of test animals, usually expressed as the weight of substance per weight or volume of water, air or feed, e.g., mg/l, mg/kg or ppm.
LCO	Lawn Care Operator
LD_{50}	Median Lethal Dose. Statistically derived single dose causing death in 50% of the test animals when administered by the route indicated (oral, dermal, inhalation), expressed as a weight of substance per unit weight of animal, e.g., mg/kg.
LOAEC	Lowest Observed Adverse Effect Concentration
LOAEL	Lowest Observed Adverse Effect Level
LOC	Level of Concern
LOEC	Lowest Observed Effect Concentration
mg/kg/day	Milligram Per Kilogram Per Day
MOE	Margin of Exposure
MP	Manufacturing-Use Product
MRID	Master Record Identification (number). EPA's system of recording and tracking studies submitted.
MRL	Maximum Residue Level

N/A	Not Applicable
NASS	National Agricultural Statistical Service
NAWQA	USGS National Water Quality Assessment
NG	No Gloves
NMFS	National Marine Fisheries Service
NOAEC	No Observed Adverse Effect Concentration
NOAEL	No Observed Adverse Effect Level
NPIC	National Pesticide Information Center
NR	No respirator
OP	Organophosphorus
OPP	EPA Office of Pesticide Programs
ORETF	Outdoor Residential Exposure Task Force
PAD	Population Adjusted Dose
PCA	Percent Crop Area
PDCI	Product Specific Data Call-In
PDP	USDA Pesticide Data Program
PF10	Protection factor 10 respirator
PF5	Protection factor 5 respirator
PHED	Pesticide Handler's Exposure Data
PHI	Pre-harvest Interval
ppb	Parts Per Billion
PPE	Personal Protective Equipment
PRZM	Pesticide Root Zone Model
RBC	Red Blood Cell
RED	Reregistration Eligibility Decision
REI	Restricted Entry Interval
RfD	Reference Dose
RPA	Reasonable and Prudent Alternatives
RPM	Reasonable and Prudent Measures
RQ	Risk Quotient
RTU	(Ready-to-use)
RUP	Restricted Use Pesticide
SCI-GROW	Tier I Ground Water Computer Model
SF	Safety Factor
SL	Single layer clothing
SLN	Special Local Need (Registrations Under Section 24C of FIFRA)
STORET	Storage and Retrieval
TEP	Typical End-Use Product
TGAI	Technical Grade Active Ingredient
TRAC	Tolerance Reassessment Advisory Committee
TTRS	Transferable Turf Residues
UF	Uncertainty Factor
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WPS	Worker Protection Standard

ABSTRACT

The Environmental Protection Agency (EPA or the Agency) has completed the human health and environmental risk assessments for pentachlorophenol and is issuing its risk management decision. The risk assessments, which are summarized below, are based on the review of the required target database supporting the use patterns of currently registered products and additional information received through the public docket. After considering the risks identified in the revised risk assessments, comments received, and mitigation suggestions from interested parties, the Agency developed its risk management decision for uses of pentachlorophenol that pose risks of concern. As a result of this review, EPA has determined that pentachlorophenol containing products are eligible for reregistration, provided that risk mitigation measures are adopted and labels are amended accordingly. That decision is discussed fully in this document. The Agency is aware that research is ongoing regarding pentachlorophenol. The Agency may revisit this decision in the future.

I. INTRODUCTION

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was amended in 1988 to accelerate the reregistration of products with active ingredients registered prior to November 1, 1984 and amended again by the Pesticide Registration Improvement Act of 2003 to set time frames for the issuance of Reregistration Eligibility Decisions. The amended Act calls for the development and submission of data to support the reregistration of an active ingredient, as well as a review of all submitted data by the U.S. Environmental Protection Agency (EPA or the Agency). Reregistration involves a thorough review of the scientific database underlying a pesticide's registration. The purpose of the Agency's review is to reassess the potential hazards arising from the currently registered uses of the pesticide; to determine the need for additional data on health and environmental effects; and to determine whether or not the pesticide meets the "no unreasonable adverse effects" criteria of FIFRA.

Pentachlorophenol (PCP) is a general biocide which has been used extensively as a fungicide, bactericide, herbicide, molluscicide, algaecide and insecticide by agriculture and other industries including textiles, paints, oil drilling and forestry. Pentachlorophenol also contains chlorinated dibenzodioxins and chlorinated dibenzofurans (CDDs and CDFs) and hexachlorobenzene (HCB) as contaminants formed during the manufacture process. These compounds are inherently toxic, as well as environmentally persistent, and their presence may increase the ecological risk associated with the use of pentachlorophenol. Pentachlorophenol is only one of many sources of CDDs, CDFs, and HCB in the environment making it difficult to quantify the portion of the aggregate environmental risk from CDDs, CDFs, and HCB that is attributable to pentachlorophenol wood treatment uses. The main use of pentachlorophenol, as a heavy duty wood preservative, is to treat utility poles. Although its only remaining use in the U.S. is as a heavy duty wood preservative, pentachlorophenol has been used in rice and sugar production, in water treatment, as a pre-harvest defoliant in cotton, and as a general pre-emergence herbicide. It has also been utilized in numerous products including adhesives, construction materials, leather and paper. Pentachlorophenol is currently classified as a Restricted Use Product (RUP) when used as a heavy duty wood preservative and is predominately used to treat utility poles and cross arms.

This document presents the Agency's revised human health and ecological risk assessments and the Reregistration Eligibility Decision (RED) for pentachlorophenol. The pentachlorophenol case consists of one PC Code: 063001. Pentachlorophenol has been used as a wood preservative since 1936; however, the first pesticidal product containing pentachlorophenol was registered in 1950. For a list of the current products, please see Appendix A.

Currently, all of the pentachlorophenol produced in the U.S. is utilized in wood preservation. There are approximately 60 million utility-owned wood poles and 54 million crossarms in service across the United States which have been treated with wood preservatives (mainly pentachlorophenol and creosote; EPRI 1993). Approximately 36 million of the wood poles in service have been treated with pentachlorophenol (Malecki, 1992), and approximately

95.8% of the crossarms in service were treated with pentachlorophenol (EPRI 1993). An estimated 3% of the treated poles are replaced annually.

The Agency has determined that analysis of the potential need for a special hazard-based safety factor under the FQPA is not needed at this time. The Agency does not anticipate dietary or drinking water exposures based on the registered use patterns and there are no tolerances or tolerance exemptions for the use of pentachlorophenol as an active ingredient. Therefore, an FQPA hazard analysis is not necessary at this time.

This document presents the Agency's decision regarding the reregistration eligibility of the registered uses of pentachlorophenol. In an effort to simplify the RED, the information presented herein is summarized from more detailed information which can be found in the technical supporting documents for pentachlorophenol in this RED. The revised risk assessments and related addenda are not included in this document, but are available in the Public Docket at www.regulations.gov (Docket ID EPA-HQ-OPP-2004-0402).

This document consists of six sections. Section I is the Introduction. Section II provides a Chemical Overview, a profile of the use and usage of pentachlorophenol and its regulatory history. Section III, Summary of pentachlorophenol Risk Assessments, gives an overview of the human health and environmental assessments, based on the data available to the Agency. Section IV, Risk Management and Reregistration, presents the reregistration eligibility and risk management decisions. Section V, What Registrants Need to Do, summarizes the necessary label changes based on the risk mitigation measures outlined in Section IV. Finally, the Appendices list all use patterns eligible for reregistration, bibliographic information, related documents and how to access them, and Data Call-In (DCI) information.

II. Chemical Overview

A. Regulatory History

Pentachlorophenol was first registered as an active ingredient by the United Sates Department of Agriculture (USDA) on December 1, 1950. In 1970, the Environmental Protection Agency (EPA) was established and was charged with protecting human health and the environment, and assumed all pesticide registrations from USDA. Currently, there are six products containing pentachlorophenol as an active ingredient. Pentachlorophenol is a fungicide, bactericide, herbicide, molluscicide, algaecide and insecticide and is only registered for use as a heavy duty wood preservative.

The production of pentachlorophenol for wood preserving began on an experimental basis in the 1930s. In 1947 nearly 3,200 metric tons of pentachlorophenol was reported to have been used in the U.S. by the commercial wood preserving industry. Pentachlorophenol was one of the most widely used biocides in the U.S. prior to regulatory actions to cancel and restrict certain non-wood preservative uses of pentachlorophenol in 1987. Prior to the 1987 Federal Register Notice (Vol. 52, No. 13) which canceled and restricted certain non-wood uses, pentachlorophenol was registered for use as an herbicide, defoliant, mossicide, and as a disinfectant.

Indoor applications of pentachlorophenol are prohibited. These restrictions were imposed on pentachlorophenol registrations as part of the Agency's Special Review process as indicated in the *U.S.EPA Position Document 4 for Wood Preservative Pesticides: Creosote, Pentachlorophenol and Inorganic Arsenicals (1984, amended 1986)*. PD 4 announcing the termination of the Special Review for the non-wood uses of pentachlorophenol was signed 12/29/92 and was published 2/93.

The use of pentachlorophenol to treat wood intended for use in interiors is also prohibited, except for a few low exposure uses (i.e., those support structures which are in contact with the soil in barns, stables, and similar sites and which are subject to decay or insect infestation). Pentachlorophenol is a restricted use pesticide for sale and use by certified applicators only.

In 2000, the Agency canceled 12 products containing pentachlorophenol due to the registrant's failure to pay registration maintenance fees. This resulted in cancellation of all uses of pentachlorophenol as a remedial treatment (a non-pressure treatment using a brush) of utility poles.

The Agency has received requests by the registrants of pesticide products containing pentachlorophenol to voluntarily amend to terminate certain uses of affected products. Two registrants, KMG Chemicals, Inc. and Vulcan Chemicals, requested this action to be effective immediately. KMG Chemicals, Inc. requested that all non-pressure treatment and non-thermal treatments for their product (Pentacon 40) be deleted. Vulcan Chemicals requested to voluntarily cancel spray uses for two of their products (Vulcan GLAZD Penta and Vulcan Premium Four Pound [PCP-2] Concentrate). The Agency has processed these requests. These voluntary use cancellations leave only pressure and thermal wood treatment uses of pentachlorophenol.

B. Chemical Identification

Technical Pentachlorophenol

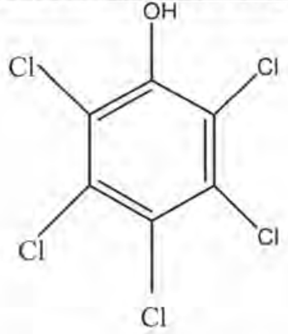

Figure #1. Molecular Structure of Pentachlorophenol

Common name:	Pentachlorophenol
Chemical name:	2,3,4,5,6-pentachlorophenol
Chemical family:	Aromatic Hydrocarbon Chlorophenol
Empirical formula:	$C_6H\,Cl_5O$
CAS Registry No.:	87-86-5
Case number:	2505
OPP Chemical Code:	063001
Molecular weight:	266.34 g/mol
Other names:	Pentachlorophenol is abbreviated as PCP. Product names include Dowicide EC-7, Penchlorol, Penta, Pentacon, Penwar, Priltox, Sinituho and Weedone.
Basic manufacturer:	KMG-Bernuth, Inc.
Chemical properties:	Pentachlorophenol is light brown to tan (Pure pentachlorophenol, however, is white needle-like crystals). It is a solid with a phenolic odor. Pentachlorophenol has a density of 1.978 g/ml; a dissociation constant (K_a) of 1.6×10^{-14}; has a pH of 4.99; and sublimes at $54 \pm 2°C$. Pentachlorophenol has a melting point of 190-191° C; and has a boiling point of 309° C (decomposes). The vapor pressure is 1.1×10^{-4} mm Hg at 25°C. Pentachlorophenol has a Log K_{OW} of 5.05 at pH 5.1; a Log K_{OC} of 2430 (Georgia, sandy loam), 3420 (Ohio, clay loam), 706 (California, sandy loam), 1410 (Nebraska, blue sandy loam); and its solubility at 20°C is 14 mg/L in water, 1.7 g/g in methanol, and 0.014 g/g in benzene.

C. Use Profile

The following information is a description of the currently registered uses of pentachlorophenol products, and an overview of use sites and application methods. A detailed table of the pentachlorophenol uses that are eligible for reregistration can be found in Appendix A.

Type of Pesticide: Pentachlorophenol is a restricted use pesticide used as a heavy duty wood preservative (fungicide, bactericide, herbicide, molluscicide, algaecide and insecticide).

Carpenter Ants
Mold
Lyctus Powderpost Beetles
Powderpost Beetles
Termites
Wood Rot/Decaying Fungus
Wood Rot/Decaying Organisms
Wood Stain Fungus

Use Classification: Restricted use.

Use Sites: The only registered use of pentachlorophenol is as a heavy duty wood preservative.

Lumber
Seasoned Lumber
Timbers
Wood
Wood Poles/Posts
Wood Products
Wood Pressure Treatment

Formulation Types: soluble concentrate and ready to use

D. Methods and Rates of Application:

A summary of the pentachlorophenol registered uses is given in Table 1 and a more detailed listing is included in Appendix A. Pentachlorophenol is registered for use as a heavy duty wood preservative. All other uses have been canceled.

Table 1: Pentachlorophenol Use Site and Application Rates

Company Name	Label #	Product Name	Formulation
KMG-Bernuth, Inc.	61483-1	Penta 5 Sure-Treat Wood Preserver	RTU
	61483-2	Dura-Treet 40 Wood Preserver	SC
	61483-3	KMG-B Penta Ol Technical Pentachlorophenol	Intermediate
	61483-58	Pentacon-7	RTU
	61483-59	Pentacon-10	RTU
	61483-62	Vulcan GLAZD Penta	Technical

Note: RTU is Ready to Use, and SC is Soluble Concentrate.

E. Disposal Information

In a broad sense, two types of waste are generated through the use of pentachlorophenol wood preservatives: wood treated with pentachlorophenol and industrial waste generated through the application of pentachlorophenol. The disposal requirements differ for each type of waste.

1. Treated Wood

Discarded pentachlorophenol treated lumber is usually land disposed in either construction and demolition landfills, municipal solid waste landfills, or industrial non-hazardous waste landfills. Many state and local governments may have specific regulations, guidelines, or recommendations for the management and disposal of discarded pentachlorophenol treated wood, either explicitly, or sometimes under the larger category of "treated wood." Therefore, EPA recommends that persons contact their state and local authorities regarding specific policies or regulations concerning the disposal of pentachlorophenol treated wood.

EPA estimates that there will remain a supply of pentachlorophenol treated wood that will ultimately require disposal, considering the amount of this building material currently in use, and its typical service life (which can be many years). EPA continues to evaluate the potential impacts of land disposal of discarded pentachlorophenol treated wood.

2. Waste Generated at Wood Treatment Facilities

There are also hazardous waste regulations under the Resource Conservation and Recovery Act (RCRA) that apply specifically to wastes generated at facilities where wood preservatives are used to treat wood. On December 6, 1990 EPA promulgated several hazardous waste listings applicable to wastes generated by wood treaters using certain wood preservative chemicals. (55 *FR* 50450; December 6, 1990 *Federal Register*). One of these hazardous waste listings (Hazardous Waste Number F032) can be found in the hazardous waste regulations at 40 CFR 261.31, and reads as follows:

- ***F032:*** Wastewaters (except those that have not come into contact with process contaminants), process residuals, preservative drippage, and spent formulations from wood preserving processes generated at plants that currently use or have previously used chlorophenolic formulations (except potentially cross-contaminated wastes that have had the F032 waste code deleted in accordance with Sec. 261.35 of this chapter or potentially cross-contaminated wastes that are otherwise currently regulated as hazardous wastes (i.e., F034 or F035), and where the generator does not resume or initiate use of chlorophenolic formulations). This listing does not include K001 bottom sediment sludge from the treatment of wastewater from wood preserving processes that use creosote and/or pentachlorophenol.

Because pentachlorophenol preservative is a "chlorophenolic formulation," wastes generated from its use falls within the scope of this hazardous waste listing. Thus, wood treaters using pentachlorophenol preservatives would be hazardous waste generators (with respect to any in-scope wastewaters, process residuals, preservative drippage, etc. that are generated) and would be subject to the applicable requirements under RCRA Subtitle C, for example, notification of hazardous waste activity, obtaining an EPA Identification number, use of a hazardous waste manifest for off-site shipments of waste, and most significantly, the use and maintenance of a drip pad as described in 40 CFR 262.34(a)(1)(iii) and part 265, subpart W.

III. Summary of Risk Assessments

A. Background on Wood Preservative Risk Assessment

The purpose of this summary is to assist the reader by identifying the key features and findings of these risk assessments and to help the reader better understand the conclusions reached in the assessments. The human health and ecological risk assessment documents and supporting information listed in Appendix C were used to formulate the safety finding and regulatory decision for pentachlorophenol. While the risk assessments and related addenda are not included in this document, they are available from the OPP Public Docket EPA-HQ-OPP-2004-0402, and may also be accessed from www.regulations.gov. Hard copies of these documents may be found in the OPP public docket. The OPP public docket is located in Room S-4900, One Potomac Yard, 2777 South Crystal Drive, Arlington, VA 22202, and is open Monday through Friday, excluding Federal holidays, from 8:30 a.m. to 4:00 p.m.

The Agency's use of human studies in the pentachlorophenol risk assessment is in accordance with the Agency's Final Rule promulgated on January 26, 2006, related to Protections for Subjects in Human Research, which is codified in 40 CFR Part 26.

For almost all pesticides subject to reregistration, EPA employed an active ingredient-focused approach rather than an application method-focused approach. That is, EPA typically evaluated and made reregistration eligibility decisions for each active ingredient and its associated use sites rather than each use site and its associated active ingredients ("RED for active ingredient X" rather than "RED for applications made by application method X"). However, due to the unique nature in which the chemicals are applied, EPA made the decision early in the reregistration process (circa 1988) to evaluate heavy duty wood preservative uses collectively using an application method-focused approach.

The term "heavy duty" wood preservative is used to differentiate wood preservatives applied using specialized high pressure treatment cylinders (also called "retorts") from those applied using non-specialized methods (e.g., brush, dip). Figure 1 presents a photograph of a treatment retort. There are three heavy duty wood preservative cases subject to reregistration: chromated arsenicals (Case 0132), pentachlorophenol (Case 2505), and creosote (Case 0139). Because these cases include only heavy duty wood preservatives, to improve readability the words "heavy duty" are often omitted in favor of the generic term "wood preservative" throughout the RED and supporting documents. The Agency notes that other heavy duty wood preservatives exist outside Case 0132, 2505, and 0139; however, uses of these preservatives were not subject to reregistration because the chemicals were not registered prior to November 1, 1984 and are therefore outside the scope of the three heavy duty wood preservative REDs. Heavy duty wood preservatives not included in Case 0132, 2505, and 0139 will be evaluated in the future under the registration review program.

Figure 1. Heavy Duty Wood Preservative High Pressure Treatment Cylinder (Retort)

Again, due to the unique nature in which heavy duty wood preservatives are applied, wood preservative risk assessment requires a different approach than those used for standard agricultural or antimicrobial pesticides. For example, unlike agricultural pesticide handlers who may be exposed to pesticides when mixing/loading, applying, or re-entering an area treated with a pesticide, treatment facility workers may be exposed to pesticides when handling treated wood and/or performing activities related to operating the treatment cylinder.

This presents two challenges for risk assessment. First, because very few chemicals are applied using retorts, limited data are available to estimate worker exposure. Second, because many of the Agency's exposure models were designed to assess risk from agricultural chemicals, exposure estimates are expected to be conservative and may not be representative of "real world" exposure. The Agency acknowledges these challenges and considered these and other factors when making its reregistration and risk management decisions.

B. Human Health Risk Assessment

Pentachlorophenol is a general biocide which has been used extensively as a fungicide, bactericide, herbicide, molluscicide, algaecide and insecticide by agriculture and other industries including textiles, paints, oil drilling and forestry. However, the only remaining uses of pentachlorophenol are as a heavy duty wood preservative. Pentachlorophenol also contains chlorinated dibenzodioxins and chlorinated dibenzofurans (CDDs and CDFs) and hexachlorobenzene (HCB) as contaminants formed during the manufacture process. However, pentachlorophenol is only one of many sources of CDDs, CDFs, and HCB in the environment making it difficult to quantify the portion of the aggregate environmental risk from CDDs, CDFs, and HCB that is attributable to pentachlorophenol wood treatment uses.

CDDs and CDFs have been identified as micro-contaminants in technical grade pentachlorophenol. CDDs and CDFs have been found throughout the world at low concentrations in air, soil, water, sediment, fish and shellfish, and other food products such as meat and dairy products. CDDs and CDFs are members of a family of polychlorinated isomers of "dioxin-like" compounds. Physical and chemical properties and toxicity vary with the degree of chlorination. The most toxic congener of the family is 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD).

The dioxin/furan contaminants of pentachlorophenol present a unique case for purposes of risk characterization. Up to 17 CDD/CDF congeners are produced as contaminants in the manufacture of technical grade pentachlorophenol. All of these contaminants have chlorine substitution in at least the 2,3,7, and 8 positions, thus imparting these contaminants with "dioxin like" activity. Thus, all must be considered in the risk assessment for the contaminants of pentachlorophenol.

HCB has also been identified as a micro-contaminant in technical grade pentachlorophenol, and is not a naturally occurring compound. It is present in the environment through emissions into the atmosphere due to the manufacture of PCP and numerous emission processes, industrial discharge of HCB containing wastes into waterways as well as due to the manufacturing processes of some pesticides. Since HCB is a micro-contaminant in technical grade pentachlorophenol, it must also be considered in the risk assessment for the contaminants of pentachlorophenol.

1. Toxicity of Pentachlorophenol

A brief overview of the toxicity studies used for determining endpoints in the risk assessment is outlined below in Table 1. Further details on the toxicity of pentachlorophenol can be found in the "Pentachlorophenol-Toxicology Chapter for the Reregistration Eligibility Decision Document.," dated August 29, 2008; and the "***PENTACHLOROPHENOL:*** - Revised Toxicology Endpoint Report.," dated February 11, 2008. These documents are available on the Agency's website in the EPA Docket at: http://www.regulations.gov (Docket ID EPA-HQ-OPP-2004-0402).

The Agency has reviewed all toxicity studies submitted for pentachlorophenol and has determined that the toxicological database is sufficient for reregistration. The studies have been submitted to support guideline requirements. Major features of the toxicology profile are presented below. Table 1 gives a summary of the acute toxicity data and the toxicological endpoints selected for the exposure scenarios are summarized in Table 3. As stated previously, the Agency is aware that research is ongoing regarding pentachlorophenol. The Agency may revisit this decision in the future.

a. Acute Toxicity

The acute toxicity database for pentachlorophenol is considered complete. The acute toxicity of pentachlorophenol is low for dermal toxicity (Toxicity Category IV) and primary dermal irritation (Toxicity Category III) but shows higher toxicity for acute oral toxicity and primary eye irritation (Toxicity Category II). No dermal sensitization was observed with the technical test material. Acceptable acute inhalation toxicity data for pentachlorophenol were not available, but waivers were granted for these data.

The Pentachlorophenol Task Force previously submitted data to the Agency on efforts to develop methods to conduct inhalation studies. This effort was without success, based on an inability to generate consistent chamber concentrations of pentachlorophenol. The Agency has reviewed the documents in its possession regarding requests for waivers of inhalation toxicity data requirements, attempts at generating respirable atmospheres of pentachlorophenol, and conclusions reached in the Position Document 4 for Wood Preservatives (USEPA, 1984). Several difficulties were apparently encountered in the attempt to generate respirable particles of pentachlorophenol. It is concluded that, other issues notwithstanding, the real issue is the ability to maintain a consistent chamber concentration of pentachlorophenol. The previous decision to allow waivers for the acute and 90-day inhalation toxicity studies is upheld, but a Toxicity Category I for inhalation hazard will be assigned. The assignment of a Toxicity Category I is also consistent with regulatory decisions made previously for use of respirators from occupational exposure to pentachlorophenol (USEPA, 1984).

The following table summarizes the acute toxicity of pentachlorophenol. It is noted that the studies cited are older data, in which the test material may contain measureable concentrations of contaminants such as hexachlorodioxins and hexachlorobenzene.

Table 2. Summary of Acute Toxicity Data for Pentachlorophenol

Guideline No.	Study Type	MRID #(s)	Results	Toxicity Category
Acute Toxicity				
870.1100 (§81-1)	Acute Oral	00101715	LD50 = 155 mg/kg (M); LD50 = 137 mg/kg (F)	II
870.1200 (§81-2)	Acute Dermal Toxicity	00101715	LD50 > 3980 mg/kg	IV
870.1300 (§81-3)	Acute Inhalation Toxicity	waiver granted		I
870.2400 (§81-4)	Primary Eye Irritation	00101715	Corneal involvement at day 7 post-instillation	II
870.2500 (§81-5)	Primary Dermal Irritation	00101715	Moderate irritation at 72 hours post-application	III
870.2600 (§81-6)	Dermal Sensitization	42594301	no sensitization observed using Buehler method	NA

b. Carcinogenicity

Pentachlorophenol was classified as a B2 carcinogen (probable human carcinogen) at a joint February 1990 meeting of the FIFRA Science Advisory Panel and Science Advisory Board. The SAP/SAB concluded that the liver tumors, pheochromocytomas, and hemangiosarcomas were treatment-related and supported the B2 classification. These tumors were observed in female mice from a study conducted by the National Toxicology Program in 1989 (NTP Technical Report 349, March 1989) using pure pentachlorophenol or a technical grade formulation, Dowicide EC-7. In November of 1990, the Health Effects Division's Carcinogenicity Assessment Review Committee met and concurred with the B2 classification and also recommended quantification of risk using the combined incidence of hemangiosarcomas, liver tumors, and pheochromocytomas in female mice from the two data sets generated with the two pentachlorophenol formulations used in the NTP study (Health Effects Division document # 013274, HED archive record series). Using a 3/4 scaling factor, an oral cancer risk estimate (q_1*) of 7.0 x 10^{-2} was calculated on this basis The slope factor was calculated as the geometric mean of the individual slope factors derived from two data sets: female mouse data for technical grade and Dowicide EC-7 pentachlorophenol.

EPA is currently completing a new Integrated Risk Information System (IRIS) assessment that will include a cancer unit risk value for pentachlorophenol. Based on the ongoing re-evaluation of the science to estimate carcinogenic potential of pentachlorophenol, OPP will use the current risk estimate for pentachlorophenol until any new risk estimates are fully peer reviewed. However, the EPA process of regulating pesticides allows for reevaluation at any time if new information from the peer review process of the carcinogenic potential of pentachlorophenol warrants.

c. Toxicological Endpoints

On November 25, 1997, the Health Effects Division's Hazard Identification Review committee evaluated the toxicology data base of pentachlorophenol, selected doses and endpoints for acute dietary, chronic dietary (RfD) as well as occupational and residential exposure risk assessments, assessed the carcinogenic potential and addressed the sensitivity of infants and children from exposure to Pentachlorophenol as required by the Food Quality Protection Act (FQPA). In February of 2008, the Agency evaluated updated information with respect to the carcinogenicity of pentachlorophenol. The toxicity endpoints used in the current risk assessment are summarized below in Table 3.

Table 3. Toxicological Endpoints for Pentachlorophenol

Exposure Scenario	Dose Used in Risk Assessment, UF	Target MOE, Uncertainty Factory (UF) for Risk Assessment	Study and Toxicological Effects
Dietary Risk Assessments			
Acute Dietary (all populations)	An acute dietary assessment is not needed for the registered antimicrobial uses of pentachlorophenol, however, an acute endpoint of 30 mg/kg/day was selected from a developmental toxicity study in rats (MRID 43091702), with an uncertainty factor of 100 to calculate the acute RfD.		
Chronic Dietary (all populations)	A chronic dietary assessment is not needed for the registered antimicrobial uses of pentachlorophenol; however, a chronic endpoint of 1.5 mg/kg/day, the LOAEL from a chronic toxicity study in dogs (MRID 43882701), was previously selected, with an uncertainty factor of 300 to calculate the chronic RfD.		
Non-Dietary Risk Assessments			
Incidental Oral	An incidental oral risk assessment is not required for the registered antimicrobial uses of pentachlorophenol.		
Dermal (short- and intermediate-term)	NOAEL = 30 mg/kg/day	MOE = 100	Developmental Toxicity study – rats MRID 43091702
Dermal (long-term)	LOAEL = 1.5 mg/kg/day UF: 3X for lack of a NOAEL	MOE = 300	Chronic Toxicity study – dogs MRID 43982701
Inhalation (all durations)	No inhalation data available for pentachlorophenol. Inhalation risks for occupational exposure were not performed because most inhalation values derived from the biomonitoring study in workers were below the level of quantitation, thus implying that the majority of worker exposure is through dermal contact with pentachlorophenol		

Exposure Scenario	**Dose Used in Risk Assessment, UF**	**Target MOE, Uncertainty Factory (UF) for Risk Assessment**	**Study and Toxicological Effects**
Carcinogenicity (oral)	Classified as a B2 (probable human carcinogen) carcinogen by the Health Effects Division Carcinogenicity Assessment Review Committee and EPA's Science Advisory Board. An oral cancer risk estimate (q_1*) of 7.0 x 10^{-2} was calculated based on the incidences of hepatocellular neoplasms, adrenal medullary neoplasms, and hemangiosarcomas that developed in female mice treated with technical grade PCP or Dowicide EC-7 (NTP, 1989). The slope factor was calculated as the geometric mean of the individual slope factors derived from two data sets: female mouse data for technical grade and Dowicide EC-7 pentachlorophenol.		

Notes: UF = uncertainty factor, NOAEL = no observed adverse effect level, LOAEL = lowest observed adverse effect level, PAD = population adjusted dose (a = acute, c = chronic) RfD = reference dose.

2. Toxicity of Dioxin/Furan

The concept of toxic equivalency factors (TEFs) has been developed to facilitate risk assessment of exposure to chemical mixtures of CDDs and CDFs. In this procedure, individual TEFs are assigned to the various congeners of CDDs and CDFs. These values have been published by both the USEPA and the World Health Organization (Younes, 1998) and are based on assigning relative values in relation to 2,3,7,8-TCDD, which is assigned a TEF value of 1.0, it being the most potent congener. Multiplying the exposure concentration of individual congeners by their respective TEFs yields a toxic equivalency, which, when summed for all the components of the mixture, gives the toxic equivalency quotient (TEQ) for that mixture and is an indication of the additional exposure from the pentachlorophenol contaminants.

Recent developments in science policy in the Agency have resulted in a shift towards calculation of non-cancer risk from dioxins and furans using a body burden approach rather than a dose or intake approach. This is appropriate for dioxin/furan contaminants of pentachlorophenol due to the long half-life of these chemicals. The Agency's Office of Research and Development (ORD) has led the effort in characterizing hazards and risks from exposure to dioxins and dioxin-like compounds, and the OPP, in its assessment of non-cancer risks posed by the dioxin/furan contaminants in pentachlorophenol, is working with ORD to express these risks using the methodologies developed in ORD for calculation of body burdens from exposure to the contaminants in pentachlorophenol treated wood.

a. Acute and Chronic Toxicity

Acute and chronic non-cancer toxicity have not been determined and are pending assessment using models developed by the Agency's Office of Research and Development (ORD) to determine actual body burdens. Only long-term dioxin absorbed doses are presented for calculation of the lifetime average daily doses (LADDs).

b. Carcinogenicity

A carcinogenic endpoint related to absorbed doses of CDD and CDF micro-contaminants has been identified. A cancer risk greater than one in a million is of concern.

In 1985, EPA classified 2,3,7,8-TCDD and related compounds as "probable" human carcinogens based on the available data. Since that time, the database relating to the carcinogenicity of dioxin and related compounds has grown and strengthened considerably. Under EPA's current approach, 2,3,7,8-TCDD is best characterized as a "human carcinogen." This means that, based on the weight of all of the evidence (human, animal, mode of action), 2,3,7,8- TCDD meets the stringent criteria that allows EPA and the scientific community to accept a causal relationship between 2,3,7,8-TCDD exposure and cancer hazard. Other dioxin-like compounds are characterized as "likely" human carcinogens primarily because of the lack of epidemiological evidence associated with their carcinogenicity, although there is a strong inference based on toxic equivalency that they would behave in humans as 2,3,7,8-TCDD does.

At this time, the knowledge of the mechanism of action of dioxin, receptor theory, and the available dose-response data do not firmly establish a scientific basis for replacing a linear procedure for estimating cancer potency. Therefore, for purposes of cancer risk assessment, the Agency is using the currently published slope factor of 1.0×10^5 $(mg/kg/day)^{-1}$ for the 2,3,7,8 congener.

For additional information, please see the *Pentachlorophenol- Risk Assessment for the Reregistration Eligibility Decision (RED) Document*, dated August 29, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

3. Toxicity of Hexachlorobenzene

The Agency has identified HCB as a persistent, bio-accumulative, and toxic (PBT) environmental pollutant contaminating water and food-chain sources. Human health effects associated with exposure to HCB include skin lesions, nerve and liver damage as short-term effects. Long-term effects from lifetime exposures include damage to liver and kidneys, reproductive effects, benign tumors of endocrine glands, and cancer.

The manufacturing process of pentachlorophenol produces several known contaminants of toxicological concern including HCB. The exposure and risk assessment for HCB in pentachlorophenol will focus on the use of pentachlorophenol as a wood preservative and the potential occupational exposure to HCB through this use.

a. Acute and Chronic Toxicity

The toxicology of hexachlorobenzene is discussed in detail within the 1991 "Drinking Water Criteria Document for Hexachlorobenzene", prepared by the U.S. EPA's Office of Health and Environmental Assessment (U.S. EPA, 1991) and the "ATSDR Toxicological Profile for Hexachlorobenzene" (ATSDR, 2002). Both assessments characterize the acute toxicity of HCB as low, with oral LD50 values in the range from 3500-10,000 mg/kg in rats, and other data citing 1700 mg/kg in rats, 2600 mg/kg in rabbits, and 4000 mg/kg in mice.

b. Carcinogenicity

The Agency has classified HCB as a B2 (probable human) carcinogen, based on data sets that showed induction of tumors of the thyroid, liver, and kidney in three rodent species (U.S.EPA, IRIS, 1996). In the IRIS database, the oral cancer slope factor was 1.7 (mg/kg/day)$^{-1}$ based on hepatocellular carcinomas in female Sprague-Dawley rats using a 2/3's animal to human scaling factor. However, based on current Agency policy a 3/4's scaling factor is applied to adjust the slope factor. The cancer slope factor for HCB was modified by 0.6X to account for the newer factor. For this evaluation, carcinogenic risk was assessed for non-dietary exposure to HCB using the modified cancer slope factor of 1.02 (mg/kg/day)$^{-1}$.

c. Toxicological Endpoints

The Agency has selected toxicity endpoints for HCB for use in exposure and risk assessments. These endpoints were selected using the available scientific literature on HCB (U.S. EPA, 2003). A summary of these endpoints is shown below in Table 4.

Table 4. Toxicological Endpoints for Hexachlorobenzene

Exposure Scenario	Dose	Endpoint	Study	Target MOE
Non-Dietary Risk Assessments				
Incidental Oral: Short-Term	NOAEL= 40 mg/kg/day	body weight loss, hyperesthesia, tremors, convulsions in maternal rats at 60 mg/kg/day.	Developmental Toxicity- Rat (Khera, 1974)	100
Incidental Oral: Intermediate-Term	NOAEL= 0.5 mg/kg/day	increased incidence of liver porphyrin levels in female rats at 2 mg/kg/day	15 Week Oral Toxicity- Rat (Kuiper- Goodman et al, 1977)	100
Dermal: Short-Term	Oral NOAEL = 40 mg/kg/day	body weight loss, hyperesthesia, tremors, convulsions in maternal rats at 60 mg/kg/day.	Developmental Toxicity- Rat (Khera, 1974)	100
Dermal: Intermediate-Term	Oral NOAEL = 0.5 mg/kg/day	increased incidence of liver porphyrin levels in female rats at 2 mg/kg/day	15 Week Oral Toxicity- Rat (Kuiper- Goodman et al, 1977)	100
Dermal: Long-Term	Oral NOAEL =0.08 mg/kg/day	hepatic centrilobular basophilic chromogenesis at 0.29 mg/kg/day	Chronic Toxicity - Rat (Arnold et al., 1985)	100
Inhalation: Short-, Intermediate-, and Long-Term	No route-specific endpoints are available for HCB. Therefore, in accordance with Agency policy, oral endpoints and route extrapolation are employed to estimate inhalation risks as needed.			1000
Oral Cancer Slope Factor (CSF)	$Q^*=1.02$ $(mg/kg/day)^{-1}$ (Extrapolated using a Q^* of 1.7 $(mg/kg/day)^{-1}$ derived from a linearized multistage model to which a 3/4 scaling factor was applied: $1.7 \times 0.6 = 1.02$)	B2 (probable human carcinogen) based on data showing significant increases in liver and renal tumor incidences in hamsters and rats	Sourced to EPA REDs for DCPA, November 1998, and Chlorothalonil, April 1999 and EPA's IRIS Database.	The Agency typically will not allow Occupational non-dietary risks to exceed 10^{-6}.

Recommended MOEs of 100 are based on applied uncertainty factors used to account for inter-species extrapolation (10x) and intra-species variability (10x).

For additional information, please see the *Pentachlorophenol- Risk Assessment for the Reregistration Eligibility Decision (RED) Document*, dated August 29, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

4. Dietary Exposure and Risk from Food and Drinking Water

There are no existing food uses for the wood preservative uses of pentachlorophenol. Dietary monitoring data assembled by the Food and Drug Administration indicated the presence of pentachlorophenol in certain food items (i.e. milk, pears, pork, but these data are old (i.e. 1991), and FDA discontinued monitoring for pentachlorophenol residues after 1992 based on lack of detectable residue. Since wood treated with pentachlorophenol is not available for sale to the general public, and play activities in children around treated utility poles is not likely to occur, residential risk assessment is not necessary for pentachlorophenol and a FQPA analysis is not needed. However, population-based biological monitoring data from the National Health and Nutrition Surveys (NHANES) were available to assess the exposure of the general population to pentachlorophenol. The NHANES data provides an encompassing review of all pentachlorophenol exposures; the specific pentachlorophenol treated wood contribution to total pentachlorophenol exposure cannot be differentiated. Because NHANES does not include exposures to children under the age of 6 years old, the Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP) study (Wilson, et al. 2007) was used to include estimates of exposures to children under 6 years old. For additional information on the potential risks resulting from residential exposure, please see section 6 Residential Exposure and Risk.

It should be noted that the majority of developmental toxicity studies on pentachlorophenol show no teratogenic effects, but some older studies, especially those of Schwetz et al. (1974) and Welsh et al. (1987), showed toxic effects of pentachlorophenol in offspring that occurred at dose levels below those producing maternal toxicity. In addition, it is recognized that the contaminants hexachlorodioxin and 2,3,7,8 tetrachlorodioxin are considered teratogenic chemicals. Due to this reason combined with the knowledge that hexachlorodioxin is a contaminant of pentachlorophenol, the warning labels on pentachlorophenol formulations with respect to potential teratogenic effects have remained.

For additional information, please see the *Previous Pentachlorophenol Dietary Exposure and Risk Chapter Used In 2004 for the Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; *Previous Polychlorinated dibenzo-p-dioxins (CDDs) and Polychlorinated dibenzofurans (CDFs) Dietary Exposure Chapter Developed in 2005 for the Pentachlorophenol Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; *Previous Hexachlorobenzene (HCB) Dietary Exposure Chapter Developed in 2005 for the Pentachlorophenol Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; and *Revised PCP Human Exposure RED Chapter*, dated September 8, 2008 located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

a. Dietary and Drinking Water

Dietary risk is characterized in terms of the Population Adjusted Dose (PAD), which reflects the reference dose (RfD), either acute or chronic. This calculation is performed for each population subgroup. A risk estimate that is less than 100% of the acute or chronic PAD is not of concern.

b. Pentachlorophenol

Typically a dietary risk assessment would not be necessary for pentachlorophenol based upon the current restrictions on use of this pesticide that have been in place since 1984. However, monitoring data from FDA from 1991 showed levels of pentachlorophenol in only a few food items, and at levels that approached the limit of detection. Therefore, the Agency conducted a dietary assessment based on available monitoring data. Using conservative assumptions and the dietary monitoring data collected when pentachlorophenol was still present in certain foods (1991), exposure to pentachlorophenol through food (based on FDA monitoring data) represents 2.4% of the chronic RfD for the most exposed subpopulation in the U.S. (Children ages 1-6). Exposure to all other groups represents less than 0.5% of the chronic RfD.

Surface water runoff from pentachlorophenol treated utility poles may be a possible source for pentachlorophenol or its transformation products in drinking water or in foods. Estimated Environmental Concentrations (EECs) for surface water have been calculated by the Agency. Drinking water levels of concern (DWLOCs) for acute and chronic dietary risk from drinking water were calculated. DWLOCs calculated for surface water for pentachlorophenol were 10,465 ppb for adult males and females and 2,990 ppb for children ages 1-6. Using the PRZM-EXAMS model, available environmental fate data, and conservative assumptions, the estimated environmental concentrations calculated by the Agency for surface water were less than 1 ppb. EECs for groundwater were not available for comparison against DWLOC values; however, based on pentachlorophenol's physical/chemical characteristics and available monitoring data, it is not expected to add significantly to this risk assessment.

For additional information, please see the *Previous Pentachlorophenol Dietary Exposure and Risk Chapter Used in 2004 for the Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; and, *Estimated Environmental Concentrations (EECs) for Pentachlorophenol Using PRZM-EXAMS Models*, dated March 3, 2008 located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

c. Dioxins and Furans

A dietary risk assessment was not necessary for pentachlorophenol; however, the Agency has examined residue data that demonstrates there are potential sources of dietary exposure to low concentrations of dioxins/furans found throughout the world.

Dietary intake is generally recognized as the primary source of human exposure to CDDs and CDFs. Residue data are available for meat, fish, dairy products, eggs and fruits and vegetables. Residue data are reported in terms of both parts per trillion (ppt) and in terms of toxicity equivalents for both CDDs and CDFs.

Very little residue data are available for crops for residues of CDD and CDF; however, there is a limited amount of residue data available for foods of Canadian and U.S. origin for fruits, vegetables and wheat. The only residues reported for these commodities were for the octachlorodibenzodioxin congener and ranged from 0.6 - 8 ppt.

Samples of vegetable oil from the U.S. were analyzed for CDD and CDF cogence. No residues of tetrachlorodibenzodioxin (TCDD) were detected in the samples. Residues of the other cogence of CDDs and CDFs analyzed for ranged from 0.22 ppt - 33.1 ppt. The 33.1 ppt value is for the octachlorodibenzodioxin congener.

Toxicity equivalent residue data are reported for both environmental media and food. Food residue data are for levels found in both Canadian and U.S. vegetable fats, fish, shellfish, milk and dairy products, eggs, meat and poultry. Mean residues are all reported at levels of less than 2 ppt CDD and CDF toxicity equivalents. The maximum mean CDD/CDF toxicity equivalent residues were reported in freshwater fish at 1.2±1.2 ppt.

For additional information, please see the *Previous Polychlorinated dibenzo-p-dioxins (CDDs) and Polychlorinated dibenzofurans (CDFs) Dietary Exposure Chapter Developed in 2005 for the Pentachlorophenol Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

d. Hexachlorobenzene

A dietary risk assessment was not necessary for pentachlorophenol; however, there are other potential sources of dietary exposure to HCB. Therefore, the Agency has also examined residue monitoring data for HCB in food commodities.

There are currently no HCB pesticide tolerances established for food commodities and there are no registered uses for HCB on food commodities. However, dietary exposure to residues of HCB will likely occur as an incidental residue on terrestrial crops as a result of direct application of a pesticide containing HCB as an impurity to agricultural crops in the field. Dietary exposure to HCB residues on terrestrial crops and aquatic organisms can also occur as a result of HCB emission into the atmosphere from various sources followed by deposition of HCB onto agricultural crops, and from industrial discharge or agricultural pesticide run-off into waterways. The source of HCB residues occurring in food commodities cannot be distinguished in an analysis for residues. Therefore, it is not certain that these residues result from use of PCP-treated wood.

Residue monitoring data for HCB are available from the USDA Pesticide Data Program; the USDA Field Safety and Inspection Service; the FDA Pesticide Residue Monitoring Program on meat, milk, fish and various other agricultural commodities; and the FDA Total Diet Study. The monitoring data reflect the analyses of thousands of food samples and cover a period of several years.

The data show few residues of HCB were detected in monitoring samples from FDA or USDA. The majority of detected residues were reported in fish. Detectable residues were more likely to be found in domestic monitoring samples than in imported samples. The majority of reported HCB residues are trace amounts (0.01 ppm range).

For additional information, please see the *Previous Hexachlorobenzene (HCB) Dietary Exposure Chapter Developed in 2005 for the Pentachlorophenol Reregistration Eligibility Decision (RED) Document*, dated March 7, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

5. Residential Post-application Exposure and Risk

The opportunity for residential consumer contact is limited since pentachlorophenol treated wood is not sold to the general public; however, population-based biological monitoring data from the National Health and Nutrition Surveys (NHANES) were available to assess the exposure of the general population to pentachlorophenol. The NHANES data provides an encompassing review of all pentachlorophenol exposures; the specific pentachlorophenol treated wood contribution to total pentachlorophenol exposure cannot be differentiated. Because NHANES does not include exposures to children under the age of 6 years old, the Children's Total Exposure to Persistent Pesticides and Other Persistent Organic Pollutants (CTEPP) study (Wilson, et al. 2007) was used to include estimates of exposures to children under 6 years old. For additional information, please see the "Revised PCP Human Exposure RED Chapter," September 8, 2008.

Sources of pentachlorophenol other than the currently registered pressure treatment of wood include hexachlorobenzene and lindane, as an emission from incineration of chlorine-containing waste, and also during pyrolysis of polyvinyl chlorides (ATSDR 2001). In the past, PCP was also registered as a termiticide, fungicide, herbicide, molluscicide, algaecide, disinfectant, and for antifoulant paint. It was also used as a preservative for timber used in the construction of log homes. The use of PCP was restricted to wood treatment in 1984.

a. Residential Post-application Non-cancer Exposure and Risk Using NHANES

The following information has been excerpted from Cohen (2008). Since the 1960s, the National Center for Health Statistics, a division of the Centers for Disease Control and Prevention has conducted the National Health and Nutrition Surveys (NHANES), a series of US national surveys of the health and nutrition status of the non-institutionalized civilian population. NHANES 2001 to 2002 included laboratory measurements on 9,929 subjects. This analysis uses urinary concentrations of pentachlorophenol measured in urine spot samples of at least 20 mL collected from a random one-third sample of 3,028 subjects of ages 6 and older. The dose conversion calculations also used the NHANES measurements of creatinine concentrations, body weight, body height, as well as the age, gender, and race of each subject. The NHANES 2001-2002 data were obtained from the NHANES website: www.cdc.gov/nchs/nhanes.htm. Although pentachlorophenol data have been collected for the 2003-2004, these data have not yet been publicly released. The data are expected to be released by the end of 2008.

EPA evaluates health effects in terms of toxicity endpoints that represent an exposure level in mg or μg per kilogram body weight that is not expected to be associated with adverse health effects. The conversion of measured spot urine concentrations to daily doses can be difficult because of variable dilution caused by wide fluctuations in fluid intake and excretion. Dose calculation is also difficult because there is no way to determine from the NHANES data from what route of exposure (i.e., oral, dermal, inhalation) and when (i.e., duration and time interval prior to measurement) the exposure to PCP occurred, and because of uncertainty and variability in the absorption, distribution, metabolism, and excretion (ADME) parameters.

The long-term target MOE of 300 was used to assess the pentachlorophenol non-cancer risks. The non-cancer risk drivers are for pentachlorophenol, not HCB (i.e., pentachlorophenol non-cancer risks are greater than those of HCB). Therefore, only the non cancer risks for pentachlorophenol were provided. The Agency is following the outcome of the current EPA's Office of Research and Development (ORD) body burden approach/research for the non-cancer risks to dioxin. The Agency is aware that research is ongoing regarding pentachlorophenol. The Agency may revisit this decision in the future.

Total potential exposures and risks from NHANES are presented for the following age groups and subpopulations: all age groups (MOE of 70730); ages 6-11 (MOE of 69544); ages 12-19 (MOE of 58512); ages 20-59 (MOE of 74329); ages ≥ 60 (MOE of 69980); male (MOE of 75512); females (MOE of 66666); Mexican-American (MOE of 134690); white (MOE of 71396), non-Hispanic (MOE of 71396); and black, non-Hispanic (MOE of 47774). The total exposure and risk calculated using the NHANES data demonstrates that for pentachlorophenol (e.g., assuming all pentachlorophenol exposure results from pentachlorophenol treated poles, presentation of various dose conversion methods including the assumption that all individuals excrete a daily urine volume of the 95th percentile of the population), the total risks result in no unreasonable adverse effects from the currently registered wood preservative use.

b. Residential Post-application Non-cancer Exposure and Risk Using CTEPP

The long-term target MOE of 300 was used to assess the non-cancer risks to children 1.5 to 5 years old. The CTEPP data indicate 89 and 99 percent of the samples had detectable levels of pentachlorophenol in NC and OH, respectively. However, the total potential exposure and risk calculated using the CTEPP data demonstrates that for children 1.5 to 5 years old, risks resulting from pentachlorophenol exposure below the Agency's level of concern. MOEs range from 2,400 to 95,000.

c. Residential Post-application Cancer Exposure and Risk Using NHANES and CTEPP

The lifetime average daily dose (LADD) is estimated by combining the results of both the CTEPP and NHANES data sets. The LADD is estimated by averaging the estimated daily dose for each year in a lifetime of 75 years. This assumes the frequency and lifetime duration of exposure is constant (i.e., exposed 365 days per year and 75 years of exposure). CTEPP data are used to estimate the ages 0 to 5 years and NHANES is used to estimate ages 6 to 75 years. In addition to the LADD, the 95th percent lower and upper confidence intervals are also provided for the means. A detailed description of the LADD estimate combining both CTEPP and NHANES data sets are provided in Cohen (2008).

There are currently other sources of pentachlorophenol exposure that are not attributable to pentachlorophenol pressure treated wood; however, the general population biological monitoring data do not allow for the proportioning of exposure to source of contamination. Therefore, the exposures and risks reported are based on the total exposure to pentachlorophenol. Direct measurements of dioxins/furans and HCB exposures for the general population attributed to pentachlorophenol pressure treated wood are not available for this assessment. Therefore, to be inclusive of determining potential exposures to pentachlorophenol contaminants, the amounts of dioxins/furans and HCB in pentachlorophenol are used to extrapolate pentachlorophenol measured exposures to estimate dioxin/furan and HCB exposures.

The potential cancer risks for pentachlorophenol, HCB, and dioxin are 9.8E-7, 1.1E-9, and 5.8E-7, respectively. The risks at the 95th percent upper confidence interval for pentachlorophenol, HCB, and dioxin are 1.5E-6, 1.6E-9, and 8.7E-7, respectively. Future refinements to this assessment should focus on determining contributions of sources to total pentachlorophenol exposure.

6. Aggregate Risk Assessment

The Food Quality Protection Act amendments to the Federal Food, Drug, and Cosmetic Act (FFDCA, Section 408(b)(2)(A)(ii)) require "that there is reasonable certainty that no harm will result from aggregate exposure to pesticide chemical residue, including all anticipated dietary exposures and other exposures for which there are reliable information." Aggregate exposure is the total exposure to a single chemical (or its residues) that may occur from dietary (i.e., food and drinking water), residential, and other non-occupational sources, and from all known or plausible exposure routes (oral, dermal, and inhalation). Typically in a case such as pentachlorophenol, the Agency would not conduct acute and chronic aggregate assessments based on the lack of dietary exposure, the lack of pentachlorophenol to enter or persist in groundwater, and the lack of residential applications.

However, as discussed above, the Agency used the NHANES and CTEPP data to estimate the exposure of the general public to pentachlorophenol from a national survey of random individuals. Based on the wide survey and number of samples, these data provide a broad view of pentachlorophenol exposure from all sources. Although a typical aggregate assessment was not conducted, the NHANES and CTEPP data have provided actual aggregate exposure information for pentachlorophenol. Additional information can be found in the *Revised PCP Human Exposure RED Chapter*, dated September 8, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

7. Occupational Exposure and Risk

Workers can be exposed to pentachlorophenol through mixing, loading, applying a pesticide or re-entering treated sites. There are potential exposures from use in commercial and industrial settings *via* the dermal and inhalation routes.

Significant exposure is not expected due to mixing/loading per se because treatment plants utilize automated methods for chemical preservative delivery (metered feed/pump) and closed application techniques (treatment cylinder). However, there is the potential for workers near the treatment cylinder door to inhale treatment solution mist when the door is opened following treatment and/or to contact treatment solution residue on equipment such as charge cables and the treated wood itself. Although in many cases treated wood is moved mechanically (e.g., forklifts), this is not required on current product labeling and is currently accomplished manually in some cases.

For treatment facility exposure scenarios, where possible the Agency estimated risk for each job function that could be performed at a typical treatment facility. Although an effort was made to differentiate risk estimates by job function, the Agency acknowledges that the studies used to estimate exposure reflect actual treatment facility practices in that one person often performed more than one job function. Therefore, estimated risks presented by job function are not considered representative of one individual performing one job function and may reflect additional exposure and risk incurred by performing tasks outside the definitions presented below.

- ***Treatment Operator (TO):*** Primary duties for a pressure treatment operator include opening closing valves transferring treatment liquids, opening and closing treatment vessel doors, cleaning pentachlorophenol residues on doors and latches, performing tram maintenance and positioning, and handling leads, chains and cleanup.

- ***Treatment Assistant (TA):*** TAs perform many of the same functions as the TO including opening and closing valves and doors, cleaning pentachlorophenol residues on doors and latches, performing tram maintenance and positioning, and handle leads and chains and cleanup. However, TAs may perform more manual duties such as drip pad and filter cleaning.

- ***Loader Operator (LO):*** LOs operate open-cab forklifts used to load untreated wood onto charge trams, move charges into and out of treatment cylinders, remove charge leads and bands from treated wood, distributed treated wood to load-out area, and load treated wood for shipment. Most work is done in and around drip pad area. LOs may perform certain out-of-cab tasks such as collecting tank samples and performing test boring and lab analysis of treatment solutions in wood.

- ***Tram Setter (TS):*** TSs manually position trams for loading, place wood spacers on trams where needed to elevate wood to be treated and place drawbridges for treatments. TSs also performs lead and chain handling and operates cylinder door controls. They perform various labor and cleanup duties in treatment and drip pad area including sweeping pressure-washed drip pad and tracks; removing and shredding all bands from treated stacks of lumber, picking up and disposing of treated CCA wood waste, cleaning cylinders, and handling hazardous waste.

- ***Stacker Operator (SO):*** SOs work at a fixed position at a facility that mechanically remove wood spacers from stacks of treated (including freshly treated) lumber. They operate lumber stacking devices which arrange treated boards in stacks for banding and shipment to customers, and remove wood spacer sticks from bundles of treated boards. The major task is to manually position ends of all treated loose boards moving through device so they are evenly positioned. They also perform minor maintenance on the equipment and site.

- ***Supervisor (S):*** The Supervisors mainly perform the duties of a second LO when the LO at this site is busy performing other tasks. They take test borings and pressure-wash the drip pad. In addition, Ss perform tasks away from the treatment areas including bringing untreated wood to the treatment loading dock from other parts of the plant.

- ***Test Borer (TB):*** The TB bores lumber after treatment. TB cuts borings from treated poles or ties for on-site analysis to test for preservative penetration. They also perform other QC laboratory duties. Most time is spent away from the treatment area.

- ***Tally Man (TM):*** The main duties of the TM include counting and inspecting incoming and outgoing truckloads of wood products (untreated and treated wood), and supervision of loading and unloading of lumber trucks at drip pad and elsewhere. They also perform some treatment-related duties, such as end-marking of treated items or chaining of charges for treatment and removal of lead cables after treatment.

a. Pentachlorophenol Occupational Handler Exposure and Risk

The Agency has determined that there are potential worker risks of concern for mixers, loaders, applicators, and handlers associated with the currently registered uses of pentachlorophenol. For occupational handlers, potential short and intermediate-term non-cancer risks are not of concern (i.e., MOE greater than 100); however, potential non-cancer long-term dermal risks (i.e., MOE less than 300) for the pressure treatment operators using liquid formulation (MOE of 230) are of concern. For pressure treatment assistants using both crystalline grade product (MOE of 130) and liquid formulation (MOE of 79) potential long-term non-cancer risks are also of concern.

Total potential cancer risks for all four handler scenarios assessed are of concern (i.e., risks greater than 1.0×10^{-6}). (insert 10-4 to 10-6 is ok when benefits are seen) The results for the cancer risk estimates indicate that cancer risks are of concern for the treatment operator handling both crystalline grade product (7.9×10^{-5}) and liquid formulation (1.7×10^{-4}), and for the treatment assistant handling both crystalline grade product (3.1×10^{-4}) and liquid formulation (4.9×10^{-4}).

b. Dioxin Occupational Handler Exposure and Risk

Handler exposure to pentachlorophenol wood preservatives, as product concentrates and treatment solutions result in potential exposure to CDDs and CDFs during handler operations (mixers, loaders, and applicators of pentachlorophenol) in pressure treatment plants.

Non-cancer handler risks have not been calculated and are pending assessment using models developed by the Agency's Office of Research and Development (ORD) to determine actual body burdens. Only long-term dioxin/furan absorbed doses are presented for calculation of the lifetime average daily doses (LADDs) used for the handler cancer risk assessment.

Occupational handler cancer risk estimates have been calculated for dioxin/furan exposures resulting from the registered uses of pentachlorophenol. A cancer risk estimate greater than one in a million ($1.0x10^{-6}$) is of concern. Most of the assessed occupational handler scenarios exceed the Agency's level of concern for potential worker cancer risks. Potential cancer risks are greater than $1.0x10^{-4}$ for the pressure treatment operator handling liquid formulation ($2.0x10^{-4}$), the pressure treatment assistant handling crystalline product ($3.6x10^{-4}$), and the liquid formulation ($5.6x10^{-4}$). Potential cancer risks are greater than $1.0x10^{-5}$for the treatment operator handling the crystalline product ($9.0x10^{-5}$).

c. Hexachlorobenzene Handler Exposure and Risk

Handler exposure to pentachlorophenol wood preservatives, as product concentrates and treatment solutions result in potential exposure to HCB during handler operations (mixers, loaders, and applicators of pentachlorophenol) in pressure treatment plants.

For absorbed short-, intermediate- and long-term exposures to HCB, the Agency's level of concern are MOEs that are less than 100. None of the occupational handler scenarios assessed exceeded the Agency's level of concern for potential non-cancer risks.

Occupational handler cancer risks have been calculated for HCB exposures resulting from the registered uses of pentachlorophenol. A cancer risk greater than one in a million ($1.0x10^{-6}$) is of concern. None of the occupational handler scenarios assessed exceeded the Agency's level of concern (i.e., $1.0x10^{-6}$).

d. Pentachlorophenol Occupational Post-application Exposure and Risk

The Agency has determined that there are no potential non-cancer risks of concern relating to occupational post-application exposure to individuals following pentachlorophenol applications in wood pressure treatment facilities. However, potential post-application cancer risks for pressure treatment loader operator ($6.9x10^{-5}$), pressure treatment test borer ($6.1x10^{-5}$), general helpers ($3.6x10^{-5}$), and electrical utility linemen ($2.5x10^{-5}$) are of concern. A potential cancer risk that is greater than one in a million (i.e., $1.0x10^{-6}$) is of concern.

For additional information, please see the *Revised PCP Human Exposure RED Chapter*, dated September 8, 2008, located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

e. Dioxin/Furan Occupational Post-application Exposure and Risk

Occupational post-application exposure scenarios for dioxins and furans resulting from the registered uses of pentachlorophenol were identified primarily for pressure treatment workers. In addition, a scenario was included for utility linemen. Post-application or reentry exposures in treatment plants may occur after the wood has been pressure treated. Individuals may be exposed to dioxins and furans through contact with pentachlorophenol treated wood products or equipment used to pressure treat wood. Exposure activities include sampling pentachlorophenol retort mixtures, moving trams and treated poles, boring wood cores, and performing cleanup activities on drip pads. The industrial workers involved in post-application activities for this assessment include the test borer, loader operator, and general helper (as representative of pressure treatment plant workers), and the utility linemen involved with post-application handling of pentachlorophenol treated utility poles. The average doses for the pressure treatment operator and treatment assistant were used to estimate long-term exposure to dioxins and furans resulting from the uses of pentachlorophenol. Where applicable, the pentachlorophenol exposures were converted into CDD and CDF equivalents using the TEQ approach in order to estimate exposure and assess risk. These long-term dioxin absorbed doses were calculated for the representative scenarios by adjusting the pentachlorophenol absorbed doses by the EPA-TEQ factor of 0.813 ng/mg as derived from EPA industry monitoring data for pentachlorophenol production years 1998-1999.

Potential non-cancer post-application risks have not been quantified and are pending assessment using models developed by the Agency's Office of Research and Development (ORD) to determine actual body burdens. Only long-term dioxin absorbed doses are presented for calculation of the lifetime average daily doses (LADDs) used for the post-application cancer risk assessment.

Potential occupational post-application cancer risks have been calculated for dioxin/furan exposures resulting from the registered uses of pentachlorophenol. A cancer risk estimate greater than one in a million (1.0×10^{-6}) is of concern. Most of the assessed occupational handler scenarios exceed the Agency's level of concern for potential worker cancer risks. Potential cancer risks are greater than 1.0×10^{-5} for the pressure treatment loader operator (8.0×10^{-5}), pressure treatment test borer (6.5×10^{-5}), general helpers (4.7×10^{-5}), and electrical utility linemen (3.0×10^{-5}).

For additional information, please see the *Occupational Exposure and Risk Assessment of Dioxins and Furans (CDDs/CDFs) in Pentachlorophenol*, dated September 8, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

f. Hexachlorobenzene Post-application Exposure and Risk

Occupational post-application exposure scenarios for HCB resulting from the registered uses of pentachlorophenol were identified primarily for pressure treatment workers. In addition, a scenario was included for utility linemen. Post-application or reentry exposures in treatment plants may occur after the wood has been pressure treated. Individuals may be exposed to HCB through contact with pentachlorophenol treated wood products or equipment used to pressure-treat wood.

The Agency has determined that Margins of Exposure (MOEs) of 100 or greater are appropriate for acceptable risks from absorbed short-, intermediate- and long-term exposures to HCB. None of the occupational post-application scenarios assessed exceeded the Agency's level of concern for non-cancer aggregate risks.

Potential occupational post-application cancer risks have been calculated for HCB exposures resulting from the registered uses of pentachlorophenol. A cancer risk estimate greater than one in a million ($1.0\text{x}10^{-6}$) is of concern. None of the occupational post-application scenarios assessed exceeded the Agency's level of concern (i.e., $1.0\text{x}10^{-6}$) for potential cancer risks.

For additional information, please see the *Occupational Exposure and Risk Assessment of Hexachlorobenzene (HCB) in Pentachlorophenol*, dated March 6, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

8. Pentachlorophenol Human Incident Data

An extensive body of literature exists on the health effects (acute and chronic) of pentachlorophenol in humans. Many of the pentachlorophenol incident reports are well structured and appear in the literature to be well executed. Populations are well defined, controls are generally selected appropriately, and analyses are appropriate and adequate. However, major weaknesses in exposure assessment methods often limit the validity of reported findings, either positively or negatively. Of the 24 original articles reviewed for this document, a large majority used questionnaire or interview data, provided either by the study participants or by surrogates, as exposure variables. Often, this information was for mixed exposures including known or unknown contaminants rather than for pentachlorophenol alone. Industrial hygiene monitoring data was rarely available for the assessment of individual exposures. Therefore, in some instances, industrial hygiene expertise was used to judge exposures.

Even considering the above limitations, a reasonably strong argument can be made that exposure to pentachlorophenol is associated with increased risks of a number of diseases, namely chloracne, soft tissue sarcoma (STS), and non-Hodgkin's lymphoma (NHL). Increased risks of developing STS were reported in six studies, although statistical significance was reached in only three. Of five studies reporting increased risk for NHL, only one was statistically significant. Increased risks were also reported for lymphatic cancer, hematopoietic cancer, and Parkinson's Disease, but the associations were generally not significant. While it is known that nerve conduction velocity is slowed by exposure to chlorophenols, as well as many other chemicals, studies with this dysfunction as an endpoint showed ambivalent results. Two studies showed associations between exposure of parents to chlorophenols and negative effects in subsequently born offspring, but results in these studies were not statistically significant.

Considering the number of studies, the consistency among a number of outcomes, as well as the general absence of statistical significance, there appears to be reasonable evidence that exposure to chlorophenols may often be associated with chloracne, STS, NHL, and possibly abnormal births. Whether these health effects result from exposure to pentachlorophenol specifically, or to one or more other chemicals typically found as contaminants, is not clear. Based on the evidence collected to date, careful control of exposures to chlorophenols, including pentachlorophenol, is certainly warranted.

For additional information, please see the *Epidemiology and Incident Reports Associated with Pentachlorophenol*, dated March 9, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

D. Environmental Risk Assessment

Pentachlorophenol is used mainly as a wood preservative and is usually applied to wood as a liquid formulation (5% solution) composed of pentachlorophenol plus hydrocarbon diluents such as P-9 oil, No. 2 fuel oil, kerosene or mineral spirits. Formulated products may include from 5% to greater than 80% active ingredient and typically include water repellents such as paraffin. Introduction of pentachlorophenol into the environment may occur from spills and runoff, and through releases from treated wood by leaching and/or volatilization; these may occur at wood treatment, storage and disposal sites as well as at the locations of wood usage. Pentachlorophenol may also enter the environment by wastewater discharge or holding pond overflow, both of which may occur at wood treating facilities.

Pentachlorophenol contains chlorinated dibenzodioxins and chlorinated dibenzofurans (CDD and CDFs) as contaminants formed during the manufacture process. The main use of pentachlorophenol, a wood preservative, is to treat utility poles. There are an estimated 36 million pentachlorophenol treated utility poles in service in the United States. Annually, nearly 1 million additional utility poles are replaced (3 percent replacement rate) on land and in water. The Agency has estimated that the utility poles in service contain approximately 374 kg of dioxin toxicity equivalents (I-TEQs). The CDD and CDFs in these poles may be released into the environment via volatilization and leaching. In addition, CDD and CDFs may enter the environment during the pressure-treatment of the utility poles when the utility poles are removed from service and are disposed in landfills. These compounds are inherently toxic, as well as environmentally persistent, and their presence may increase the ecological risk associated with the use of pentachlorophenol. There are many congeners of CDDs and CDFs, ranging from monochlorinated to octachlorinated. The most toxic for each compound seems to be the 2, 3, 7, 8-tetrachlorinated congener, referred to as TCDD or TCDF for dioxin or furan, respectively.

Pentachlorophenol is only one of many sources of CDDs and CDFs in the environment making it difficult to quantify the portion of the aggregate environmental risk from CDDs and CDFs that is attributable to pentachlorophenol wood treatment uses.

Hexachlorobenzene (HCB) is also a contaminant formed during the manufacturing process of pentachlorophenol and is a very stable chlorinated aromatic compound that was commonly used as a pesticide until 1965. Currently, there are no commercial uses of the substance in the United States. HCB may be formed as a byproduct during the manufacture of chemicals used as solvents, pesticides and other chlorine-containing compounds. Small amounts of this compound can also be produced during combustion processes such as burning of city wastes.

HCB is widely distributed throughout the global ecosystem because if its mobility and resistance to degradation. It has been detected in all environmental media and in numerous types of living organisms including insects, aquatic biota, birds and mammals. HCB has also been shown to bioaccumulate in both aquatic and terrestrial organisms.

A summary of the Agency's environmental risk assessment is presented below. The following risk characterization is intended to describe the magnitude of the estimated ecological hazards and environmental risks for the currently registered antimicrobial uses of pentachlorophenol and its micro-contaminants.

1. Environmental Fate and Transport

In general, the environmental fate and transport of pentachlorophenol in soil and water will depend on the pH of the systems. The chemical behavior and the physical properties of pentachlorophenol will depend on whether it exists primarily as the phenol (under more acidic conditions) or the phenolate anion (under basic conditions).

a. Pentachlorophenol

- ***Water:*** Pentachlorophenol is hydrolytically stable in water at pH 4 to pH 9, precluding hydrolysis as a major degradation process in the environment. Chemical degradation of pentachlorophenol in water will occur mainly through photo-degradation. In surface water, pentachlorophenol will rapidly photo-degrade when exposed to direct sunlight, with more rapid degradation occurring with increased pH (when the compound is dissociated).

- ***Soil:*** Wood treated with pentachlorophenol may release the compound through volatilization or leaching. Additionally, pentachlorophenol may be photo-degraded on the wood surface, making degradates available for leaching. All three processes are affected by the solvent systems/carriers used in the application of the compound. The leaching of pentachlorophenol out of utility poles may also partially depend on the method of application (pressure or thermal treatment). Pentachlorophenol may be leached from the poles as the compound moves with either aqueous solution (as from rain) or with the solvent down the pole, either at the surface or within the pole. Based on experimental data, it was determined that the main mechanism for the leaching of pentachlorophenol and its micro-contaminants is the downward migration of the oil carrier along the vertical axis of the pole, designated as "Gravitational Induced Downward Migration of Oil" (GIDMO). Leaching of pentachlorophenol in aqueous solution from rainwater is not considered to be as important as GIDMO, as the replenishment rate at pole surfaces is a limiting factor with respect to the availability of the compound for leaching. Thus, contamination of subsurface soil found in the vicinity of utility poles may result from the downward movement of pentachlorophenol within the pole, with subsequent leaching from the bottom part of the pole to the soil surface or to the subsoil near the underground portion of the pole, as well as from the downward movement of pentachlorophenol from the surface soils to the subsoil. When leaching of pentachlorophenol from treated poles occurs, the simultaneous leaching of the carrier solvents may affect the mobility of the compound in the soil. Literature and laboratory studies indicate that pentachlorophenol applied in oil is rapidly transported from the upper portion of the poles to the underground portion for the first few years of use, and became relatively constant with time.

Because of the demonstrated tendency for pentachlorophenol to adsorb to soils and the moderately rapid degradation of the compound in the environment, it is not likely that groundwater contamination will result from usage of utility poles, except in situations where the bottom of the pole is directly in contact with the water table (or with a fluctuating water table) or where the leaching occurs from multiple poles in a wood storage or treatment area.

- ***Air:*** Pentachlorophenol is a relatively volatile compound, while its sodium salt in nonvolatile. In the atmosphere, volatilized pentachlorophenol may undergo photolytic degradation or may react with photo-chemically produced hydroxyl radicals. Atmospheric pentachlorophenol which is associated with particulate matter or moisture will be lost from the atmosphere through wet deposition. Based on pentachlorophenol's low Henry's law constant, volatilization from aqueous systems will not be a significant mode of transport in the environment.

For detailed discussions of the environmental fate and transport of pentachlorophenol, see the *Environmental Fate and Transport Assessment of Pentachlorophenol (PCP) for Reregistration Eligibility Decision (RED) Process*, dated February 16, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

b. Dioxins/Furans

Presence of CDDs and CDFs in the environmental compartments resulting from the wood preservative use is due to volatilization into air; leaching from PCP treated poles into water and soil; dry and wet deposition onto air, water, and soils; and sorption into soils. The available data indicate that CDDs and CDFs, particularly the tetras- and higher chlorinated congeners, are extremely stable under most environmental conditions. However, some of these congeners, under certain conditions, are photolytically unstable and in some cases undergo photo-oxidation. Most of the congeners are also resistant to biodegradation under aerobic or anaerobic soil conditions and most are persistent in soils.

The process of bioaccumulation has been observed in the benthic organisms, however, bio-transformation processes up the food chain have not been observed. Fish and invertebrates can likely bioaccumulate 2,3,7,8-substituted CDD and CDFs from water columns and sediments. However, because most CDD and CDFs in a water column and sediment are associated with particulate matter and dissolved organic matter, bioaccumulation most likely starts with uptake of CDD and CDFs by benthic organisms directly from sediment pore waters and by ingestion of contaminated particles. Organisms preying on benthic organisms would possibly transfer the CDD and CDFs up the food chain but no sound scientific data have been obtained.

For detailed discussions of the environmental fate and transport of dioxins/furans, see the *Environmental Fate Modeling of Dioxin in Technical Grade Pentachlorophenol*, dated March 4, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

c. Hexachlorobenzene

HCB is a stable and highly persistent molecule and does not hydrolyze in aqueous medium and is likely to become immobile in soils. It has large sorption partition coefficients. Aerobic and anaerobic biodegradation half lives are long and therefore the main route of dissipation would possibly be through sorption to soils in the terrestrial settings and to sediment organic and inorganic particulate matter in aqueous medium. Because the K_{OC} is high it has a tendency to bind strongly with soil particles and therefore less mobile, the possibility of contamination by HCB of ground water does not seem likely. Because of high binding constants with soils, HCB may possibly accumulate in benthic sediment and bioaccumulate in benthic organisms. Based on monitoring data, it is unlikely that HCB concentration in surface water would exceed 10 ppt (0.01 μg/L).

For detailed discussions of the environmental fate and transport of hexachlorobenzene, see the *Environmental Fate Modeling of Hexachlorobenzene in Technical Grade Pentachlorophenol*, dated March 4, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

2. Terrestrial and Aquatic Organism Exposure and Risk

An ecological risk assessment was conducted to assess impacts of pentachlorophenol residues from treated wood uses. Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects.

a. Pentachlorophenol

The environmental risk assessment indicates that typical concentrations of pentachlorophenol in terrestrial and aquatic environments from wood treatment uses are not expected to be of sufficient quantity or duration to adversely impact terrestrial or aquatic organisms.

b. Dioxins/Furans

Currently there are no FIFRA guideline studies required for the micro-contaminants dioxin/furan, since they are not currently registered, and data on the ecological effects of CDDs and CDFs are relatively limited. Most research efforts have been focused primarily on 2,3,7,8-chlorinated CDD and CDFs, especially 2,3,7,8-TCDD. CDDs and CDFs are very highly toxic to birds, mammals and aquatic organisms. CDDs (and possibly furans) are capable of producing lasting toxic effects; even a relatively short exposure to TCDD (as little as 6 hours) can result in mortality of fish eggs occurring as much as 80 days later. TCDD is a known endocrine disruptor, and it is likely that other dioxin congeners and furans produce similar effects. Available literature indicates that there are potential acute and chronic risks to birds and chronic risks to mammals from CDDs and CDFs from pentachlorophenol treated wood, especially considering the tendency of CDDs and CDFs to persist and bioaccumulate.

Acute and chronic risks to aquatic organisms are unlikely to occur from runoff of CDDs and CDFs from pentachlorophenol treated wood. However, due to uptake of these compounds by sediment, coupled with the persistence and bioaccumulation of CDDs and CDFs, they may eventually reach toxic levels and pose risks to aquatic organisms through the food web.

Pentachlorophenol is only one of many sources of CDDs and CDFs in the environment making it difficult to quantify the portion of the aggregate environmental risk from CDDs and CDFs that is attributable to pentachlorophenol wood treatment uses.

All environmental exposure and risk assessments are associated with uncertainties which may range from low to high, thus affecting the reliability or certainty of the risk estimations. In the case of the environmental assessment for CDDs and CDFs the uncertainties associated with this assessment are considered high. However, there are no well-established environmental exposure models or methods for determining wildlife (and, particularly, terrestrial wildlife) exposures to 2, 3, 7, 8-TCDD, CDDs, or CDFs released from pentachlorophenol-treated utility poles into the environment.

For the terrestrial environmental assessment, where estimated Risk Quotients (RQs) exceed acute and chronic Levels of Concern (LOCs) for avian and small mammal species, the Agency recognizes that these risk calculations are highly conservative and contain a high degree of uncertainty. Because of this conservatism and uncertainty, EPA believes that these risk calculations may overestimate the potential terrestrial risks which may occur. It is possible, for example, that the present calculated RQs may be orders of magnitude lower than determined.

In an attempt to better characterize this terrestrial assessment the Agency wants to point out the two highly conservative and unrealistic assumptions used in this assessment:

- ***Feeding Activity**:* It is assumed that small mammals and birds will selectively feed (all day and every day until mortality or reproductive effects occur) within a 5 cm (or 2 inches) area surrounding a pentachlorophenol-treated telephone pole; and

- ***Diet**:* It is assumed that 100 % of a small mammal's or bird's diet will be contaminated with 2, 3, 7, 8-TCDD, CDDs, and/or CDFs (while feeding within the 2 inches area).

Although the Agency used these assumptions, we acknowledge that both are highly conservative, unrealistic, and unlikely to occur because:

- ***Home ranges:*** The home ranges (where animals roost/rest, nest, breed, feed) for the surrogate species (bobwhite quail and meadow vole), as well as for other species, are considerably larger (in acres) than a 2 inches area around a pentachlorophenol-treated utility pole. This aspect negates the assumption that organisms will selectively feed within 2 inches of a pentachlorophenol-treated utility pole.

- ***Animal food items:*** Considering the home ranges and feeding habits of small mammals and birds, it is highly unlikely that 100 % (or possibly any portion) of these organisms' diets will be contaminated with dioxins. The assessment addresses a 2 inches area around a pentachlorophenol-treated pole and ingestion of only soil and plant matter. However, birds and small mammals will move freely throughout their home ranges and consume dietary items that typically include animal matter as well as plant matter. Further, soil ingestion often occurs incidentally unless (as with birds) the organism is actively seeking grit in its diet.

Additionally, the Agency notes that:

- ***Environmental fate:*** CDD and CDFs are highly lipophilic (fat soluble), neutral organic compounds that are tightly sorbed onto soils and therefore have limited tendencies to move from the point of deposition. They are primarily sorbed to clay and organic matter because of high surface area and chemical reactivity of these soil components. As a result, the characteristics of these compounds and the soil components are expected to negate the assumption that 2, 3, 7, 8-TCDD, CDDs, or CDFs might move significant distances from pentachlorophenol-treated utility poles into large portions of an animal's home range (thus, providing for increased exposure).

- ***Environmental modeling:*** The environmental modeling used to estimate soil EECs for bobwhite quail and meadow voles is based primarily on dioxin levels released via wood erosion as opposed to leaching. Thus, the estimated concentrations in soils immediately adjacent to pentachlorophenol-treated utility poles are based on the accumulation of wood particles which break away from the pole due to wood erosion. This creates additional uncertainty for the terrestrial risk assessment since soil ingestion by small mammals and birds may, or may not include ingestion of such wood particles. Further, these soil EECs were used to estimate the EECs in plant dietary matter. This creates more uncertainty in the assessment as well.

Considering the above, the Agency does not want to discount the highly toxic nature of 2, 3, 7, 8-TCDD, CDDs, or CDFs, which may be released from pentachlorophenol-treated utility poles into the environment. However, the Agency acknowledges the difficulties in estimating terrestrial wildlife exposures since there are no well-established environmental exposure models or methods for determining terrestrial wildlife exposures to 2, 3, 7, 8-TCDD, CDDs, or CDFs released from such utility poles into terrestrial environs. We recognize that the terrestrial risk assessment approach used is conservative and has a high degree of uncertainty. That being said, we believe the weight of evidence indicates that the terrestrial risks for birds and mammals foraging near pentachlorophenol-treated utility poles is minimal.

Environmental RQs for terrestrial, aquatic, and plant species have been calculated using non-guideline studies for CDDs and CDFs resulting from all potential sources. Avian acute and chronic RQs (63 and 68 respectively), and mammal chronic RQs (4) are of concern. The Agency typically considers RQs above 0.5 data to be of concern. The RQs for aquatic organisms and plants (both terrestrial and aquatic) were calculated and are not of concern. For additional information, please see Chlorinated Dibenzo Dioxins (CDDs) and Chlorinated Dibenzo Furans (CDFs) as Contaminants of Pentachlorophenol Ecological Hazard and Risk Assessment for the Pentachlorophenol Reregistration Eligibility Decision (RED) Document, dated September 18, 2008. This document is located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

c. Hexachlorobenzene

Currently there are no FIFRA guideline studies for the micro-contaminant HCB, since it is not currently registered, and data on the ecological effects of HCB are relatively limited. Scientific literature indicates that HCB has a limited potential to adversely affect aquatic organisms in the short-term, primarily due to its very low solubility in surface water. Release of HCB from pentachlorophenol treated wood into terrestrial or aquatic environments at a concentration of 6 ug/L is not expected to result in adverse acute or chronic effects to non-target or listed species of birds, mammals or aquatic animals. However, reviewed literature indicates that HCB may have potential to adversely affect both aquatic and terrestrial organisms due to its persistence in the environment and its ability to readily accumulate in the aquatic and terrestrial food webs. No honey bee toxicity data are available for HCB.

HCB concentrations in the tissues of aquatic organisms equilibrate very slowly with concentrations in the water. As a result, the chronic toxicity tests for fish species (e.g., rainbow trout and fathead minnows) may not have been of sufficient duration to allow for the full equilibration of HCB in fish tissue with surface water concentrations. Also, due to the tendency of HCB to bioaccumulate in the aquatic food web, there is the potential for adverse effects to higher-trophic level organisms from exposure to HCB in their diet.

Once in birds, HCB is excreted into the eggs, which results in uptake by the embryos. HCB concentrations measured in the eggs of sea birds and raptors from a number of locations around the world approach those associated with reduced embryo weights in herring gulls (1.5 mg/kg), suggesting that HCB has the potential to harm embryos of avian species. For mammals, a sensitive endpoint for chronic HCB exposure is the reduction of birth weight and increased mortality in mink offspring exposed to 1 ppm HCB (0.16 mg/kg BW-day) for 47 weeks. This observation is ecologically significant because field studies have observed HCB concentrations in fish tissue at a number of sites worldwide that are within an order of magnitude of the dietary toxicity level of 1 ppm. This suggests that HCB has the potential to cause adverse effects in mink and perhaps other fish-eating mammals, especially given HCBs tendency to bioaccumulate. The contribution of HCB from pentachlorophenol uses vs. non-pesticidal sources in aquatic and terrestrial environments is a large uncertainty.

3. Risks to Listed Species

Section 7 of the Endangered Species Act (ESA), 16 U.S.C. Section 1536(a)(2), requires that federal agencies consult with the National Marine Fisheries Service (NMFS) for marine and andronomus listed species, or with the United States Fish and Wildlife Services (FWS) for listed wildlife and freshwater organisms, if proposing an "action" that may affect listed species or their designated habitat. Each federal agency is required under the Act to insure that any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of designated critical habitat. To jeopardize the continued existence of a listed species is to "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of the species." 50 CFR §402.02.

To comply with subsection (a)(2) of the ESA, EPA's Office of Pesticide Programs has established procedures to evaluate whether a proposed registration action may directly or indirectly appreciably reduce the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of any listed species (U.S. EPA 2004). If any of the Listed Species LOC Criteria are exceeded for either direct or indirect effects in the Agency's screening-level risk assessment, the Agency identifies any listed or candidate species that may occur spatially and temporally in the footprint of the proposed use. Further biological assessment is undertaken to refine the risk. The extent to which any species may be at risk determines the need to develop a more comprehensive consultation package as required by the ESA.

An environmental risk assessment to CDDs and CDFs to listed species has not been conducted at this time; however, there are potential acute and chronic risks to birds and chronic risks to mammals from CDDs and CDFs resulting from pentachlorophenol treated wood. The results of the environmental risk assessment indicate that threatened and endangered species would not be expected to be adversely affected directly by exposure to the micro-contaminant HCB present in pentachlorophenol. However, as discussed above, the strong tendency of CDDs, CDFs, and HCB to persist and bioaccumulate could lead to secondary adverse effects to higher trophic level organisms, or direct effects to organisms exposed to CDDs, CDFs, and HCB from pentachlorophenol use over longer periods of time. Sensitive animals, such as endangered and threatened species may also be at risk; however, it is important to note that pentachlorophenol is not the only source of HCB, CDDs and CDFs in the environment. They are one of many making it difficult to quantify the portion of the environmental risk from HCB, CDDs and CDFs that is attributable to pentachlorophenol wood treatment uses.

Based on the use patterns for pentachlorophenol, there is potential for pentachlorophenol wood treatment uses to overlap with listed species and a more refined assessment may be warranted. This assessment would include direct, indirect and habitat effects, and the refined assessment should involve clear delineation of the action area associated with pentachlorophenol wood treatment uses and best available information on the temporal and spatial co-location of listed species with respect to the action area. This analysis has not been conducted for this assessment. An endangered species effect determination will not be made at this time.

For detailed discussions of all aspects of the environmental risk assessment, see the *Ecological Hazard and Environmental Risk Assessment RED Chapter for Pentachlorophenol*, dated February 26, 2008; *Ecological Hazard and Environmental Risk Assessment RED Chapter for Chlorinated Dibenzo Dioxins and Chlorinated Dibenzo Furans (CDDs and CDFs) – Supplement to the Pentachlorophenol RED*, dated February 26, 2008; and, *Ecological Hazard and Environmental Risk Assessment RED Chapter for Hexachlorobenzene (HCB) – Supplement to the Pentachlorophenol RED*, dated February 26, 2008; located on the Federal Government Public Docket website at www.regulations.gov (Docket ID #EPA-HQ-OPP-2004-0204).

IV. Reregistration Eligibility and Risk Management Decisions

A. Reregistration Eligibility Decision

Section 4(g)(2)(A) of FIFRA calls for EPA to determine, after submission of relevant data concerning an active ingredient, whether or not products containing the active ingredient are eligible for reregistration. EPA has previously identified and required the submission of the generic (i.e., active ingredient-specific) data required to support reregistration of wood preservative products containing pentachlorophenol as an active ingredient. The Agency has reviewed these generic data, and has determined that the data are sufficient to support a reregistration eligibility decision for the wood preservative uses of pentachlorophenol (see Appendix B).

EPA considered the available information and, after a thorough evaluation of the risks and benefits associated with each use, has determined that the wood preservative uses of pentachlorophenol presented in Appendix A will not pose unreasonable risks to humans or the environment provided that (1) all risk mitigation measures are implemented, (2) label amendments are made as described in Section V, and (3) confirmatory data requirements are satisfied. Accordingly, should a registrant fail to implement any of the conditions and requirements for reregistration identified in this document, the Agency may take regulatory action to address the potential risk concerns from the use of pentachlorophenol.

1. Regulatory Rationale

The Agency has determined that wood preservative uses of pentachlorophenol are eligible for reregistration provided that the registrants implement the conditions and requirements in this RED including amended labeling and submission of additional data. With amended labeling, EPA believes that the uses presented in Appendix A will not present risks inconsistent with FIFRA and that the benefits of pentachlorophenol to society outweigh the remaining risks. A summary of EPA's rationale for reregistering and managing risks associated with continued use is presented below.

a. Summary of Risks

As discussed in Section III of this document, EPA acknowledges the complexity and uncertainties associated with assessing potential risk from exposure to pentachlorophenol and its micro-contaminants, dioxin/furans and hexachlorobenzene. Therefore, the risks presented in this document may overestimate actual risk. Notwithstanding, EPA identified the following risk estimates of concern associated with the continued use of wood preservatives containing pentachlorophenol:

- Potential occupational cancer and non-cancer risk from dermal exposure to pentachlorophenol.
- Potential environmental risk from exposure to dioxin/furan resulting from pentachlorophenol use.

- Without the adoption of additional protective measures to reduce exposure to pentachlorophenol and its micro-contaminants continued use would not meet the "no unreasonable adverse effects" criteria of FIFRA.

b. Summary of Benefits and Alternatives

A detailed discussion of pentachlorophenol benefits and alternatives is presented in the document entitled, "A Qualitative Economic Impact Assessment of Alternatives to Pentachlorophenol as a Wood Preservative" dated April 14, 2008.

Chemical alternatives to pentachlorophenol wood preservatives include chromated arsenicals, creosote, copper and zinc naphthenates, ammoniacal/alkaline copper quaternary (ACQ), copper azole (CBA), sodium borates (SBX), and copper HDO (CX-A). Non-chemical alternatives include virgin vinyl, plastic wood composites, high density polyethylene, rubber lumber, concrete, fiberglass, steel, naturally resistant wood poles, and glass.

Although many chemical and non-chemical alternatives exist for wood treated with pentachlorophenol, many are not truly interchangeable due to safety, environmental, efficacy, and/or economic considerations. In the case of utility poles, for example, the material selected can affect the maintenance personnel's safety. Although steel utility poles may result in less human or environmental exposure to pentachlorophenol, they also increase the likelihood of electrocution for workers. For poles treated with chemical alternatives, certain alternatives make poles more slippery and therefore harder to climb which may also affect worker safety. Although the risk of electrocution and slippage cannot be compared quantitatively to potential environmental exposure, the Agency considers direct and indirect safety consequences as a result of its decisions.

Alternatives also vary in their potential effects on the environment. The potential short- and long-term environmental impacts of many chemical and non-chemical alternatives are unknown. Pentachlorophenol, on the other hand, has been the subject of numerous toxicity, exposure, environmental fate, and ecological effects studies. Because there are varying amounts of information on each alternative, it is difficult to quantitatively or qualitatively estimate the potential environmental impacts of alternatives; however, the potential environmental impacts of pentachlorophenol and its micro-contaminants are relatively well understood compared to certain chemical and non-chemical alternatives.

Chemical and non-chemical alternatives also vary in efficacy. In many cases, efficacy is the determining factor for selecting the preservative and/or material used. For example, pentachlorophenol treated crossarms are less likely to warp, crack, twist (causing stress on the wires), or drip then some of the alternatives. In addition, utility and other public works companies require products proven to be capable of withstanding extreme conditions for long periods of time. In the short-term, a product treated with an alternative preservative may offer comparable efficacy compared to a product treated with a pentachlorophenol; however, comparable efficacy may or may not be observed over the entire expected lifespan of the product (e.g., a utility pole may require replacement much sooner than if it had been treated with pentachlorophenol). Because certain alternatives do not offer the same level of efficacy and because the end products themselves (e.g., utility poles) may not last as long as pentachlorophenol, they also cannot be considered as direct replacements.

Finally, economic considerations almost always impact decisions regarding project materials. Included in economic considerations are initial costs (e.g., cost of wood treatment), lifespan and maintenance costs of the product, and disposal costs. Although many exceptions exist, pentachlorophenol generally offer lower initial costs than many alternatives, offer documented and predictable lifespan, and in many cases can be disposed of in municipal landfills. Because certain alternatives, although lower in initial costs, do not offer the same resistance and/or do not last as long as pentachlorophenol treated products, they also cannot be considered as direct replacements. Economic considerations are particularly relevant to utility and other public works uses because increased costs are frequently passed on to the public.

c. Risk/Benefit Finding

In its risk assessments, EPA identified potential risks of concern for workers exposed to pentachlorophenol at wood treatment plants. Notwithstanding, eliminating these uses could result in reliance on products with greater safety risks, increased adverse effects on the environment, reduced effectiveness, and higher costs that could be passed on to the general public (e.g., public works entities). Therefore, after a thorough evaluation of the risk estimates and benefits, EPA has determined that certain uses of wood preservative uses of pentachlorophenol will not pose unreasonable risks to humans or the environment provided that (1) all risk mitigation measures are implemented, (2) label amendments are made as described in Section V, and (3) current data gaps and confirmatory data requirements are satisfied.

2. Endocrine Disruptor Effects

EPA is required under the FFDCA, as amended by FQPA, to develop a screening program to determine whether certain substances (including all pesticide active and other ingredients) "may have an effect in humans that is similar to an effect produced by a naturally occurring estrogen, or other endocrine effects as the Administrator may designate." Following recommendations of its Endocrine Disruptor Screening and Testing Advisory Committee (EDSTAC), EPA determined that there was a scientific basis for including, as part of the program, the androgen and thyroid hormone systems, in addition to the estrogen hormone system. EPA also adopted EDSTAC's recommendation that EPA include evaluations of potential effects in wildlife. For pesticides, EPA will use its authorities under FIFRA and/or the FFDCA to require any necessary data on endocrine-related effects. As the science develops and resources allow, screening for additional hormone systems may be added to the Endocrine Disruptor Screening Program (EDSP).

3. Cumulative Risks

Risks summarized in this document are those that result only from the use of pentachlorophenol. The Food Quality Protection Act (FQPA) requires that, when considering whether to establish, modify, or revoke a tolerance, the Agency consider "available information" concerning the cumulative effects of a particular pesticide's residues and "other substances that have a common mechanism of toxicity." Unlike other pesticides for which EPA has followed a cumulative risk approach based on a common mechanism of toxicity, EPA has not made a common mechanism of toxicity finding as to pentachlorophenol. EPA has not assumed that the pentachlorophenol share a common mechanism of toxicity with other compounds.

4. Public Comments and Response

Through EPA's public participation process, EPA worked with stakeholders and the public to reach the regulatory decisions for pentachlorophenol. During the 60-day public comment period ending on June 16, 2008, the Agency received comments on the revised risk assessments from several respondents: Parents for a Safer Environment, California Regional Water Quality Control Board, Pentachlorophenol Task Force, Chlorine Chemistry Division of the American Chemistry Council, Beyond Pesticides et al., Utility Solid Waste Activities Group, as well as several concerned consumers. All comments and EPA's comment response documents are available at http://www.regulations.gov in docket number EPA-HQ-OPP-2004-0402.

B. Risk Management Decision

The Agency has concluded that continued use of wood preservatives containing pentachlorophenol would not meet the "no unreasonable adverse effects" criteria of FIFRA unless the mitigation measures and associated label changes presented in Table 5 and Table 7, respectively, are implemented and confirmatory data are submitted. Information is not currently available to quantify the amount of risk reduction; however, implementing these risk reduction measures will reduce potential worker exposure as well as potential environmental exposure to pentachlorophenol and its micro-contaminants. Additional PPE and engineering controls are needed to help reduce potential exposure and risk to workers, and the addition of a final vacuum is needed to help reduce potential environmental exposure and risk. The Agency will require confirmatory monitoring data to ensure that the measures below are protective.

Although the measures below are required at this time, in the future, registrants may request that EPA remove or reduce certain restrictions or mitigation measures based upon submission of acceptable toxicity and exposure studies that demonstrate risk exposure to pentachlorophenol is below EPA's level of concern.

Table 5 discusses the risk mitigation measures for wood preservatives containing pentachlorophenol. Engineering controls are specific to thermal and/or ambient treatments of pentachlorophenol. Additional mitigation measures are being implemented for thermal pentachlorophenol due to the potential for increased inhalation exposure.

Table 5. Risk Mitigation Measures for Wood Preservatives Containing Pentachlorophenol

Risk Estimates of Concern	Mitigation Measure(s)	Required Label Language
Occupational cancer and non-cancer risk estimates from inhalation exposure to pentachlorophenol	After treatment, personnel must not be located within 15 feet of the cylinder opening until the cylinder is ventilated and the door is completely open	"At the conclusion of the treatment, the cylinder must be ventilated by purging the post-treatment cylinder through fresh air exchange. The ventilation process is considered complete after a minimum of 2 volume exchanges based on the empty treatment cylinder volume. The exhaust pipe of the vacuum system or any air moving device utilized in conducting the air purge must terminate into a containment vessel such as a treating solution work tank or water/effluent tank. The ventilation process may be accomplished by one of the following methods: 1) activating an air purge system that operates while the cylinder door remains closed; or 2) using a device to open and hold open the cylinder door (no more than 6 inches) to allow adequate ventilation and activating the vacuum pump. If the second method is utilized, at the conclusion of the treatment, no personnel may be located within 15 feet of the cylinder when open (cracked) until the cylinder has been ventilated. In the event of equipment malfunction, or to place the spacer to hold the door open during venting, only personnel wearing specified PPE are permitted within 15 feet of the cylinder opening prior to ventilation. After ventilation is complete, the cylinder door may be completely opened."
Occupational cancer and non-cancer risk estimates from dermal exposure to pentachlorophenol	The treatment process must include a final vacuum to remove excess preservative from the wood	"The treatment process must include a final vacuum to remove excess preservative from the wood. The final vacuum must attain a vacuum equal to or greater than the initial vacuum. This vacuum must be held for an appropriate time period based on wood species, retention levels, and commodity treated to remove excess preservative from the wood."
	Automatic opening, closing, and locking devices (Elevated Temperature	"As of December 31, 2013, for elevated temperature pressure treatment with pentachlorophenol, automatic, remotely operated devices must be used to open, close, lock, and unlock cylinder doors."

Risk Estimates of Concern	**Mitigation Measure(s)**	**Required Label Language**
Occupational cancer and non-cancer risk estimates from dermal exposure to pentachlorophenol	Pentachlorophenol)	
	Lock/unlock cylinder doors using automatic locking devices (Ambient Temperature Pentachlorophenol)	"As of December 31, 2013, for ambient temperature pressure treatment with pentachlorophenol, an automatic locking/unlocking device must be used to accomplish locking and unlocking of the cylinder door."
	Allow excess preservative to drain before removing charges from the treatment cylinder and prior to shipment	"After treatment, wood must be moved to a drip pad capable of recovering excess preservative until the wood is drip free."
	Personnel must wear personal protective equipment when handling treated wood/equipment, when cleaning the cylinder, and approaching cylinder prior to ventilation	"All personnel handling treated wood or handling treating equipment (including poles/hooks used to retrieve charge cables) that has come in contact with preservative must wear the following PPE: * washable or disposable coveralls or long-sleeved shirt and long pants, * chemical resistant gloves, and * socks plus industrial grade safety work boots with chemical resistant soles. All personnel cleaning or maintaining the treatment cylinder gasket/equipment or working with concentrate or wood treatment preservative must wear the following PPE: * washable or disposable coveralls or long-sleeved shirt and long pants, * chemical resistant gloves, * socks plus industrial grade safety work boots with chemical resistant soles, and * a full face shield. In the event of equipment malfunction, or for door spacer placement, all personnel located within 15 feet of the cylinder opening prior to cylinder ventilation must wear the following PPE: * washable or disposable coveralls over long-sleeved shirt and long pants, * chemical resistant gloves, * socks plus industrial grade safety work boots with chemical resistant soles, and * a properly fitting half mask elastomeric respirator with appropriate

Risk Estimates of Concern	Mitigation Measure(s)	Required Label Language
		cartridges and/or filters. Entry to confined spaces is regulated by Federal and/or State Occupational Safety and Health Programs. Compliance is mandated by law. Individuals who enter pressure treatment cylinders or other related equipment that is contaminated with the wood treatment preservative (e.g.,cylinders that are not free of the treatment preservative or preservative storage tanks) must wear protective clothing and/or equipment as required by Federal and/or State Occupational Safety and Health Compliance laws."
Occupational cancer and non-cancer risk estimates from dermal exposure to pentachlorophenol	Cylinder openings and door pits	"Cylinder openings and door pits must use grating and additional measures such as sumps, dams or other devices which prevent or remove spillage of the preservative."
	Personnel must not retrieve charge cables by hand	"Personnel must not directly handle the charge cables, poles or hooks used to retrieve charge cables, or other equipment that has contacted the preservative without wearing chemical resistant gloves."
	Personnel must not place or remove bridge rails by hand	"As of December 31, 2013, mechanical methods must be used to place/remove bridge rails."
	Personnel must not eat, drink, or smoke in work areas	"Eating, drinking, and smoking is prohibited in the treatment cylinder load-out area, drip pad area, and engineering control room of wood treatment facilities. EXCEPTION: Where treating operator control rooms are isolated from the treating cylinders, drip pad, and work tanks, eating, drinking, and smoking (depending on local restrictions) are permitted."
	Work clothing must be left at the treatment facility	"Personnel must leave aprons, protective coveralls, chemical resistant gloves, work footwear, and any other material contaminated with preservative at the treatment facility."
Aquatic organisms acute and chronic risk estimates from exposure to	Double vacuum for wood used in aquatic and other sensitive environments	"For treated wood that will be used in marine or other aquatic or sensitive environments, a double vacuum must be used. Following the pressure period and once the pentachlorophenol has been pumped back to the work tank, a vacuum shall be applied for a minimum of one and a half hours at not less than 22 inches of Hg (560 KPa) (adjusted for elevation) of vacuum to recover excess preservative. Then, depending on plant equipment: 1) vacuum for a minimum of one and a half hours at not less than 22 inches of Hg (560 KPa) (adjusted for elevation); or 2) steam material for one hour minimum and then pull not less than 22 inches of

Risk Estimates of Concern	Mitigation Measure(s)	Required Label Language
		Hg (560 KPa) (adjusted for elevation) vacuum for a minimum of one and a half hours. Maximum temperature during steaming shall not exceed 240 degrees F (115.5 degrees C), as specified in the Best Management Practices (Aug. 2006) issued by the Western Wood Preservers Association, Southern Pressure Treaters' Association, Timber Piling Council, and Wood Preservation Canada."

1. Dioxin/Furan Reduction

Label modifications stipulating use of a final vacuum for all pentachlorophenol treated wood and a double vacuum for wood used in aquatic and other sensitive environments will reduce the amount of pentachlorophenol, CDDs and CDFs on the surface of the treated wood, thus reducing the amount of chemical that can leach into the environment. In addition the Agency is requiring that a terrestrial field dissipation study be submitted to confirm the dioxin levels leaching to the soil, and plant and organisms around pentachlorophenol treated utility poles.

The Pentachlorophenol Task Force has submitted information outlining changes in pentachlorophenol manufacturing process. These changes have been made in an effort to lower the concentrations of CDDs, CDFs as contaminants in pentachlorophenol.

The Agency has conducted a preliminary review of these data and determined that there is potential for a reduction in the amount of CDDs and CDFs in the pentachlorophenol. However, the laboratory data analysis is incomplete, and the data submitted does not detail the methodology, including, the concentrations of each congener (C); fraction of each congener (R); and methods used to calculate TEQ.

Based on incomplete information concerning the manufacturing process, the Agency cannot quantify the reduction in the amount of CDDs and CDFs available for release from pentachlorophenol-treated wood. Therefore, the Agency is requiring additional data regarding the manufacturing process for pentachlorophenol. The data needs are identified in Section V of this document.

2. Management of Pentachlorophenol-treated Materials

The Agency is aware that materials such as utility poles or railroad ties may be sold for reuse after their original intended use has ended. The typical lifespan for a utility pole or railroad tie depends on climate, setting and other factors. These materials are often sold into a secondary market where they may be installed in residential settings for garden borders, etc. Because the lifespan of these treated materials is fairly long, the Agency believes that the pentachlorophenol leaching from the treated material is significantly less than when it was originally placed into service. The Agency has not conducted a risk assessment of these secondary uses of pentachlorophenol treated materials but has begun to evaluate these uses and has found that other options such as disposing of these materials in a landfill, or incinerating these materials for energy generation are also currently practiced. Further evaluation of the potential risks and benefits associated with these secondary uses of pentachlorophenol treated materials will be conducted during the Registration Review process for this active ingredient.

3. Registration Review of Pentachlorophenol

Through this reregistration action, the Agency is implementing mitigation measures discussed above to reduce exposure to workers in wood treatment facilities. In an effort to determine if these mitigation measures are effective in reducing exposure, the Agency is requiring that exposure monitoring studies be conducted at wood treatment facilities. In addition, the Agency may shorten the Registration Review cycle from the current 15 year time-frame. The Agency plans on conducting Registration Review for pentachlorophenol once the submission and review of new data is complete.

V. What Registrants Need to Do

The Agency has determined that wood preservative products containing pentachlorophenol are eligible for reregistration provided that the conditions and requirements for reregistration identified in this RED are implemented (see Section IV). The registrants will also need to amend product labeling for each product.

The database supporting the reregistration of pentachlorophenol wood preservatives has been reviewed and determined to be adequate to support a reregistration eligibility decision. However, additional confirmatory data are required to support continued registration.

A. Manufacturing Use Products

1. Generic Data Requirements

The generic databases supporting the reregistration of pentachlorophenol for currently registered wood preservative uses has been reviewed and determined to be adequate to support a reregistration eligibility decision. However, the confirmatory data presented in Table 9 are required. Generally, registrants will have 90 days from receipt of a generic data call-in (GDCI) to complete and submit response forms or request time extensions and/or waivers with a full written justification. Timeframes for submitting generic data will be presented in the GDCI.

Table 6. Generic Data Required to Support Pentachlorophenol Wood Preservative Registrations

EPA Guideline Number	Requirement Name
GLN 830.1550	Product Identity and Composition
GLN 830.1600	Description of Materials Used to Produce the Products
GLN 830.1620	Description of Production Process
GLN 830.1650	Description of Formulation Process
GLN 830.1670	Discussion of Formation of Impurities
GLN 835.6100	Terrestrial Field Dissipation (potential dioxin exposure in substrate and organism sampling around treated utility poles)
GLN 875.1100	Dermal Outdoor Exposure
GLN 875.1200	Dermal Indoor Exposure
GLN 875.1300	Inhalation Outdoor Exposure
GLN 875.1400	Inhalation Indoor Exposure
GLN 875.1600	Applicator Exposure Monitoring Data Reporting
GLN 875.1700	Product Use Information

For pentachlorophenol technical grade active ingredient products, the registrant needs to submit the following items:

Within 90 days from receipt of the generic data call-in (DCI):

1. Completed response forms to the generic DCI (i.e., DCI response form and requirements status and registrant's response form); and

2. Submit any time extension and/or waiver requests with a full written justification.

Within the time limit specified in the generic DCI:

1. Cite any existing generic data which address data requirements or submit new generic data responding to the DCI.

Please contact Diane Isbell at (703) 308-8154 with questions regarding generic reregistration.

By US mail:
Document Processing Desk
Diane Isbell
Office of Pesticide Programs (7510P)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460-0001

By express or courier service:
Document Processing Desk
Diane Isbell
Office of Pesticide Programs (7510P)
U.S. Environmental Protection Agency
One Potomac Yard, Room S-4900
2777 South Crystal Drive
Arlington, VA 22202

B. End-Use Products

1. Product Specific Data Requirements

Section 4(g)(2)(B) of FIFRA calls for the Agency to obtain any needed product-specific data regarding the pesticide after a determination of eligibility has been made. The registrant must review previous data submissions to ensure that they meet current EPA acceptance criteria and if not, commit to conduct new studies. If a registrant believes that previously submitted data meet current testing standards, then the study MRID numbers should be cited according to the instructions in the Requirement Status and Registrants Response Form provided for each product. The Agency intends to issue a separate product-specific data call-in (PDCI) outlining specific data requirements.

Generally, registrants will have 90 days from receipt of a PDCI to complete and submit response forms or request time extensions and/or waivers with a full written justification. Registrants will have eight months to submit product-specific data.

For wood preservative end-use products containing the active ingredient pentachlorophenol, the registrants need to submit the following items for each product.

Within 90 days from the receipt of the product-specific data call-in (PDCI):

1. Completed response forms to the PDCI (i.e., PDCI response form and requirements status and registrant's response form); and

2. Submit any time extension or waiver requests with a full written justification.

Within eight months from the receipt of the PDCI:

1. Two copies of the confidential statement of formula (EPA Form 8570-4);

2. A completed original application for reregistration (EPA Form 8570-1). Indicate on the form that it is an "application for reregistration";

3. Five copies of the draft label incorporating all label amendments outlined in Table 10 of this document;

4. A completed form certifying compliance with data compensation requirements (EPA Form 8570-34);

5. If applicable, a completed form certifying compliance with cost share offer requirements (EPA Form 8570-32); and

6. The product-specific data responding to the PDCI.

Please contact Adam Heyward at (703) 308-6422 with questions regarding product reregistration and/or the PDCI. All materials submitted in response to the PDCI should be addressed as follows:

By US mail:
Document Processing Desk
Adam Heyward
Office of Pesticide Programs (7510P)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460-0001

By express or courier service:
Document Processing Desk
Adam Heyward
Office of Pesticide Programs (7510P)
U.S. Environmental Protection Agency
Room S-4900, One Potomac Yard
2777 South Crystal Drive
Arlington, VA 22202

2. Labeling for End-Use Products

To be eligible for reregistration, labeling changes are necessary to implement measures outlined in Section IV. Specific language to incorporate these changes is presented in Table 10. Generally, conditions for the distribution and sale of products bearing old labels/labeling will be established when the label changes are approved. However, specific existing stocks time frames will be established case-by-case, depending on the number of products involved, the number of label changes, and other factors.

Amended product labeling must be submitted no later than March 31, 2009. Registrants may generally distribute and sell products bearing old labels/labeling for 26 months from the date of the issuance of this Reregistration Eligibility Decision document. Persons other than the registrant may generally distribute or sell such products for 52 months from the approval of labels reflecting the mitigation described in this RED. However, existing stocks time frames will be established case-by-case, depending on the number of products involved, the number of label changes, and other factors. Refer to "Existing Stocks of Pesticide Products; Statement of Policy," *Federal Register*, Volume 56, No. 123, June 26, 1991.

Table 7. Required Label Changes for Manufacturing and End-Use Wood Preservative Products Containing Pentachlorophenol

Description	Pentachlorophenol: Required Labeling Language	Placement on Label
	Manufacturing-Use Products	
For all Manufacturing Use Products	"Only for formulation as a preservative for the following use(s) [fill blank only with those uses that are being supported by MP registrant]."	Directions for Use
One of these statements may be added to a label to allow reformulation of the product for a specific use or all additional uses supported by a formulator or user group.	"This product may be used to formulate products for specific use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)." "This product may be used to formulate products for any additional use(s) not listed on the MP label if the formulator, user group, or grower has complied with U.S. EPA submission requirements regarding support of such use(s)."	Directions for Use
Environmental Hazards Statements Required by the RED and PR Notice 93-10 and 95-1	"Do not discharge effluent containing this product into lakes, streams, ponds, estuaries, oceans, or other waters unless in accordance with the requirements of a National Pollution Discharge Elimination System (NPDES) permit and the permitting authority have been notified in writing prior to discharge. Do not discharge effluent containing this product to sewer systems without previously notifying the local sewage treatment plant authority. For guidance contact your State Water Board or Regional Office of the EPA."	Precautionary Statements

Description	Pentachlorophenol: Required Labeling Language	Placement on Label
	End-Use Products	
PPE Requirements Established by the RED	"Personal Protective Equipment (PPE)" "All personnel handling treated wood or handling treating equipment (including poles/hooks used to retrieve charge cables) that has come in contact with preservative must wear the following PPE: * washable or disposable coveralls or long-sleeved shirt and long pants, * chemical resistant gloves, and * socks plus industrial grade safety work boots with chemical resistant soles. All personnel cleaning or maintaining the treatment cylinder gasket/equipment or working with concentrate or wood treatment preservative must wear the following PPE: * washable or disposable coveralls or long-sleeved shirt and long pants, * chemical resistant gloves, * socks plus industrial grade safety work boots with chemical resistant soles, and * a full face shield. In the event of equipment malfunction, or for door spacer placement, all personnel located within 15 feet of the cylinder opening prior to cylinder ventilation must wear the following PPE: * washable or disposable coveralls over long-sleeved shirt and long pants, * chemical resistant gloves, * socks plus industrial grade safety work boots with chemical resistant soles, and * a properly fitting half mask elastomeric respirator with appropriate cartridges and/or filters. Entry to confined spaces is regulated by Federal and/or State Occupational Safety and Health Programs. Compliance is mandated by law. Individuals who enter pressure treatment cylinders or other related equipment that is contaminated with the wood treatment preservative (e.g.,cylinders that are not free of the treatment preservative or preservative storage tanks) must wear protective clothing and/or equipment as required by Federal and/or State Occupational Safety and Health Compliance laws."	Immediately following/below Precautionary Statements: Hazards to Humans and Domestic Animals

Description	Pentachlorophenol: Required Labeling Language	Placement on Label
User Safety Requirement	"Personnel must leave aprons, protective coveralls, chemical resistant gloves, work footwear, and any other material contaminated with preservative at the treatment facility." "Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables exist, use detergent and hot water. Keep and wash PPE separately from other laundry." "Discard clothing and other absorbent material that have been drenched or heavily contaminated with the product's concentrate. Do not reuse them." "Eating, drinking, and smoking are prohibited in the treatment cylinder load-out area, drip pad area, and engineering control room of the wood treatment facilities." EXCEPTION: Where treating operator control rooms are isolated from the treating cylinders, drip pad, and work tanks, eating, drinking, and smoking (depending on local restrictions) are permitted."	Precautionary Statements: Hazards to Humans and Domestic Animals Immediately following the PPE requirements
User Safety Recommendations	"USER SAFETY RECOMMENDATIONS" "Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet." "Users should remove clothing/PPE immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing." "Users should remove PPE immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."	Precautionary Statements: Hazards to Humans and Domestic Animals immediately following Engineering Controls (Must be placed in a box.)

Description	Pentachlorophenol: Required Labeling Language	Placement on Label
Other Application Restrictions (Risk Mitigation)	"At the conclusion of the treatment, the cylinder must be ventilated by purging the post-treatment cylinder through fresh air exchange. The ventilation process is considered complete after a minimum of 2 volume exchanges based on the empty treatment cylinder volume. The exhaust pipe of the vacuum system or any air moving device utilized in conducting the air purge must terminate into a containment vessel such as a treating solution work tank or water/effluent tank. The ventilation process may be accomplished by one of the following methods: 1) activating an air purge system that operates while the cylinder door remains closed; or 2) using a device to open and hold open the cylinder door (no more than 6 inches) to allow adequate ventilation and activating the vacuum pump. If the second method is utilized, at the conclusion of the treatment, no personnel may be located within 15 feet of the cylinder when open (cracked) until the cylinder has been ventilated. In the event of equipment malfunction, or to place the spacer to hold the door open during venting, only personnel wearing specified PPE are permitted within 15 feet of the cylinder opening prior to ventilation. After ventilation is complete, the cylinder door may be completely opened."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"After treatment, wood must be moved to a drip pad capable of recovering excess preservative until the wood is drip free."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"The treatment process must include a final vacuum to remove excess preservative from the wood. The final vacuum must attain a vacuum equal to or greater than the initial vacuum. This vacuum must be held for an appropriate time period based on wood species, retention levels, and commodity treated to remove excess preservative from the wood."	Directions for Use

Description	Pentachlorophenol: Required Labeling Language	Placement on Label
Other Application Restrictions (Risk Mitigation)	"For treated wood that will be used in marine or other aquatic or sensitive environments, a double vacuum must be used. Following the pressure period and once the pentachlorophenol has been pumped back to the work tank, a vacuum shall be applied for a minimum of one and a half hours at not less than 22 inches of Hg (560 KPa) (adjusted for elevation) of vacuum to recover excess preservative. Then, depending on plant equipment: 1) vacuum for a minimum of one and a half hours at not less than 22 inches of Hg (560 KPa) (adjusted for elevation); or 2) steam material for one hour minimum and then pull not less than 22 inches of Hg (560 KPa) (adjusted for elevation) vacuum for a minimum of one and a half hours. Maximum temperature during steaming shall not exceed 240 degrees F (115.5 degrees C), as specified in the Best Management Practices (Aug. 2006) issued by the Western Wood Preservers Association, Southern Pressure Treaters' Association, Timber Piling Council, and Wood Preservation Canada."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"As of December 31, 2013, for elevated temperature pressure treatment with pentachlorophenol, automatic, remotely operated devices must be used to open, close, lock, and unlock cylinder doors."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"As of December 31, 2013, for ambient pentachlorophenol treatments, an automatic locking/unlocking device must be used to accomplish locking and unlocking of the cylinder door."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"Cylinder openings and door pits must use grating and additional measures such as sumps, dams or other devices which prevent or remove spillage of the preservative."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"Personnel must not directly handle the charge cables, poles or hooks used to retrieve charge cables, or other equipment that has contacted the preservative without wearing chemical resistant gloves."	Directions for Use
Other Application Restrictions (Risk Mitigation)	"As of December 31, 2013, mechanical methods must be used to place/remove bridge rails."	Directions for Use

Appendix A: Use patterns Eligible for Reregistration
Pentachlorophenol

Use Site	Formulation	Method of Application	Application Rate/ No. of applications	Use Limitations
(10) **Wood preservatives**				
(Exterior use only) Lumber, timber's, posts, poles, and other wooden members	Ready to use Reg: 61483-1 Reg: 61483-58 Reg: 61483-59	Pressure treatment In a commercial vessel capable of physically impregnating the wood and providing adequate penetration and retention	If temperature or time is used as the treating parameter, treat for 12 to 48 hours or until effective penetration is achieved	**Restricted use pesticide** *Due to fetotoxicity and oncogenicity in laboratory animals* For retail sale and use only by certified applicators or by persons under their direct supervision and only for those uses covered by certified applicator's certification This product is intended for exterior use. Is not intended for home and farm use, must not be used for pressure or thermal treated logs used in the construction of log homes except laminated beams or building components which are in ground contact and are subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Urethane,
(Exterior use only) Lumber, timber's, posts, poles, and other wooden members	Soluble Concentrate Reg: 61483-62 Reg: 61483-2 Reg: 61483-3	Pressure treatment In a commercial vessel capable of physically impregnating the wood and providing adequate penetration and retention	Add one part of product to nine parts of fuel oil, kerosene, or other hydrocarbon with the desired volatility, and mix well If temperature or time is used as the treating parameter, treat for 12 to 48 hours or until effective penetration is achieved	**Restricted use pesticide** *Due to fetotoxicity and oncogenicity in laboratory animals* For retail sale and use only by certified applicators or by persons under their direct supervision and only for those uses covered by certified applicator's certification This product is intended for exterior use. Is not intended for home and farm use, must not be used for pressure or thermal treated logs used in the construction of log homes except laminated beams or building components which are in ground contact andare subject to decay or insect infestation and where two coats of an appropriate sealer are applied. Urethane, shellac, latex, epoxy, enamel and varnish are acceptable sealers for pentachlorophenol treated wood

APPENDIX B: Pentachlorophenol Case (2505)

Appendix B lists the **generic** (not product specific) data requirements which support the re-registration of Pentachlorophenol. These requirements apply to Pentachlorophenol in all products, including data requirements for which a technical grade active ingredient is the test substance. The data table is organized in the following formats:

1. **Data Requirement** (Columns 1 and 2). The data requirements are listed by Guideline Number. The first column lists the new Part 158 Guideline numbers, and the second column lists the old Part 158 Guideline numbers. Each Guideline Number has an associated test protocol set forth in the Pesticide Assessment Guidance, which are available on the EPA website.

2. **Guideline Description** (Column 3). Identifies the guideline type.

3. **Use Pattern** (Column 4). This column indicates the standard Antimicrobial Division use patterns categories for which the generic (not product specific) data requirements apply. The number designations are used in Appendix B.

   (1) Agricultural premises and equipment
   (2) Food handling/ storage establishment premises and equipment
   (3) Commercial, institutional and industrial premises and equipment
   (4) Residential and public access premises
   (5) Medical premises and equipment
   (6) Human water systems
   (7) Materials preservatives
   (8) Industrial processes and water systems
   (9) Antifouling coatings
   (10) Wood preservatives
   (11) Swimming pools
   (12) Aquatic areas

3. **Bibliographic Citation** (Column 5). If the Agency has data in its files to support a specific generic Guideline requirement, this column will identity each study by a "Master Record Identification (MRID) number. The listed studies are considered "valid" and acceptable for satisfying the Guideline requirement. Refer to the Bibliography appendix for a complete citation of each study.

DATA REQUIREMENT				CITATION(S)
New Guideline Number	**Old Guideline Number**	**Study Title**	**Use Pattern**	**MRID Number**
PRODUCT CHEMISTRY				
830.1550	61-1	Product Identity and Composition		Open Literature
830.1600	61-2	Description of Beginning Materials and Manufacturing Process		41002701
830.1670	61-3	Discussion of Formation of Impurities		41002701
830.1600 830.1620 830.1650	61-2a	Starting Materials and Manufacturing Process		Open Literature
830.1670	61-2b	Formation of Impurities		Open Literature
830.1700	62-1	Preliminary Analysis		40999402, 41002702
830.1750	62-2	Certification of Limits		40999402, 41002702
830.1800	62-3	Analytical Method		41002702
830.6300	63-0	Reports of Multiple phys/chem Characteristics		40999403, 41002703
830.6302	63-2	Color		Open Literature
830.6303	63-3	Physical State		Open Literature
830.6304	63-4	Odor		Open Literature
830.7200	63-5	Melting Point		Open Literature
830.7220	63-6	Boiling Point		Open Literature
830.7300	63-7	Density		Open Literature
830.7840 830.7860	63-8	Solubility		Open Literature
830.7950	63-9	Vapor Pressure		Open Literature

DATA REQUIREMENT				CITATION(S)
New Guideline Number	**Old Guideline Number**	**Study Title**	**Use Pattern**	**MRID Number**
830.7550 830.7560 830.7570	63-11	Partition Coefficient (Octanol/Water)		Open Literature
830.7000	63-12	pH		Open Literature
830.6313	63-13	Stability		Open Literature
830.6314	63-14	Oxidizing/Reducing Action		Open Literature
830.6315	63-15	Flammability		Open Literature
830.6316	63-16	Explodability		Open Literature
830.6317	63-17	Storage Stability		Open Literature
830.6319	63-19	Miscibility		Open Literature
ECOLOGICAL EFFECTS				
850.4400	122-2	Aquatic plant growth		42633704, 42633705, 42633706
850.4400	123-2	Aquatic vascular plant dose-response toxicity- *Lemna* sp.		42633704, 42633705, 42633706
850.220	71-2	Avian Dietary Toxicity		42633702
TOXICOLOGY				
870.1100	81-1	Acute Oral - Rat		00101715
870.1200	81-2	Acute Dermal - Rabbit		00101715
870.1300	81-3	Acute Inhalation - Rat		waiver
870.2400	81-4	Primary Eye Irritation - Rabbit		00101715
870.2500	81-5	Primary Dermal Irritation - Rabbit		00101715
870.2600	81-6	Dermal Sensitization		42594301
870.3250	82-3	Sub chronic Dermal Toxicity		43091702

DATA REQUIREMENT				CITATION(S)
New Guideline Number	**Old Guideline Number**	**Study Title**	**Use Pattern**	**MRID Number**
870.4100	83-1 (a)	Chronic Toxicity		43982701
870.4200	83-2(a)	Carcinogenicity in Mice		NTP, 1989
870.4300		Combined Chronic Toxicity / Carcinogencity in Rats		NTP, 1999
870.3700	83-3	Developmental Toxicity in Rabbits		43091701, 43091702
870.3700	83-3	Developmental Toxicity -Rat		43091702
870.3800		2-Genaration Reproduction Toxicity in Rats		44464101
870.5265		Salmonella thyphimurium reverse mutation assay		NTP study
870.5395		Erythrocyte micronucleus assay		43911301
870.6200		Neurotoxicity screening battery		Open literature
870.8700		Immunotoxicity		Open literature

Appendix C. Technical Support Documents

Additional documentation in support of this RED is maintained in the OPP docket, located in Room 119, Crystal Mall #2, 1801 Bell Street, Arlington, VA. It is open Monday through Friday, excluding legal holidays, from 8:30 am to 4 pm.

OPP public docket is located in Room S-4400, One Potomac Yard (South Building), 2777 South Crystal Drive, Arlington, VA, 22202 and is open Monday through Friday, excluding Federal holidays, from 8:30 a.m. to 4:00 p.m.

The docket initially contained the August 26, 2004 preliminary risk assessment and the related documents. EPA then considered comments on these risk assessments (which are posted to the e-docket) and revised the risk assessments. The revised risk assessments will be posted in the docket at the same time as the RED.

All documents, in hard copy form, may be viewed in the OPP docket room or downloaded or viewed via the Internet at www.regulations.gov

These documents include:

- Pentachlorophneol Preliminary Risk Assessment; Notice of Availability, 11/30/2004

Preliminary Risk Assessment and Supporting Science Documents:

- Pentachlorophenol: Preliminary Risk Assessment for the Reregistration Eligibility Decision, PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004
- Product Chemistry Science Chapter on Pentachlorophenol PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004.
- Pentachlorophenol Toxicology Disciplinary Chapter for the Reregistration Eligibility Decision Document, PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004, Timothy F. McMahon, Ph.D.
- Pentachlorophenol Dietary Exposure Assessments for the Reregistration Eligibility Decision. PC Code 063001, Case 2505, Antimicrobials Division 11/19/2004
- Pentachlorolphenol Occupational/Residential Exposure Assessment. PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004, Siroos Mostaghini, PhD. Senior Scientist
- Environmental Fate Assessment of Pentachlorlophenol for the Reregistration Eligibility Decision (RED). PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004
- Ecological Hazard and Environmental Risk Assessment:Pentachlorophenol PC Code 063001, Case2505, Antimicrobials Division, 11/19/2004, Richard C. Petrie Argonomist, Team Leader 3

Revised Risk Assessment and Supporting Science Documents (RED Supporting Documents):

- Pentachlorophenol: Revised Risk Assessment for the Reregistration Eligibility Decision, PC Code 063001, Case 2505, Antimicrobials Division 8/29/2008 Timothy F. McMahon, Ph.D. Senior Toxicologist/Risk Assessor
- Product Chemistry Science Chapter on Pentachlorophenol PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004.
- Pentachlorophenol Toxicology Disciplinary Chapter for the Reregistration Eligibility Decision Document, PC Code 063001, Case 2505, Antimicrobials Division, 3/16/2008, Timothy F. McMahon, Ph.D.
- Pentachlorophenol Dietary Exposure Assessments for the Reregistration Eligibility Decision. PC Code 063001, Case 2505, Antimicrobials Division 11/19/2004
- Pentachlorolphenol Occupational/Residential Exposure Assessment. PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004, Siroos Mostaghini, PhD. Senior Scientist
- Environmental Fate Assessment of Pentachlorlophenol for the Reregistration Eligibility Decision (RED). PC Code 063001, Case 2505, Antimicrobials Division, 11/19/2004.
- Ecological Hazard and Environmental Risk Assessment:Pentachlorophenol PC Code 063001, Case2505, Antimicrobials Division, 11/19/2004, Richard C. Petrie Argonomist, Team Leader 3.

Appendix D. Citations Supporting the Reregistration Eligibility Decision (Bibliography)

GUIDE TO APPENDIX D

1. CONTENTS OF BIBLIOGRAPHY. This bibliography contains citations of all studies considered relevant by EPA in arriving at the positions and conclusions stated elsewhere in the Pentachlorophenol Reregistration Eligibility Decision Document. Primary sources for studies in this bibliography have been the body of data submitted to EPA and its predecessor agencies in support of past regulatory decisions. Selections from other sources including the published literature, in those instances where they have been considered, are included.

2. UNITS OF ENTRY. The unit of entry in this bibliography is called a "study." In the case of published materials, this corresponds closely to an article. In the case of unpublished materials submitted to the Agency, the Agency has sought to identify documents at a level parallel to the published article from within the typically larger volumes in which they were submitted. The resulting "studies" generally have a distinct title (or at least a single subject), can stand alone for purposes of review and can be described with a conventional bibliographic citation. The Agency has also attempted to unite basic documents and commentaries upon them, treating them as a single study.

3. IDENTIFICATION OF ENTRIES. The entries in this bibliography are sorted numerically by Master Record Identifier, or "MRID" number. This number is unique to the citation, and should be used whenever a specific reference is required. It is not related to the six-digit "Accession Number" which has been used to identify volumes of submitted studies (see paragraph 4(d)(4) below for further explanation). In a few cases, entries added to the bibliography late in the review may be preceded by a nine character temporary identifier. These entries are listed after all MRID entries. This temporary identifying number is also to be used whenever specific reference is needed.

4. FORM OF ENTRY. In addition to the Master Record Identifier (MRID), each entry consists of a citation containing standard elements followed, in the case of material submitted to EPA, by a description of the earliest known submission. Bibliographic conventions used reflect the standard of the American National Standards Institute (ANSI), expanded to provide for certain special needs.

a. Author. Whenever the author could confidently be identified, the Agency has chosen to show a personal author. When no individual was identified, the Agency has shown an identifiable laboratory or testing facility as the author. When no author or laboratory could be identified, the Agency has shown the first submitter as the author.

b. Document date. The date of the study is taken directly from the document. When the date is followed by a question mark, the bibliographer has deduced the date from the evidence contained in the document. When the date appears as (1999), the Agency was unable to determine or estimate the date of the document.

c. Title. In some cases, it has been necessary for the Agency bibliographers to create or enhance a document title. Any such editorial insertions are contained between square brackets.

d. Trailing parentheses. For studies submitted to the Agency in the past, the trailing parentheses include (in addition to any self-explanatory text) the following elements describing the earliest known submission:

(1) Submission date. The date of the earliest known submission appears immediately following the word "received."

(2) Administrative number. The next element immediately following the word "under" is the registration number, experimental use permit number, petition number, or other administrative number associated with the earliest known submission.

(3) Submitter. The third element is the submitter. When authorship is defaulted to the submitter, this element is omitted.

(4) Volume Identification (Accession Numbers). The final element in the trailing parentheses identifies the EPA accession number of the volume in which the original submission of the study appears. The six-digit accession number follows the symbol "CDL," which stands for "Company Data Library." This accession number is in turn followed by an alphabetic suffix which shows the relative position of the study within the volume.

1. MRID Studies

Citation	
None	Electric Power Research Institute (EPRI). 1993. Biodegradability of pentachlorophenol in the environment: a literature review. Document EPRI TR-102172s. Final Draft/April 1993.
None	Malecki, R.1992. Regulations regarding the disposal of treated wood. Proceedings of wood pole seminar. Sept. 17-18, Syracuse, NY.

None	NTP Technical Report TR 349 on the Toxicology and Carcinogenesis Studies of Pentachlorophenol in B6C3F1 Mice. March, 1989.
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00259257	Selim, S. 1985. Evaluation of the Dermal Absorption Characteristics of Pentachlorophenol. Unpublished study prepared by Biological Test Center. 18p. also listed under MRID 00148495.
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40999403	Hildebrand, D. (1989) (Vulcan Pentachlorophenol) - Physical and Chemical Characteristics. Unpublished study prepared by Vulcan Chemicals. 82 p.
41002701	Martin, M. (1989) (Idacon Pentachlorophenol) - Product Identity and Composition. Unpublished study prepared by Idacon, Inc. 33 p.
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41002703	Martin, M. (1989) (Idacon Pentachlorophenol) - Physical and Chemical Characteristics. Unpublished study prepared by Idacon, Inc. 7 p.
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Appendix E. Generic Data Call-In

The Agency intends to issue a Generic Data Call-In at a later date. See Chapter V of the Pentachlorophenol RED for a list of studies that the Agency plans to require.

Appendix F. Product Specific Data Call-In

The Agency intends to issue a Product Specific Data Call-In at a later date for:

Pentachlorophneol (Case 2505) PC Code: 063001

Appendix G. Batching of Pentachlorophenol Products for Meeting Acute Toxicity Data Requirements for Reregistration

Appendix H. List of All Registrants Sent the Data Call-In

A list of registrants sent the data call-in will be posted at a later date.

UNITED
NATIONS

UNEP

SC

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Pollutants

Persistent Organic Pollutants Review Committee
Tenth meeting
Rome, 27–30 October 2014

Report of the Persistent Organic Pollutants Review Committee on the work of its tenth meeting

Addendum

Risk management evaluation on pentachlorophenol and its salts and esters

By its decision POPRC-10/1, the Persistent Organic Pollutants Review Committee adopted a risk management evaluation for pentachlorophenol and its salts and esters on the basis of the draft contained in the note by the secretariat (UNEP/POPS/POPRC.10/2). The text of the risk management evaluation, as amended, is set out in the annex to the present addendum. It has not been formally edited.

Annex

PENTACHLOROPHENOL AND ITS SALTS AND ESTERS

RISK MANAGEMENT EVALUATION

Prepared by the ad hoc working group on pentachlorophenol and its salts and esters
Persistent Organic Pollutants Review Committee

30 October 2014

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Executive Summary

1. Pentachlorophenol (PCP) and its salts and esters (sodium pentachlorophenate (Na-PCP), a PCP salt and; pentachlorophenyl laurate (PCP-L), a PCP ester) were proposed as a POPs candidate by the European Commission in 2011. At its eighth meeting, the POPs Review Committee concluded that while the PCP molecule does not meet all the screening criteria specified in Annex D, taking into account its transformation product pentachloroanisole (PCA), PCP and its salts and esters do meet the screening criteria. This led to the POPs Review Committee at its ninth meeting to decide that PCP, its salts and esters, are likely, including consideration of the transformation product, PCA, as a result of their long-range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted (Decision POPRC-9/3).

2. PCP has had multiple uses in the past (biocide, insecticide, fungicide, disinfectant, defoliant, anti-sapstain agent, anti-microbial agent and wood preservative) which have now been phased out with the remaining key use being wood preservation, particularly for use in utility poles and cross-arms, with minor uses for railway ties (cross ties or 'sleepers') and outdoor construction materials (UNECE 2010). PCP has also been used to produce the ester PCP-L, which was used in textiles, but there is no evidence of continued use. Its salt, Na-PCP, is used for similar purposes to PCP and readily dissociates to PCP. PCA is not used as a commercial chemical or pesticide and is not intentionally released directly into the environment.

3. PCP is produced by one manufacturer at a production facility in Mexico (6,600 t/per annum), which is then formulated into a manufacturing concentrate at a formulation facility in the USA (7,000 t/per annum). The main share of the PCP market and use is in North America.

4. In addition 1,800 t/per annum of Na-PCP is manufactured in India and used mainly in producing impregnated wood/particle boards to protect from fungi.

5. The use of PCP for wood treatment has already been banned or heavily restricted by a number of nations including EU Member States, Morocco, Sri Lanka, New Zealand, Indonesia, Ecuador and Australia, indicating the availability of technically feasible alternatives in those countries. PCP is used as a heavy duty industrial wood preservative in the USA and Canada (restricted to industrial use only) and continued use has been permitted in recent decisions contingent upon implementation of control and risk management measures. Additionally, use of Na-PCP appears to be mainly in India. In the USA and Canada alternative chemical treatments based around copper arsenates and creosote are used in some situations; while non-chemical alternative materials such as concrete and steel are also manufactured and used to a certain degree within infrastructure networks.

6. A number of chemical alternatives (such as chromated copper arsenate (CCA), creosote, copper naphthenate, and ammoniacal copper zinc arsenate) exist and are broadly comparable in price and application process to PCP. However alternative products are not directly interchangeable and will have specific strengths and weaknesses for any given application. The commonly used commercial chemical alternatives to PCP (and Na-PCP), namely CCA and creosote have also had concerns raised for their own environmental and health profiles.

7. Non-chemical alternatives (such as steel, concrete, fibreglass composite or heat treatment of wood) to PCP-treated wood offer possible options, with potentially longer life spans, in certain circumstances, reduced maintenance costs, pest/fire resistance, standardized specifications (noting that wood is a natural product). However, initial costs for manufacture and installation are significantly higher than treated wood and different life cycle analyses exist demonstrating that life-time costs and environmental profile can be either better or worse than treated wood with no clear resolution. In some parts of the USA, certain utility companies have indicated that they have begun to use and integrate steel utility poles which are lighter than wood (meaning reduced freight costs) and provide durability and strength. However opposing opinion highlights the increased conductivity of steel structures and requirement for protection against surface corrosion (typically through galvanization).

8. The risk profile concluded that PCP and its related compounds are likely to lead to significant adverse human health and environmental effects. In addition, the manufacturing and use of PCP-treated wood is a source of dioxins and furans. Therefore, the implementation of further control measures would reduce potential risks from exposure to humans and the environment from PCP and PCA. In addition it will reduce the potential exposure to dioxins and furans present as impurities from in-service PCP-treated wood, which is not covered by the listing of dioxins in Annex C (UNEP/POPS/POPRC.9/13/Add.3).

9. In terms of benefits of reduced PCP exposure, a prohibition would be most effective and would reduce and eventually eliminate releases of PCP to the environment, contributing to reductions in PCA. A prohibition would lead to replacement of PCP by available alternatives in uses such as utility poles and cross-arms (considered critical by Canada). However, at present some alternatives present technical feasibility issues (e.g. linked to climate conditions) and there seems to be no consensus on whether there would be a net health/environmental benefit from using different alternatives to PCP in some applications. In addition, alternatives also result in the release of other harmful substances (e.g., PAHs, heavy metals) which may require management strategies. A specific exemption for use in industrial wood preservation could overcome such concerns. Such an exemption could be time-limited and could also be linked to requirements for control of releases and emissions throughout the lifecycle as well as for management of stockpiles and waste containing PCP.

10. Overall, the suggested control measure is that PCP should be listed under Annex A to the Convention which would be consistent with the POPs properties of this intentionally produced substance and its related compounds and would send a clear signal that phasing out production and use of PCP is desirable where it provides an overall net benefit.

1. Introduction

11. On May 17, 2011 the European Community and its Member States submitted a proposal to list Pentachlorophenol (PCP) and its salts and esters in Annex A, B and/or C of the Convention (UNEP/POPS/POPRC.7/4), which was considered by the Persistent Organic Pollutants Review Committee (POPRC) at its seventh meeting held in October 2011. The Committee deferred its consideration on PCP and its salts and esters (sodium pentachlorophenate (Na-PCP), pentachlorophenyl laurate (PCP-L) to its eighth meeting, held in 2012 (UNEP/POPS/POPRC.7/19); on the basis of the receipt of additional information on the transformation of PCP to PCA (UNEP/POPS/POPRC.8/INF/7). The Committee at its eighth meeting decided that, while the PCP molecule itself does not meet all the screening criteria specified in Annex D, PCP and its salts and esters meet the Annex D screening criteria, taking into account its transformation product PCA (Decision POPRC-8/4).

1.1 Chemical identity of Pentachlorophenol and its salts and esters

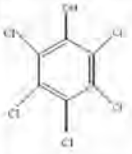
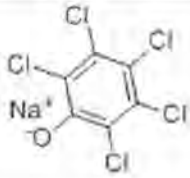
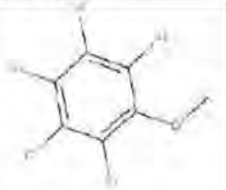
12. Pentachlorophenol is an organochlorine compound and was first introduced for use as a wood preservative in the 1930s. Since its introduction, PCP has had a variety of other applications (e.g. biocide, insecticide, fungicide, disinfectant, defoliant, anti-sapstain agent and anti-microbial agent). It has been also used in the production of the ester pentachlorophenyl laurate (PCP-L) which was used in textiles. The salt sodium pentachlorophenate (Na-PCP) was used for similar purposes as PCP and readily dissociates to PCP. The environmental toxicity, fate and behaviour profile of PCP, Na-PCP and PCP-L are quite similar. PCP is produced by reacting chlorine with phenol at high temperatures in the presence of a catalyst. Chlorinated contaminants including hexachlorobenzene, pentachlorobenzene, and dioxins and furans are produced during the manufacturing process. In addition, dioxins and furans formed during the manufacturing process can be released during the use and disposal of PCP-treated wood. Dioxins and furans are also a by-product of wood incineration (treated or untreated). These compounds are inherently toxic, as well as environmentally persistent and their presence increases the ecological and human health hazards associated with the use of PCP. As dioxins from chemical production of chlorophenols are already listed under Annex C of the Stockholm Convention, Parties should have measures in place to control these substances. Reduction measures by countries are reported in the risk profile in Section 3 (Other Considerations, paragraph 163). These measures have to be consistent with the Convention text in both Annex C and Article 5. However the presence of dioxins as impurities in PCP as a commercial product (covered by Annexes A and B) is not covered by the listing of dioxins in Annex C (UNEP/POPS/POPRC.9/13/Add.3).

13. PCA is not used as a commercial chemical or pesticide and is not intentionally released directly into the environment. PCA is a metabolite that may be formed in soil and sediment from the biodegradation of PCP under aerobic conditions by certain microorganisms.

14. There are several sources of PCP in the environment, including the release of PCP during its production and use as well as from sites contaminated by previous use. PCP and consequently PCA can also be a transformation product and metabolite of other organochlorine compounds such as hexachlorobenzene, lindane and quintozene (PCNB). The extent of these potential sources of PCP/PCA in the environment has not been quantified. PCP production and subsequent use is the only input of new PCP/PCA contamination to the global environment, other than quintozene (PCNB), as well as a source of dioxins and furans.

15. Further information pertaining to the chemical identity of PCP and its related compounds is listed in Table 1 and may be found in the Risk Profile on PCP (UNEP/POPS/POPRC.9/13/Add.3) and its supplementary information (UNEP/POPS/POPRC.9/INF/7). Information on releases can be also identified therein.

Table 1 Information pertaining to the chemical identity of PCP and its related compounds

	Pentachlorophenol	Sodium Pentachlorophenate	Pentachlorophenyl laurate	Pentachloroanisole
Chemical name and abreviation	2,3,4,5,6-pentachlorophenol (PCP)	Na-PCP	PCP-L	PCA
CAS number	87-86-5	131-52-2 and 27735-64-4 (as monohydrate)	3772-94-9	1825-21-4
Molecular formula	C_6HCl_5O and C_6Cl_5OH	C_6Cl_5ONa and C_6Cl_5ONa x H_2O (as monohydrate)	$C_{18}H_{23}Cl_5O_2$	$C_7H_3Cl_5O$
Molecular Mass	266.34 g/mol	288.32 g/mol	448.64 g/mol	280.362 g/mol
Structural formulas of the isomers and the main transformation product				

1.2 Conclusions of the Review Committee regarding Annex E information

16. The POPs Review Committee has conducted and evaluated a risk profile for PCP and its salts and esters in accordance with Annex E of the Convention including consideration of the transformation product pentachloroanisole, (UNEP/POPS/POPRC.9/13/Add.3) and has concluded that PCP its salts and esters are likely, as a result of their long-range environmental transport, to lead to significant adverse human health and environmental effects such that global action is warranted (Decision POPRC-9/3).

1.3 Data sources

1.3.1 Overview of data submitted by Parties and Observers

17. This risk management evaluation is primarily based on information that has been provided by Parties to the Convention and Observers. Data relating to Annex F were submitted by the following Parties: Argentina; Bulgaria; Canada; Croatia; China; Germany; Morocco; Nepal; Netherlands; Romania; Serbia; Sri Lanka and Sweden; and the following observers: the Alaska Community Action on Toxics with the International POPs Elimination Network and contributions from Beyond Pesticides (ACAT/IPEN), United States of America; Indian Chemical Council (ICC); Pentachlorophenol Task Force with KMG-Bemuth (PCPTF-KMG 2014) (the USA and Canadian registrant of PCP) and Wood Preservation Canada (WPC).

18. The exploration of management options for PCP prepared for the 8th meeting of the UNECE CLRTAP Task Force on Persistent Organic Pollutants (Montreal, 18 -20 May 2010) (UNECE 2010) is also used in this report. Other information sources are listed under "Other References" section of this document.

1.3.2 Information on national and international management reports

19. In 2011 Canada released a re-evaluation decision on Heavy Duty Wood Preservatives (HDWPs) and in 2013 released a Heavy Duty Wood Preservatives (HDWPs) risk management plan (RMP), which included PCP (PMRA 2013). In the United States as part of the re-registration eligibility decision for PCP, risk management measures were taken into account as part of the re-evaluation for continued use of PCP (USEPA 2008a).

1.4 Status of the chemical under International Conventions

20. PCP and its salts and esters are subject to a number of agreements, regulations and action plans:

(a) Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade;

(b) OSPAR List of Chemicals for Priority Action (1998) of the Convention for the Protection of the Marine Environment of the North-East Atlantic;

(c) Annex 1A (List of Priority Hazardous Substances) in the Third North Sea Conference;

(d) In addition, PCP has been nominated as a candidate for inclusion in Annex I of Long-range Transboundary Air Pollution (LRTAP) Protocol on POPs of the United Nations Economic Commission for Europe.

1.5 Any national or regional control actions taken

21. Specific national or regional control actions have been described under Annex F by several parties and have also been reported in the Risk Profile and its supporting information (UNEP/POPS/POPRC.9/INF/7); Section 2.5 and Appendix V).

22. For all EU Member States the use of PCP was restricted in 1991 by Council Directive 91/173/EEC and all uses including wood preservation officially terminated at the end of 2008 (according to Commission Directive 1999/51/EC). According to Annex XVII to the European Regulation (EC) No. 1907/2006 of the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), PCP and its salts and esters shall not be placed on the market, or used as a substance; as a constituent in other substances, or in mixtures, in a concentration equal to or greater than 0.1 % by weight. Additionally, PCP was excluded from Annex I to Council Directive 91/414/EEC concerning the placing of plant protection products on the market and authorisations for such products containing PCP thus had to be withdrawn in the EU by 25 July 2003 (Commission Regulation (EC) No 2076/200). Moreover, PCP was not included in Annex I or IA to Directive 98/8/EC concerning the placing of biocidal products on the market.

23. EU Directive 2010/75/EU on industrial emissions covers emissions and discharge of installations dealing with treatment of PCP containing material including waste incineration.

24. Harmonised EU legislation restricts the use of PCP as a substance or in mixtures, but some European countries – Norway, Denmark, Germany, Netherlands and Austria – have implemented additional restrictions to the import and marketing of consumer products containing PCP. As such, consumer goods treated with PCP may not be placed on the market in these countries if they contain more than 5 mg/kg of PCP and its salts and esters (Netherlands 2012, Norway 2010 and OSPAR 2004).

25. In Serbia, PCP cannot be placed on the market according to the Rulebook on Bans and Restrictions of Production, Placing on the Market and Use of Chemicals, which is harmonized with EC Regulation No. 1907/2006. (Serbia 2014)

26. PCP is not registered as a pesticide in Morocco and its import is not allowed according to Act No. 42-95 concerning the supervising and management of trade of agricultural pesticides (21st January 1997) (Morocco 2014).

27. In Sri Lanka all uses of PCP have been prohibited since 1994 and an official declaration in the form of a Government Gazette 1190/24 to ban certain pesticides including PCP was published on 29 July 2001 (Sri Lanka 2014).

28. PCP has either no uses or is banned in a number of other countries, such as New Zealand and Switzerland. In Indonesia agricultural uses have been banned. For a comprehensive list of countries with severe restrictions, or bans on PCP please see Appendix V of UNEP/POPS/POPRC.9/INF/7.

29. In Canada, PCP is only used as a heavy duty wood preservative primarily to treat utility poles and cross-arms, with other uses in outdoor construction timbers. To be used in Canada, PCP products must be registered under the Pest Control Product Act (PCPA) by Health Canada's Pest Management Regulatory Agency (PMRA). Sources of manufacture/supply must also be registered for PCP products. The PMRA published a re-evaluation decision on Heavy Duty Wood Preservatives (HDWPs) on 22 June 2011 (PMRA 2011) which granted continued registration to PCP subject to conditions that included the addition of new risk-reduction measures to product labels. In addition, as a condition of registration, treatment facilities using PCP are required to be consistent with the

"*Recommendations for the design and operation of wood preservation facilities – technical recommendations document (TRD)*" published by Environment Canada in 2004 and recently updated in December 2013. To further reduce potential environmental exposure, a Risk Management Plan for PCP and other wood preservatives was developed in 2013 by the PMRA (PMRA 2013). Guidance is also provided by Environment Canada for out-of-use treated wood and treated wood waste disposal as per the "Industrial Treated Wood Users Guidance Document" (Environment Canada, 2004a).

30. In the USA, PCP is currently classified as a Restricted Use Product (RUP) when used as a heavy duty wood preservative and is predominately used to treat utility poles and cross-arms. Wood preservative uses of PCP are only eligible for re-registration provided that the registrants implement the conditions and requirements determined in the Re-registration Eligibility Decision (RED) for PCP adopted by the Environmental Protection Agency in September 2008 (USEPA 2008a). Risk management measures were required to be implemented by 31 December 2013 (USEPA 2008a). In the USA, disposal of PCP and PCP-contaminated substances is regulated under the Resource Conservation and Recovery Act (RCRA) as F-listed (F021) or D-listed (D037) hazardous wastes (USA, 2014).

31. According to the Risk Profile, PCP is not produced or used in China. Na-PCP was used for wood preservation for the purpose of railway construction, but there is no further use for this application now due to upgrading of construction material. PCP-Na was used as molluscide, but this application has been banned and the registration of this application has been cancelled.

32. Other stakeholders, including industry organizations and major users of treated wood, have developed guidelines and best management practices (BMPs) to minimize health and environmental issues during manufacture and use of treated wood (Cooper and Radivojevic, 2012).

2. Summary information relevant to the risk management evaluation

33. Historically, according to the data profile of IRPTC (1983), 90,000 tonnes of PCP per year were produced globally. The Economist Intelligence Unit (1981) estimated world production to be of the order of 50,000-60,000 tonnes per year, based on the North American and European Community output (UNEP/POPRC.7/INF/5). By the 1990s, the widespread use was discontinued in most countries and at present it is banned in a number of countries (UNEP/POPS/POPRC.9/INF/7).

34. PCP and its salt and esters are currently produced in Mexico and in India and formulated in the USA. KMG Chemicals (2014) states that the company is the only producer of wood treating PCP in the world (under the commercial name 'Penta'), with a production facility in Matamoros, Mexico and a formulation facility in Tuscaloosa, Alabama, USA, where it formulates the solid PCP blocks produced in Mexico into a liquid concentrate. The company never produced PCP laurate esters and ceased production of Na-PCP in 2006 (UNECE, 2010). It is reported that KMG Bernuth in the USA formulated 7,257 tonnes of PCP (liquid concentrate) in 2009, marketed for wood preservation purposes in the USA, Canada, and Mexico (UNECE, 2010). No data are provided by the company on the quantities of solid PCP produced in Mexico and shipped to the USA for formulation. However the Mexican Government reported a similar level of production for 2009 (6,610 tonnes) and also supplied import/export information. Mexico reported that 3,670-7,343 tonnes of PCP were exported yearly between 2007 and 2011 to the USA (where the formulation facility is located), Colombia and Peru Mexico also reported imports of PCP from the USA, China and Germany between 1997 and 2011 (UNEP/POPS/POPRC.9/INF/7). The industry association Indian Chemical Council (ICC) reports that Na-PCP is also used in India mainly as a wood preservative but also for the preservation of water-based 'distemper paints' while in storage, with 1,800 tonnes per year of Na-PCP being produced in the state of Maharashtra and West Bengal, India (ICC 2014).

35. Based on responses from Parties and Observers, it appears that PCP is currently allowed worldwide only for wood preservation uses. Regarding its salts and esters, in addition to Na-PCP use in India for preservation of wood and paint products during storage (ICC 2014), Mexico also reported in their response to Annex E questionnaire registered uses in wood preservation, adhesives, tannery, paper and textile for Na-PCP. However Mexico has now clarified that wood preservation is the only use authorised in Mexico and that is no longer aware of any other active uses (Mexico 2014). No country has reported use of PCP-L (within the Annex F survey).

36. PCP consumption for industrial wood preservation concentrates in Canada for the treatment of utility poles, cross-arms and outdoor construction material in non-residential constructions and the USA.

37. Na-PCP is only used in India, mainly for wood preservation purposes-impregnated wood/ particle boards. In the USA and Canada PCP is only allowed as a heavy duty wood preservative for

industrial use, primarily for the treatment of utility poles and cross-arms, which account for more than 90% of PCP-consumption in those countries with the remainder being wood treated for other uses (laminated beams for bridge construction, sound barriers, fence posts and railway sleepers) (UNECE 2010).

38. The Canadian response to the Annex F questionnaire reported that PCP is registered for the treatment of wood for utility poles, cross-arms, outdoor construction materials, pilings and railway ties, although it is indicated that PCP-treated railway ties have not been installed since 1993 (Canada 2014). Late in 1990, PCP product manufacturers within Canada voluntarily withdrew PCP-based goods from a range of applications (both domestic and industrial) (Canada 1990; CCME 1997). With approximately 15 million wood poles in a distribution network that covers three quarters of a million kilometres, the predominant use of PCP is for the treatment of wood utility poles and cross-arms. Canada has reported an increase of the amount of PCP used, from 372 tonnes in 2008 to 537 tonnes in 2012 (Canada 2014).

39. The USEPA reported that in 2002, approximately 4,990-5,444 tonnes were used for utility poles, lumber and timbers. In 2002 4,083 tonnes were imported and 1,361-1,815 tonnes were produced domestically. According to a USA EPA report (USEPA 2008b), there is an estimated 130–135 million preservative-treated wood utility poles in service in the USA, representing over 90% of the pole market and presenting a replacement rate of 2 to 3% (approximately 3-5 million poles) per year (USWAG 2005). Available data show variability in the proportion of treated poles that use PCP. In 1995, about 45% of poles were treated with PCP, whereas in 2002 this figure was around 56% (based on EPA proprietary data and Vlosky (2006)).USA EPA (2008b) indicates that, in 2004, PCP-treated poles accounted for about 40% of all treated poles that year (3.9 million poles).

2.1 Identification of possible control measures

40. Following review of the available literature and inputs from the Parties and Observers, a number of possible control measures have been shortlisted. These take into account the differing capabilities and conditions among the Parties. In particular, it is noteworthy that some Parties have partially or wholly phased-out the use of PCP, while in only a very few countries (Parties and Observers) report a narrow but significant use, which is as a wood preservative, mainly for utility poles, and cross-arms. Within those countries (Canada and USA in particular) continued use based on regulatory controls has been supported in recent regulatory decisions.

41. With the aim of protecting human health and the environment from exposure to PCP a number of options for possible control measures are considered. These measures could provide varying degrees of assurance that future exposure will be controlled in relation to releases from manufacture and from the life-cycle of its use as a wood preservative, specifically those:

(a) From production of PCP;

(b) From wood treatment facilities, including during the treatment process; transfer of treated wood from dipping tanks for drying; during the drying process; from leachates and outdoor storage of treated wood; evaporation from treated wood products; from wood waste including the sawing and processing of treated wood; and as solid waste from the bottom of the dipping tank or treatment cylinder;

(c) During the installation of treated wood (including the sawing, piercing and managing of wood waste residue).

(d) During the service life of products, such as utility poles and railway cross-ties/sleepers;

(e) During use in secondary uses e.g. domestic use in gardens (though the extent of this use is unknown and is prohibited in Canada);

(f) During the waste phase, either when landfilled or incinerated; and

(g) From contaminated sites, where PCP can persist for many years.

42. Note that manufacture of PCP leads to production of contaminants including HCB, PeCB, dioxins and furans, which are already listed in the Convention. Dioxins and furans formed during the manufacturing process are released from treated articles. Control measures introduced in the Canada USA and Europe have reportedly led to reductions in concentrations of dioxins and furans as impurities in PCP, as set out in the Risk Profile (paragraph 163). Canada provided detailed information on control measures in place to manage dioxin releases from PCP and its non-chemical alternatives. (UNEP/POPS/POPRC.10/INF/19)

43. As indicated above (paragraph 35), it is understood that the identified non-wood treatment uses in the risk profile are no longer active. Therefore there would be no negative (or positive) impacts for these uses of inclusion of PCP under the Convention, and hence no need for derogation for these uses. The focus of the remaining discussion is therefore only upon wood preservative use.

44. A *prohibition* on production, use, import, and export of PCP (inclusion on Annex A) would eliminate new inputs of the substance into the life-cycle of products and would reduce and eventually eliminate releases to the environment from these sources. It would require the use of alternative chemical wood preservatives, or alternative materials to be used in applications such as utility poles and cross-arms, as well as railway sleepers and outdoor construction timbers. It would also address exposure through the other uses of PCP (though no information is available on the extent of other current uses, so they are not considered in any detail). It might also be appropriate to consider prohibiting the marketing of existing PCP-treated articles (for example the Netherlands has restricted those that contain more than 5 mg/kg) (Netherlands 2014).

45. A *restriction* on use could be implemented in a number of ways. One option would be to limit PCP use to industrial wood preservation (as the only use identified in north America), which would remove the potential for releases from other uses such as treatment of wood for non-industrial (e.g. domestic) use, or use in leather or textiles, either contemporary uses, or through reinstatement of historical uses. Parties would therefore need to be included on the register of specific exemptions or acceptable purposes. There could be a requirement to review the specific exemptions or acceptable purposes and time-limited requirements to report on progress with elimination of PCP as with other substances on the Convention (e.g. perfluorooctane sulfonate, PFOS). Another option could be to limit the uses covered, for example as wood preservatives only for utility poles and cross-arms but not for some of the other uses, such as outdoor construction materials, pilings or railway sleepers (e.g. UNECE (2010) suggest that more alternatives are available for timber and lumber uses than for utility poles, and that these could be more readily replaced). It could be appropriate to include the production of PCP as a specific exemption or acceptable purpose (depending on the Annex in which PCP might be included). It is assumed that such a restriction could be introduced through inclusion on Annex A or B.

46. Restrictions or prohibition could also be complemented with requirements for measures to control emissions. Requirements for *control of discharges and emissions* could take various forms, and ideally would be targeted at all of the life-cycle stages where emissions can occur. By way of example, Canada's recent decision (PMRA 2011) which found currently registered uses to be acceptable was contingent upon implementation of additional control measures, most notably adherence to the TRD on recommendations for the design and operation of wood preservation facilities (Environment Canada 2004b), which is supported by technical guidance. These include, among other things numerous guidelines related to each of the following: Chemical receiving and unloading area; chemical storage; chemical mixing; treatment process systems; wood drip areas; treated wood storage areas; general practices; maintenance; waste handling/disposal; and monitoring. Environment Canada (Environment Canada 2004a) has also published guidelines that address the later life-cycle stages, covering issues such as: locating new storage facilities and managing existing ones; installation and handling; considering alternatives at sensitive sites; and managing waste wood (encouraging re-use, tracking post-use wood, using the waste management hierarchy).

47. Furthermore, as part of the USA's Re-registration Eligibility Decision (RED) (USA 2014) and Cost Estimates for Risk Mitigation Technologies at a Typical Wood Treatment Plant (USEPA 2008c), a number of control measures are highlighted, including: installing automatic doors on treatment cylinders to replace manual doors; installing hydraulic bridge rails to replace manual bridge rails; and pulling a final vacuum after completing the wood treatment (reducing bleeding during post-treatment handling, shipping, storage and product use). Such measures will reduce but not completely eliminate releases of PCP.

48. In addition, the labelling, or branding (as practised in Canada US) of new PCP-treated wood would help to facilitate proper environmentally sound management of stockpiles and wastes in full compliance with Article 6 of the Convention. The practicalities of applying labelling or branding would require further investigation.

49. The unintentional formation of impurities such as dioxins and furans during PCP manufacture should already be addressed by the current Annex C (unintentional releases) listing of dioxins and furans. There is no information at this time of PCP being an unintentionally formed impurity and therefore, currently no basis for Annex C listing.

50. Listing under the Convention would also make it subject to the provisions on stockpiles and waste in Article 6. Article 6 in the Convention requires that wastes and stockpiles are handled in a safe, efficient and environmentally sound manner. The article also requires disposal in such a way that the POP content is destroyed or irreversibly transformed, or otherwise disposed of in an environmentally sound manner. The article bans disposal operations that lead to recovery, recycling, reclamation, direct use or alternative use of POPs material if they are above the low persistent organic pollutant content referred to in paragraph 1(d)(ii) to be established by joint work with the Basel Convention Conference of the Parties. Pressure-treated wood at the end of its service-life will still contain some PCP, although there are some indications that the amount remaining will be relatively low (USA 2014). This wood will need to be disposed of in accordance with Article 6. As incineration can lead to the unintentional production of dioxins, the BAT/BEP guidelines and provisions of Annex C of the Convention are likely to be of relevance in the operation of the appropriate elimination or disposal technology. Re-use in e.g. gardens may not be allowed under Article 6(d)(iii) if the wood contains PCP above the low POP content established by the Stockholm Convention.

51. International trade in treated wood waste and other PCP-containing waste could potentially be significant. For example, in 2012, Canada exported around 92,000t of waste consisting of, containing or contaminated with PCP (e.g. wood wastes, contaminated soils). These exports were made to the US for the purpose of environmentally sound disposal in accordance with Canada's Export and Import of Hazardous Wastes and Hazardous Recyclable Material Regulations and the Basel Convention (Canada 2014). Article 6 of the Convention is therefore also of relevance in the case of PCP.

52. Parties could also consider implementing *maximum residue levels in water, soil, sediment or food*. The USA has established various drinking water standards (USA 2014) and occupational exposure limits (USEPA, 2000); Canada has introduced guidelines for PCP in drinking water and soil (Health Canada 2012 and CCME 1997) as well as occupational exposure (Canada 2014b); and PCP is covered by WHO drinking water guidelines (WHO, 2003). In addition, the Netherlands has remediated large areas of land contaminated by PCP over a set "intervention value" (Netherlands 2014). In accordance with Article 6. 1.(e) of the Convention, Parties should endeavour to develop strategies for identifying sites and remediating contaminated sites in an environmentally sound manner.

2.2 Efficacy and efficiency of possible control measures in meeting risk reduction goals

2.2.1 Technical feasibility

Prohibition on use

53. No information has been identified to suggest that there would be any concerns over technical feasibility in prohibiting PCP use in uses other than wood treatment. The sole remaining non-wood use identified from India, is the use of Na-PCP as a biocide in distemper paints to protect the product while in storage. The quantity of Na-PCP used for this purpose is unknown, with wood treatment likely to be the main use of Na-PCP. India manufactures and uses approximately 1800 tonnes of Na-PCP per annum (ICC 2014b). No assessments of alternatives are made available from India. Uses other than wood preservation are not considered further because no information is available on any actual present-day use in non-wood-preservative applications.

54. As set out in section 2.3 on alternatives, there are a wide range of chemical and material alternatives in current use in many countries where they are both technically and economically viable. The wide commercial availability of alternatives for PCP indicates technical feasibility under a range of conditions. It might therefore be possible to continue the main activities involved (e.g. utility transmission), although some of the alternatives would provide a technically inferior solution, and some may provide superior solutions, including nonchemical alternatives, in certain circumstances. The fact that different wood preservatives are more suited to particular climates and geographies than others should not be overlooked in the context of technical feasibility. Equally certain preservatives are suited to specific species of tree, for example, PCP for wood poles is reportedly more suitable than alternatives such as creosote and CCA for southern pine and Douglas fir (the latter being the most widely used for utility poles in the Western USA) (GEI 2005). It is reported that use of some chemical alternatives could lead to distortions in wood cross-arms, leading to strain on electrical wires and associated power outages in these circumstances (GEI 2005). In this respect the use of non-chemical alternatives might also provide a valuable option as replacement for PCP. Furthermore, it is also reported that wooden poles can allow greater flexibility of use (e.g. compared to non-wood poles which require retrofitting if new lines are adding to an existing transmission line) (USA 2014b).

Moreover, the use of wood poles and cross arms allows utilities to quickly obtain replacements on short notice, following a fire, storm, or other incidents that result in the need to replace a large number of poles quickly. For example, following Hurricane Sandy in the USA, wood treating companies supplied utilities with approximately 65,100 wood poles and 103,500 wood crossarms within just a few weeks (Bush 2013). Steel poles are engineered to meet standards, and can be fabricated for different strengths based on size and need of the line designer. Steel poles can be manufactured to replace wood poles in an existing line without the need of retrofitting or rerunning lines, under certain conditions[1].

55. ACAT/IPEN (2014b) notes that these concerns appear to have been adequately addressed in the many countries that have already eliminated PCP use in wood preservation. Also countries with climatic conditions similar to Canada have transitioned away from PCP to other chemical alternatives / non-chemical materials. The PCPTF (2014c) highlights that the use of PCP as a heavy duty wood preservative for utility networks has not been significant outside the USA and Canada, with some of the countries that have banned PCP for wood preservation not actually using it to a significant extent for this purpose (Canada and PCPTF 2014c).

56. A key concern for technical feasibility of a prohibition on use is that it would require significant industry changes for countries where PCP use occurs (e.g. Canada and USA). In these countries it is argued that the use of PCP is critical because there are limitations with respect to the alternatives (Environment Canada 2013) and the fact that wooden poles cannot be individually replaced as they reach the end of their service life (using alternatives to wooden poles would require the replacement of whole sections of utility lines which function as an integrated system) (USEPA 2014B).

57. A prohibition on re-use of treated materials could be technically challenging to implement although it could be facilitated through labelling or branding. Materials such as utility poles or railroad ties may be sold for reuse, often into a secondary market where they may be installed in residential settings for garden borders (USA 2014) and it is likely to be difficult to identify and control use of PCP-treated wood for such uses. Labelling or branding of articles containing PCP would facilitate prevention of such residential re-uses, and consequently potential health or environmental impacts.

Restriction on use

58. A restriction on use could establish specific exemptions or acceptable purposes, such as use in wood preservation, with other uses not being possible. Again, no technical feasibility concerns have been identified for non-wood-treatment activities.

59. A restriction could overcome the identified technical feasibility concerns with a full prohibition by providing specific exemptions for uses (e.g. for utility poles for which there seems to be greater level of socio-economic impact or issues with the availability of alternatives than with the other uses such as for outdoor construction materials, pilings or railway sleepers) which could be time-limited to allow for (or require) further investigation, development and registration of alternatives, and could also be linked to requirements for control of emissions.

Control of discharges and emissions

60. Controlling discharges and emissions to the environment appears to be technically feasible, at least in terms of controls to reduce emissions during the manufacturing and wood-treatment process, although it would not eliminate all releases. For example, Canada reports (Canada 2014) that 54 of the 55 wood treatment facilities operating in Canada are certified under a certification programme ensuring that facilities fulfill the requirements outlined by Canada's TRD (see above). All nine of the companies reported as using PCP were certified (Environment Canada 2014). The joint US EPA and PMRA re-evaluation concluded that under these control measures, risks to human health and the environment were sufficiently controlled to permit continued use In Mexico, the production of PCP is regulated under a variety of environmental laws, with the production facility being required to have an authorisation from the Ministry of Environment and Natural Resources ("SEMARNAT") regarding environmental impact.

61. Measures to address handling and use of treated wood (i.e. after the impregnation process) are likely to be more technically challenging to implement, given the much more disperse use and large

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[1] American Galvanizers Association submission during the POPRC 10

numbers of organisations and individuals involved. Labelling or branding requirements of PCP-treated wood would alleviate this problem.

62. Given that dioxins and furans can be released from PCP-treated wood (as set out in the risk profile), measures to control releases of PCP from treated wood in service could also reduce, but not eliminate, dioxin emissions to the environment.

Waste management and stockpiles

63. Labelling or branding requirements would facilitate the identification and management of wastes and stockpiles of wood containing PCP. If the wastes exceed the low POP content value they will be subject to destruction or irreversible transformation Treatment of such wastes must be conducted according to Article 6 obligations and taking the BAT/BEP guidelines into account.

2.2.2 *Identification of critical uses*

64. None of the information received from the Parties/Observers or reviewed in the literature suggests that any of the non-wood-treatment uses are considered to be critical.

65. Canada has identified PCP and its chemical alternatives (ACZA, CCA, creosote) as being critical given the limitations of non-wood alternatives (PMRA 2011). Therefore the use of PCP in wood treatment for registered uses, which include utility poles but also other uses such as outdoor construction materials, is considered as critical by Canada (Canada 2014) due to current limitations of chemical and non-wood alternatives (see UNEP/POPS/POPRC.10/INF/19). In addition the US and Canadian assessments concluded that PCP is acceptable for continued registration as a heavy- duty wood preservative taking into account the control measures required. The United States, as an observer government, offers a similar situation.

66. In India Na-PCP is used mainly for impregnated wood/particleboards to protect them from fungi in both industrial and domestic setting.

67. Depending on the circumstances of use, the negative impact on society that could result if no exemption or acceptable purpose is permitted for this use could include e.g. reduced longevity of wood utility poles with some chemical alternatives (with a consequential need for more frequent replacement and associated economic and environmental impacts), as well as safety concerns highlighted above when using certain types of wood for cross-arms (GEI 2005).

2.2.3 *Costs and benefits of implementing control measures*

Prohibition on use

68. In terms of environmental and health benefits of reduced PCP/PCA exposure, a prohibition would be most effective in continuing to reduce releases of PCP to the environment. However, a prohibition would lead to increased use of alternative chemicals, most of which have toxic properties of concern, or alternative materials, with different life-cycle analyses coming to different conclusions on whether wood, concrete or steel are best from a life-cycle perspective (Bolin 2011, Aqua-e-Ter 2012 and SCS Group 2013). Different arguments can be made as to whether there would be a net health/environmental benefit from using alternatives to PCP.

69. If a prohibition on manufacture were to be introduced, this would impose costs for countries producing the substance (e.g. Mexico), assuming that facilities would need to cease production. The company's sales of PCP were estimated at around $30m in 2009 (UNECE 2010) (a breakdown for PCP and/or for Mexican production was not available in the latest financial report). It is likely that these losses would be offset by increases in sales for producers of alternatives, though the geographical spread of impacts could probably differ.

70. In terms of a prohibition on use, since power generation and telephone companies use PCP widely in North America –about 38% of all utility poles are treated with PCP in USA for example (Aqua-e-Ter 2012). In Canada approximately 15% of timber poles are treated with PCP with the remainder being treated with CCA (based on WPC survey) – the majority of the socio-economic impacts would fall on Canada, the USA and on those other countries still using PCP in wood preservation (such as India). The Steel Market Development Institute (2011) indicates that one major utility in the USA (Tucson Electric Power) has begun converting to the use of steel poles and claims that "more than 600 electric utility companies are using steel distribution poles, with some converting the majority of their distribution system poles to steel" (Steel Market Development Institute, 2011). The Wood treating industry is of the contrary view that steel poles are still used for only a small

portion of the market, and mostly for more specialised applications (PCPTF-KMG 2014b). There would be limited or no costs for countries that have already prohibited use.

71. The main cost elements associated with a prohibition on use would include:

(a) Differences in costs for purchasing and processing the alternatives in manufacture of utility poles and other products (see the section on 'information on alternatives'). Alternatives with a higher initial purchase price may actually be more cost effective over the life of the product when durability and other factors are taken into account;

(b) Changes in material and labour costs due to a different frequency of replacement of e.g. utility poles (wooden poles treated with less efficacious preservatives would need more frequent replacement; steel and concrete poles may need less frequent replacement, dependent on application);

(c) Changes in the associated equipment needed to install, inspect, and maintain utility poles made of alternative materials (e.g., steel). The resulting effects on worker safety have not been quantified for either PCP-treated poles or for alternatives;

(d) Costs for wood treaters associated with loss of revenues and potentially costs associated with loss of residual value of their capital equipment, offsets by potential gains by other treatment.

(e) There are nine treaters using PCP in Canada (Environment Canada 2014);

(f) If a prohibition is extended to in-service and already treated wood (i.e. phased replacement of existing stock), costs associated with identifying/monitoring the presence of PCP-treated wood, diversion to other uses and replacement of in-service wood and disposal.

Restriction on use

72. A restriction on use would not have the same degree of benefit as a prohibition in terms of reduced PCP exposure, given that utility poles and cross-arms would remain as specific exemptions or acceptable purposes. The above comments regarding the net change in health/environmental costs and benefits of using PCP should also be taken into account. However, a restriction allowing continued use of PCP only in (industrial) wood preservation or NaPCP in impregnated wood/particle boards, would have the benefit of eliminating exposure through any other current or the reintroduction of historical/new uses.

73. A restriction allowing continued use for specified (exempt) uses could minimise some of the more significant negative costs identified for a prohibition, such as loss of sales revenues and employment from manufacture, as well as lost revenues or redundant capital equipment for wood treaters. However, it will also minimize the more significant benefits identified for a prohibition, such as increase of sales revenues and employment from manufacturers and industries involved in the sales/application of alternatives.

74. The costs associated with replacing PCP under a restriction or a prohibition could be significantly reduced if replacement is allowed to be undertaken at a slower pace in countries where use is still considered critical.

Control of discharges and emissions

75. There would be benefits of reduced discharges from wood preservation facilities releases; in-service and at the end-of-life stage. No quantitative information has been identified on the relative scale of emissions from these stages and the extent that they could be reduced by complying with best available techniques / best environmental practices. Measures to improve wood treatment practices (especially those that reduce the amount of free PCP in the wood) could contribute to reducing releases during service life.

76. A US EPA (USEPA 2008c) analysis for worker mitigation strategies estimated the average total costs of mitigation strategies per plant as around:

(a) Automatic door: $700,000 for a small plant and $1,100,000 for a large plant (rounded);

(b) Automatic bridge rails: $200,000 and $300,000 respectively;

(c) Pulling final vacuum: $55,000 and $85,000 respectively.

It should be noted that these mitigation measures were evaluated as part of an evaluation of occupational exposure via the dermal and inhalation routes. They are provided within the text as a guide, but it should be recognised that measures to reduce or eliminate releases of PCP to the environment would need a re-evaluation of the scope required.

77. The extent, to which these additional costs might actually be borne, however, is unknown since it is not known how many facilities already have such measures in place. All Canadian PCP treatment plants facilities already conform to the requirements of the TRD (Canada 2014).

78. There would also be costs associated with control of emissions from use of the treated wood, such as related to storage facilities, use of alternatives at sensitive sites and management/tracking of waste wood.

79. Controls can minimize but not completely eliminate releases of PCP and other POPs from manufacturing and treatment facilities.

Waste management and stockpiles

80. Depending on the waste management route adopted, there could be changes in costs. For example, diverting old treated wood to incineration from landfill could destroy the PCP (making sure that dioxin formation is minimised), but this would likely come at a cost, e.g. of increased incineration capacity. However, there could also be reduced costs associated with the need for reduced treatment of landfill leachates contaminated with PCP.

81. If restrictions are introduced on sales of PCP-treated wood to secondary markets (e.g. garden boundaries), there could be potential changes in costs through availability and use of alternative (e.g. virgin) materials, costs associated with disposal and also costs of identifying this wood (e.g. through labelling or branding).

Environmental quality guidelines in water, soil, or sediment and remediation of land

82. Provided that environmental quality guidelines are adhered to, these could limit human and environmental exposure to PCP, and hence provide additional benefits.

83. In addition to the benefits in terms of reduced exposure for humans and the environment, it is possible that a restriction prescribing industrial pollution prevention or prohibition on use could lead to decreased costs through e.g. reducing the extent of land contamination and hence the need for land remediation costs.

84. It is clear that remediation of historically PCP-contaminated land represents a long-term and expensive challenge, with level of cost depending on the intervention levels used and extent of remediation. For example, the US EPA spent $US3.2 million in 2009-10 cleaning up a single PCP contaminated site (Havertown) (USEPA 2012). A project is underway in New Zealand (where past use of PCP is one of the major sources of contaminated sites) to clean up a canal contaminated with dioxins from PCP use at timber treatment plants prior to 1990, with an estimated cost of NZ$4.4 million (US$3.7 million) (BOPRC 2014). Large areas have also been remediated in other regions, such as the Horst area of the Netherlands (Netherlands 2014), which was necessary in order to allow for residential development in the area. Reduced land contamination could also lead to an increase in land values, as another benefit of the various control measures under consideration. However, past practices leading to contaminated sites as described above may not be indicative of current industrial PCP practices, nor the potential for contamination based on current practices.

2.3 Information on alternatives (products and processes)

2.3.1 Introduction

85. The responses to the Annex F request for information along with supporting information from USA and Canada identify that the sole use for PCP is for industrial wood treatment, with particular key use for utility poles and cross-arms (see section 2.0). The ICC (ICC Annex F response) also quotes the use of Na-PCP for treatment of wood and the ICC (2014b) further identify active use for Na-PCP: as a biocide in water-based distemper paints to resist microbial degradation while in storage ahead of use. Communication from Mexico (2014) indicated that the only current active use remaining with Mexico is for wood treatment, noting other identified uses had now ceased.

86. Utility poles and cross-arms form a key part of the power network infrastructure with load bearing structures which are required to meet standard levels of performance to ensure continued transmission of electricity. Both chemical and non-chemical alternatives exist for PCP within these applications, and more broadly within wood treatment a number of accepted wood preservation chemicals exist with potential to replace PCP dependent on the specific application. Table 2 originally produced within the USA EPA assessment of alternatives (US EPA 2008b) and repeated within the

UNECE exploration of management options (UNECE 2010) provides details of viable chemical alternatives and approved applications by the American Wood Preservatives Association (AWPA). These applications are also expected to be representative of pesticide use in Canada and Mexico. The following sections provide a detailed breakdown of chemical alternatives (2.3.2), non-chemical alternatives (2.3.3) and then finally a summary of cost comparisons for both chemical and non-chemical replacements for PCP (2.3.4). Three LCA are available (Bolin 2011, Aqua-e-Ter 2012, IVL 2011). The IVL study submitted during the POPRC 10 is a comparison of the environmental impacts from utility poles from different materials.

2.3.2 *Chemical alternatives for wood preservation*

87. The USA EPA assessment of alternatives (US EPA 2008b) identifies the key major mass production preservatives for wood as PCP, chromated copper arsenate (CCA) and creosote-based products. The Canadian guidance document for industrial treated wood (Environment Canada 2004a) concurs with these identified preservatives with the addition of Ammonical Copper Zinc Arsenate (ACZA). A number of additional preservatives (Ammonium Copper Quaternary (ACQ), and Copper Naphthenate have also been identified as being used within North America and may provide viable options for the treatment of wood for certain scenarios where PCP is currently used. In New Zealand ACQ and Copper Naphthenate are approved preservatives along with CCA (which is the major product), copper azoles, and azoles/permethrin. Borate salts are also used but these are non-fixed preservatives and can only be used for indoor timber uses due to their leaching potential, and are therefore not an alternative for current PCP uses. Creosote is not approved in New Zealand as is the case with PCP (New Zealand 2014).

88. Under the European Union biocidal products regulation (Regulation EU 528/2012) to date includes 32 biocide active substances which are approved at EU-level for use in wood preservative biocidal products and most of them are authorised for domestic uses. These active substances cover a broad array of applications including some of the substances already named above but the vast majority of these 32 biocide active substances are not used for industrial wood preservation. The most widely-used wood preservative for key applications such as utility poles in the EU is understood to be creosote, following the prohibition of PCP and CCA use. Further details are provided at the end of section 2.3.2.

89. The remainder of the present chapter will provide a breakdown of each key alternative with an analysis of its technical feasibility, highlighting its potential strengths, weaknesses and risks to health and the environment.

Chromated Copper Arsenate (CCA)

90. CCA is a product made up of active ingredients in a ratio of 5:3:2 for chromic acid, arsenic acid and cupric oxide, respectively (Canada 2014b). The product is already widely used in North America and is recognised as the main preservative wood treatment product in the USA for industrial use, with 44% market share (US EPA 2008b). It is also widely used in Canada (Canada 2014). It is also widely used in New Zealand (New Zealand 2014). While CCA is widely used for wood treatment, it was voluntarily removed from use on wood intended for the domestic/residential (e.g. homeowner) use market in 2003 in both the USA and Canada due to public health concerns. It is now limited to use on wood intended for industrial applications and handled by professional users (Environment Canada 2013, US-EPA 2008b).

91. CCA is typically used in a pressure treating process for wood following a similar process to PCP and creosote, although CCA is used at lower application temperatures: 65°C compared to 100°C for PCP and Creosote (USEPA 2008c). On completion of pressure treating (for all preservative types) it is necessary to include a drying cycle. It is however not appropriate to use kiln drying for CCA (air drying is preferred) as there is the potential to release chromium to air (USEPA 2008c). The pressure treatment process, when correctly applied, provides high fixation rates for CCA with the metal components tightly bound to wood (Environment Canada 2004a).

92. CCA has both strengths and weaknesses in treatment of wood compared to PCP. CCA is recognized as producing a clean, dry, odour free finish which is easy to paint. Conversely, as PCP is an oil-based wood treatment, PCP-treated wood can 'bleed' and typically has a phenolic odour (GEI 2005). This makes CCA-treated wood more applicable to public locations such as pavements or pedestrian areas. The high fixation rates for CCA also mean it is suitable for use in areas with high moisture soil content or high water table. However CCA treatments can have an effect on moisture content of wood leaving them particularly dry. This has previously caused additional problems for climbing utility poles, now overcome with the use of softeners (Canada 2014). For hot dry climates the use of CCA can also be an issue for shrinking, cracking or warping of wood. This is particularly an

issue for load-bearing structures such as cross-arms for utility poles (GEI 2005). The use of oil-based preservatives such as PCP and creosote provide an additional 'suppleness' to wood which can protect against warping and cracking in hot dry climates. CCA is also recognized as being corrosive to some metal types meaning that galvanized metal fastenings should be used in combination with CCA applications (UNECE 2010). This approach is taken as the industry standard in the USA (USEPA 2008b).

93. The ICC and ACAT/IPEN (ICC 2014a and ACAT/IPEN 2014) have both raised concerns regarding CCA's environmental and human health impacts, noting that CCA contains highly toxic and carcinogenic substances with concerns for these substances reaching the natural environment CCA contains two carcinogens, hexavalent chromium (CrVI) and arsenic, along with copper which is highly toxic to aquatic organisms (CDC 2013, USEPA 2013, USEPA 2008d). However, post fixation, in service CCA treated wood does not contain hexavalent chromium, but rather trivalent chromium (USEPA 1998). Trivalent chromium is classified as a group 3 ("Not classifiable as to its carcinogenicity to humans") carcinogen while hexavalent chromium is groups 1 ("Carcinogenic to humans") (IARC 2014*)*. KMG (PCPTF-KMG 2014) notes that:

CCA is no longer authorized for use in the European Union under the Biocidal Products Regulation.

94. Health Canada's Pest Management Regulatory Agency (PMRA), who carried out a joint risk assessment with the US EPA for heavy duty wood preservatives, notes that the original assessment for CCA is expected to have overestimated risk, and that wood treatment facilities following the TRD (labelling, storage, risk management plans) would greatly reduce the risk of exposure and environmental loss. The same document also states that CCA used in freshwater conditions has a low potential for leaching and that any material lost from utility poles in submerged conditions is retained in the sediment at the foot of the pole with minimal risk for exposure to aquatic species (PMRA 2011 and USEPA 2008a). Laboratory studies by Kamchanawong (2010) and Mercer (2012) assessed the leaching potential of CCA within hypothetical environments that simulate unlined landfill conditions; For the Kamchanawong this was under tropical conditions. The results of these studies highlighted potential for leaching which in real world environments may cause a concern for groundwater. However environmental relevance of these studies is unknown. In Canada and the USA, registrants voluntarily withdrew consumer (i.e. non-industrial) uses of wood treated with CCA as of 2004. These uses are therefore prohibited in Canada and the USA, as is export of wood for these purposes (USEPA 2014, US EPA 2003, PMRA 2002, and PMRA 2006). It is difficult to treat certain wood species used for utility poles with CCA due to the inability of the treatment to penetrate blocked wood pores. In addition, CCA-treated utility poles are more difficult to climb. (UNECE 2010).

95. In Sri Lanka, copper chromated borate (CCB) is used as an alternative to CCA within specific applications but not on utility poles (Sri Lanka 2014 b).

Creosote based products

96. Creosote is produced from the distillation of coal tars and contains between 200-250 chemical species, although 85% of these are polycyclic aromatic hydrocarbons (PAHs) (Environment Canada 2013). A large number of toxic substances are contained in creosote including PAHs, phenol, and cresols. Creosote is a widely-used preservative for wood with proven efficacy, although it has negative environmental and health consequences. Efficacy studies show that creosote is effective against a broad spectrum of harmful organisms, including wood rotting fungi, against wood rot in soil and water contact, against insects, and against marine borers (Sweden 2014). Creosote is widely used in the USA with 16% of the utility pole market (USEPA 2008b) and 31% of all wood in the USA (Vlosky 2009) as well as Canada (2014) and Sri Lanka, although information from Sri Lanka suggests service life is 30 to 50 years under harsh tropical climates (Sri Lanka 2014). Also in the EU, creosote is extensively used across the EU Member States, and according to the European Electricity Industry Association, Eurelectric (2010), about 1 million m^3 of wood were treated with creosote each year. Creosote is of particular use in railway ties and cross-arms for utility poles (UNECE 2010) and in the EU the majority of creosoted wood is accounted for by these uses (WEI-IEO 2008).

97. Creosote, like PCP, is an-oil based product used within industrial pressure treating of wood. In Canada, it is also used as a brush-on treatment for newly cut surfaces of pressure-treated creosote timbers and lumber for industrial applications and handled by professional users (PMRA, 2011). The use of oil-based preservatives provides a waterproof layer to wood surfaces and to an extent also the metal fittings during service life. The use of oil-based preparations such as creosote and PCP provides 'suppleness' to treated wood which can help prevent shrinking, warping and twisting, particularly in harsh climatic conditions (UNECE, 2010). This is of particular importance for load bearing structures such as railway cross-ties and cross-arms of utility poles (USEPA, 2008b). The Canadian Annex F response (Canada, 2014) states that the Canadian railway system is around 50,000 km long with

approximately 90 million ties in service. The Canadian response to the Annex F survey also states that creosote is the only significant wood preservative currently used to treat railway ties. Production and availability of creosote is tied to steel production and any market fluctuations in the steel market. PCP has been identified as an important alternative for this use, should creosote become unavailable. This highlights the importance of PCP within the resilience of the rail infrastructure for Canada.

98. Concerns have been raised regarding health and environmental effects of creosote. KMG (PCPTF-KMG, 2014) highlight that the main constituents of creosote are PAHs which are already recognized as a Persistent Organic Pollutant (POP) under the UNECE Convention on Long Range Transboundary Air Pollution (CLR-TAP). FNV (FNV, 2010) highlights that the use of creosote has been in discussion for several decades because of the harmful impact on the environment and health of workers carrying out preservation. Carpenters and construction workers are also likely to be exposed during use of treated wood. Both IARC and US EPA have determined that coal tar creosote is a probable human carcinogen (ATSDR 2002) In the USA and Canada creosote is limited to industrial applications only (USEPA, 2008b). In Europe it was added to Annex I of the biocidal products directive 98/8/EC, meaning it can no longer be placed on the market without authorisation (Sweden, 2014). It is also mentioned in annex XVII of the European REACH regulation (EC 1907/2006) covering specific restrictions on use. Health Canada's Pest Management Regulatory Agency (PMRA), who carried out the risk assessment for heavy duty wood preservatives, notes that the assessment for creosote is expected to have overestimated risk, and that wood treatment facilities following the TRD (labelling, storage, risk management plans) would greatly reduce the risk of exposure and environmental loss (PMRA, 2011).

Copper Naphthenate

99. Copper naphthenate is an oil-borne wood preservative (UNECE, 2010), which is produced as a mixture of copper salts and naphthenic acid, a by-product of petroleum refinery processes (Feldman, 1997). While the composition of copper salts are well understood, the naphthenic acid component can be of variable composition depending on the nature of the source petroleum processed (Feldman, 1997). Copper naphthenate has been approved for both industrial and domestic use in the USA (USEPA, 2008b).

100. Copper naphthenate holds a smaller proportion of the wood treatment market than CCA, PCP and creosote but demand is expected to grow (USEPA 2008b). The US-EPA data for 2004 quotes 900 tonnes used in the USA with further potential for growth. Copper naphthenate is approved for above ground, ground and freshwater use but not suitable for coastal/marine applications. Equally it can be used in the USA within pressure treating processes as can PCP, CCA and creosote.

101. Smith et al (undated) quotes quality issues experienced during the mid-1990s with specific batches of product. In these cases the product formed an emulsion during pressure treating which led to patchy treatment of utility poles and poor protection in areas where oil coverage was also poor. This notes that copper naphthenate would be concentrated in the oil fractions. Poles treated with these batches of copper naphthenate began to experience problems within four years of installation. Wood damage from fungi and pests particularly at the mid-to-top end height of the poles was experienced in a number of cases. One case study in Wisconsin, USA in 1997 quotes 217 poles where 43% were in poor repair. No recent batching issues are known to exist.

102. Information from the Toxnet database (Toxnet 2011) illustrates that despite its wide use the environmental profile and toxicity of copper naphthenate is poorly characterised; due in part to the variable nature of the petroleum product. This takes into account that the petroleum product component can have the presence of multiple compounds including notably benzene (Feldman, 1997). Toxnet also highlights that, like CCA, copper naphthenate leaches from wood and that studies on mice suggest that this substance may have potential to be genotoxic. However, the naphthenate acid molecule is not expected to bioconcentrate significantly; modelled bioconcentration factors (BCFs) are 1464-1659 (U.S. EPA, 2011), which are well below the Stockholm Convention criterion of 5000. US EPA (1996) also indicate potential health effects for occupational exposure when manually applying copper naphthenate to wood in domestic and residential settings.

Ammonical Copper Zinc Arsenate (ACZA)

103. ACZA is an aqueous product based on active ingredients in the ratio of 5:3:2: for cupric oxide, zinc oxide and arsenic acid, respectively. The ACZA product comes pre-mixed with active concentrations accounting for 10% of the formulation and ammonia as a transfer agent. ACZA can be used in pressure treatment where evaporation of the ammonia fixes the metals compounds to the surface of the wood and additionally ammonia also provides corrosion protection of working metal

parts in the tank itself during transfer of ACZA. In Canada ACZA superseded ammoniacal copper arsenate (ACA) with full registration in 1999.

104. In the USA, ACZA is more typically used in the Western States due in part to its particular ability to treat Douglas Fir, the prevalent wood type in that area (USEPA, 2008b). ACZA is less widely used in the Eastern and Southern states. Production facilities are centred in the Western States.

105. ACZA, like CCA, has a high fixation rate. It can also provide better performance than CCA in protection against some species of pest (USEPA 2008b). ACZA is also approved for use in coastal/marine applications with only a limited number of other approved preservatives (notably creosote). However while CCA provides a clean, dry, odour-free finish to treated wood, ACZA treated wood tends to retain an ammonia odour which may be less suited to public locations such as pavements or pedestrian areas.

106. The environmental profile and concerns are broadly similar to those for CCA with the presence of both arsenic and copper oxide. ACZA has the potential to leach from wood, including treated utility poles (Lebow 1996 and US EPA 2008a), it also has the potential to be toxic and an irritant on direct exposure for workers (Environment Canada, 2013). Within the USA it is listed as a 'restricted use pesticide' reserved for industrial purposes (USEPA, 2008b). Health Canada's Pest Management Regulatory Agency (PMRA), who carried out the risk assessment for heavy duty wood preservatives, notes that the assessment for ACZA is expected to have overestimated risk, and that wood treatment facilities following the TRD (labelling, storage, risk management plans) would greatly reduce the risk of exposure and environmental loss and that the use of ACZA is used only within closed systems

Other Alternative preservatives for wood treatment

107. Alongside the chemical alternatives described above, additional chemical alternatives exist; within North America (ACQ), copper azoles and sodium borates (SBX) also form part of the mixture of wood treatment products available. These alternatives are also used within New Zealand. Additionally (Subsport 2012) also identify silicone polymers as a viable alternative. In the European Union under the EU biocidal products regulation (EU 528/2012) there are 32 named active substances approved at EU for use in wood preservative biocidal products, including a number of those already detailed (EU biocides 2012), however the vast majority of these 32 biocide active substances are not used for industrial wood preservation. The Table shown in the appendix to the present risk management evaluation on pentachlorophenol and its salts and esters provides details of these substances together with applicable legislation on use restrictions for Europe. Further detailed explanation of ACQ, copper azoles and SBX as potential alternatives to PCP is given below.

Table 2 AWPA Approved uses for preservatives in wood treatment (UNECE, 2010)

	Creosote and oil borne preservatives					**Waterborne Preservatives**					
Product/application	**Creosote**	**Creosote-petroleum**	**Creosote Solution**	**PentaChloroPhenol**	**Copper Naphthenate**[d]	**Chromated Copper Arsenate**[e]	**Ammonium Copper Quaternary (ACQ) – type C and type D**	**Ammonium Copper Quaternary ACQ – type B**	**Copper Azole type B**	**Copper Azole type A**	**Ammonical Copper Zinc Arsenate (ACZA)**
Lumber, timbers and plywood											
C2-lumber, timber, bridge ties and mines ties	+	+[a]	+	+[a]	+[a]	+	+[a]	NA	+[a]	+[a]	+
C9-Plywood	+	+	+	+	NA	+	+	NA	+	+	+
C22-Permanent Wood Foundations	NR	NR	NR	NR	NA	+	+	+	+	+	+
C28-Glued laminate members	+	NA	NA	+	+	+	+	NA	NA	NA	+
Piles											
C3-Piles	+	+	+	+	+[b]	+	+	NR	NR	NR	+
C18-Marine construction	+	NR	+	NR	NA	+	NR	NR	NR	NR	+

C21-Marine lumbers and timbers	+	NA	NA	+	+	+	+	NA	+	+	+
C24-Sawn timber used to support residential & commercial structures	+	NA	NA	+	NA	+	+	NA	NA	NA	+
Poles											
C4-Poles	+	NR	+	+	NA	+	NR	+	NR	NR	+
C23-Round poles and posts used in building construction	+	NR	+	+	NA	+	NR	NR	NR	NR	+
Posts											
C5-Fence posts	+	+	+	+	+	+	+	+	+	+	+
C14 – Wood for highway	+	+	+	+	+	+	+	+[f]	+[c]	+[c]	+
C15 – Wood for commercial residential construction	+	+	+	+	+	+	+	NA	+	+	+
C16 – Wood used on farms	+	+	+	+	NA	+	+	NA	+	+	+
Cross-ties and Switch ties											
C6-Cross-ties and Switch ties	+	+	+	+	NR	NR	NR	NR	NR	NR	NR

It should be noted that although these uses may be "approved" by AWPA, the actual regulatory approvals must come from PMRA in Canada and USEPA in the USA.

NA: Not available, NR: Not recommended

a) **Not for saltwater use**

b) **Land and freshwater use; not for foundations**

c) **Posts sawn four sides only**

d) **Copper Naphthenate is also approved by AWPA as a waterborne preservative for some uses.**

e) **Chromated Copper Arsenate is available for industrial applications only**

f) **Round, half-round, and quarter-round only**

108. ACQ is a waterborne wood preservative used in a similar fashion to CCA (Environment Canada, 2013). Since the removal of CCA from the domestic wood market in Canada and the USA in 2003, the use of ACQ has grown significantly. In 2007 ACQ (and micronized ACQ) held 45% of all preservative wood treatments in the USA with CCA second placed (Vlosky 2009). However, ACQ is not currently used in the USA for utility poles and cross-arms. In Canada, while ACQ is widely used (mainly in the domestic wood market), it is not used within infrastructure applications including utility poles (Environment Canada, 2013). ACQ's widespread use has been focused within the domestic wood market and soft woods, due in part to the low occupational risk for workers and minimal risk of environmental loss (Environment Canada, 2013). ACQ is recognized as being useful for treating Douglas Fir which is typically hard to treat, but is also more corrosive to metals than CCA and ACZA. The use of ACQ would require the use of stainless steel fittings in treatment facilities which can be expensive (USEPA, 2008b). More recently, the advent of micronized ACQ provides a product with lower corrosivity and greater penetration, using finely ground copper oxide within the product to improve application (Vlosky, 2009).

109. ACQ comes as four different products labeled types A-D that contain both copper and a quaternary ammonium compounds ("quat") as actives. Of these, ACQ-A and ACQ-B contain the "quat" 'DDAC', ACQ-C contains 'ADBAC' and ACQ-D contains both 'DDAC' and 'DDACB'. All four products types are based around the ratios of copper oxide to "quat" and may contain either ammonia or ethanol amine as the carrier solution (Environment Canada, 2013). DDAC is persistent in both water and soil, while ADBAC has lower persistence issues, with a half-life of ADBAC in soil of 13 days. DDACB the active in ACQ-D is persistent and harmful to soil organisms and has guideline maximum concentrations for water at 0.0015 mg/L (Environment Canada, 2013). ACQ-A, ACQ-C and ACQ-D are all used within Canada (Environment Canada, 2013). The ammonical component evaporates quickly within air leaving copper oxide which is highly toxic to fish should it reach the natural environment (Dubey 2010). Copper is released from ACQ-treated wood in landfill leachates raising concerns over further contamination (Dubey 2010).

110. Copper azole is a waterborne product made up of copper-amine complex and co-biocides (USEPA, 2008b). Two formulations exist based on the ratio of copper to other compounds. The product is supplied as a concentrate and then diluted at point of use (Environment Canada, 2013). In the USA it is approved for above ground, ground and freshwater use but is not appropriate for use in tropical conditions or coastal/marine applications (UNECE, 2010) and is not currently used in the USA for utility poles and cross-arms. In Canada it is approved for the domestic wood market only and is not used on infrastructure applications including utility poles (Environment Canada, 2013). Like ACQ, copper azole is corrosive to metal fastenings and so stainless steel would be required, which can be expensive for treatment facility upgrades (USEPA, 2008b). However a micronized copper azole product does exist with lower levels of corrosivity and potential for deeper penetration of wood (Vlosky 2009). This particularly product is still relatively new to market with an unknown long term track record for use in infrastructure applications (USEPA, 2008b). Copper azole is not known to be carcinogenic (Environment Canada, 2013).

111. Tebuconazole (the non-metal biocide ingredient in copper azole) has a half-life of 100 days in soil and is also moderately toxic to aquatic life (Environment Canada, 2013). However tebuconazole degrades more quickly in aquatic conditions than in soil and is largely eliminated by fish reducing the potential for bioaccumulation. The product produces irritation on direct contact with skin and long term occupational exposure can lead to lung, liver and kidney damage Azoles such as Tebuconazole are effective against decay fungi, but not against termites or mold. Thus, they must be used with other chemicals, notably copper. (Townsend, 2013). Under the EU regulation for placing biocidal products on the market (EC 528/2012); Tebuconazole has been identified as a candidate who meets Persistent, Bioaccumulative and Toxic (PBT) criteria.

112. The use of copper-based preservative systems as a replacement for pentachlorophenol for treatment of critical structural components like utility poles and cross arms may not be suitable because of the presence of copper-tolerant fungi widely distributed in the environment. A variety of fungi are capable of detoxifying copper-containing compounds either by immobilization or uptake (Morrell, 1991).

113. Sodium borates are a waterborne preservative with varying amounts of borate (USEPA, 2008b). The product comes as a powder which is then mixed to the desired strength prior to use (Environment Canada, 2013). In Sri Lanka (Sri Lanka, 2014) sodium borates are used to treat rubber wood as a diffusion treatment, but their use as a replacement for PCP is limited. Sodium borates and leave wood with a clean, dry, odour-free finish. Borates compounds are toxic for reproduction in accordance with the UN GHS criteria. However they also readily leach from wet wood affecting performance (USEPA, 2008b). Sodium borates are reserved specifically for use within indoor applications or above ground where wood is continuously protected from water (UNECE, 2010) and therefore sodium borates are not an alternative for current PCP uses.

114. Copper boron azole has been proposed as an alternative to CCA but not specifically for use on utility poles and cross-arms (ICC-ES 2013). Monoethanolamine is usually used to complex with the copper, which increases costs (Townsend 2006). Copper is released from CBA-treated wood in landfill leachates raising concerns over further contamination (Dubey 2010). Copper is highly toxic to aquatic organisms (USEPA 2008d).

115. Silicone polymers also provide a possible option to treating timber products. Instead of killing fungi, this approach creates a physical barrier to fungal attack. Inorganic silicone polymers and organic acid are used in a water-based wood treatment and dried under elevated temperature (Subsport 2012). The mixture encapsulates the wood fibres, creating a physical barrier on the wood surface and making it inaccessible for rot fungus. The product is sold under the trade name OrganoWood along with a surface coating for industrial uses called OW-surface coating, by Organoclick based in Sweden (Organoclick 2014). However, PCPTF-KMG 2014 and Canada 2014b note that silicone polymers appear to be untested for widescale industrial use, particularly for utility poles and that further more silicone polymers are not registered within Canada for industrial wood use. The recommendations made by Organoclick, 2014 suggest use for above soil application. PCPTF-KMG 2014 raise a concern about the use of silicone with ground contact application as a potential issue and that given the importance of ground contact for utility poles this should be considered. While silicone polymers pose an interesting option for wood treatment their largely untested nature on the wider industrial scale means that in the short term they are not a viable replacement option for PCP without further testing.

2.3.3 Non-chemical alternatives for wood

116. Alongside the chemical alternatives to the use of PCP as a preservative for wood treatment there are also non-chemical options that are currently in use. Wood has applications within domestic and industrial construction for a broad range of uses. PCP-treated wood has particular application to infrastructure usage such as utility poles for electricity supply networks and cross-ties for rail networks. It is possible for these specific applications to adopt alternative materials such as concrete, steel, fibreglass reinforced composite (FRC) or even hardwood alternatives which are more resistant to attack from fungi and pests in some situations. This section will explore the technical feasibility, efficacy and costs of the non-chemical alternatives.

117. The application of concrete, steel and FRC provide both generic and specific technical improvements and weaknesses compared to treated wood. Table 3 provides a brief overview of the generic strengths and weaknesses summarized within the USA EPA review (USEPA, 2008b) with individual commentary following after Table 3.

Table 3 Generic improvements and weaknesses of non-wood alternative materials.

	Concrete	Steel	FRC
Generic technical improvements compared to treated wood			
Standardised size and specification	X	X	X
Less maintenance required	X	X	-
Impervious to attack from fungi and pests	X	X	X
Generic technical weaknesses compared to treated wood			
More expensive than wood poles (based on up-front costs).	X	X	X
Non-wood poles cannot be climbed using existing equipment such as'Gaffs', but are designed to provide their own systems such as 'fixed steps'	X	X	X
Increased risk of animal electrocution requiring additional insulation	X	X	-
Heavier than wood poles	X	-	-

Concrete

118. Concrete utility poles and cross-ties provide a standardized product with high tensile strength (estimated to be around 8000 psi) and durability (USEPA, 2008b). This includes greater resistance to damage from lightning strikes, fires, vibration, fungal and insect pests and wind (Bolin, 2011). Concrete poles are less likely than treated wood products to warp or twist compared to treated wood (USEPA, 2008b). New Zealand (New Zealand 2014) state that for railway cross-ties the National Rail Company in New Zealand successfully switched to concrete in 1991 which is now the preferred choice of material. The enhanced durability in ideal locations, less frequent maintenance and potential longer service life than chemically-treated wood demonstrated a high level of efficacy in meeting the structural needs of utility poles (USEPA, 2008b). A manufacturer's claim states that the service life of concrete poles can potentially reach 75 years (Stresscrete 2014), while Canada (Canada 2014b) states the average treated wood life span has been estimated at 70 years or higher (Mankowski 2002), Other estimates provided for the potential longevity of concrete poles are between 50 and 80 years, while estimates of wood pole longevity are 20 – 70 years. Detailed information has not been provided on how geographic climatic considerations affect the relative longevity of concrete and wood poles. The strong durability of concrete poles and standardised formulation can be a key factor in maintaining a long service life and preventing failure of poles at a premature point. The most significant issue for concrete compared to treated wood is weight, where concrete poles are quoted to be three times the weight of wood (Bolin 2011). The overall weight of concrete utility poles adds to freight and installation costs (USEPA, 2008b), with widescale adoption of concrete poles likely to have implications for industry who would need to 're-tool'. Concrete poles have the advantage of not requiring chemical treatment with persistent and toxic chemicals that are released into the environment, thus conferring benefits to worker and environmental health. Forest ecosystem protection and conservation of trees are additional benefits of the use of concrete rather than wood poles if trees are not from commercially managed forests, but on the other hand cement and concrete come from finite resources that must be excavated and there can be other environmental impacts in production of cement, such as the use of fly ash or other harmful substances, as well as emissions of air and water pollutants) (ACAT/IPEN, 2014b); while wood poles from commercially managed forests represent a renewable resource. Although initial purchase costs for the concrete poles are higher as indicated in some studies (USEPA 2008b), these cost differentials may be offset to some extent by added disposal costs, and there could be longer-term cost savings over the life of the poles. Life cycle

analysis studies by the wood preservative industry (Bolin, 2011 and Aqua-e-Ter, 2012) conclude that in comparison to wood based products, manufacture of concrete posts have a greater demand for natural resources such as water, and importantly are linked to much higher carbon dioxide and air quality pollutant emissions (the study assumed that treated wood and concrete poles have similar service lifespan). Concrete poles are also hygroscopic meaning that they are more susceptible to freeze/thaw damage in harsh climates. The USA EPA report also quotes data from EPRI (EPRI, 1997) which suggests that concrete posts cannot be used in coastal/marine applications as sea-salt attacks the concrete. However, a major manufacturer of concrete poles, StressCrete indicates effective use of concrete in both fresh water and saltwater environments when specially formulated for this particular environment. Because of their corrosion resistance, durability, and lack of chemical treatment, they are used in proximity to sensitive water bodies and can be used in freshwater and saltwater environments. One additional drawback for concrete structures relates to end of life: while treated wood poles can be re-installed at different locations during a working life, concrete posts can only be installed once, although the material can be recycled because it does not have to be consigned to a hazardous waste landfill.

Steel

119. Steel utility poles are manufactured as hollow structures, which allow them to be lighter than treated wood poles (by 30-50%) with similar or greater load bearing strength (USEPA, 2008b, ACAT/IPEN, 2014, and UNECE,2010). This reduced weight improves freight and installation costs. The USA EPA and UNECE reviews (USEPA, 2008b and UNECE, 2010) note that steel poles can be open to surface corrosion which can be difficult to assess by maintenance crews. They are also susceptible to below ground corrosion. However both of these issues can be overcome by using galvanized steel structures (ACAT/IPEN, 2014). Zamanzadeh (2006) states that the use of galvanized steels for below-ground structures alone may not be sufficient. Care is required when assessing the placement of poles as galvanized steel below ground can be subject to attack (particularly in acid soils) leading to corrosion which can significantly reduce service life. Assessment should be made during installation and where necessary additional measures, such as corrosion resistant backfill used. The main drawback for steel structures is that they need to be handled with care during transport and installation as they can be easily damaged (USEPA, 2008b and PCPTF-KMG, 2014). The USA EPA also notes that in overloaded weight burdens steel poles will buckle rather than split or break, which means that the transmission of electricity will be halted while repairs are carried out (USEPA, 2008b). As with any metal structure there is also an increased risk of electrocution not only to animals such as raptors but also work crews (WPC 2014), although the poles can be insulated to prevent this problem. Unlike concrete structures, steel poles can be recycled or used again as needed similar to current treated wood alternatives (Bolin, 2011). The use of steel as an alternative material for utility poles has been investigated by some of the utilities in the USA (such as Nevada, Arizona, and Austin Texas) (ACAT/IPEN, 2014) with integration in the power generation network done on a strategic targeted basis driven in part by geographic and climatic conditions. Life cycle analysis by the wood preservative industry (Bolin, 2011) concluded that in comparison to wood-based products, the manufacture of steel poles requires greater consumption of natural resources such as water, and most importantly is linked to higher emissions of carbon dioxide and air pollutants. Studies by SCS Global (2013) and Bolin (2011) suggest the service life of steel poles is between 60 – 80 years, while estimates of wood pole longevity are 20 – 70 years. Detailed information has not been provided on how geographic climatic considerations affect the relative longevity of steel and wood poles. The SCS Global study devised a matrix of 21 environmental parameters which demonstrated the longer service life of steel poles combined with reduced maintenance needs meant that steel poles had an overall better environmental profile than treated wood poles.

Fibreglass Reinforced Composite (FRC)

120. FRC-based alternatives are relatively new to market and so have a limited history of use (WPC, 2014). However, like steel and concrete, FRC provides a standardized material with known specifications (USEPA, 2008b). FRC poles, like steel, are lighter than treated wood meaning a reduction in freight and installation costs. However FRC-based products can distort when screwing down hardware (WPC, 2014) and therefore the mounting hardware may loosen over time making FRC generally not appropriate for load-bearing components such as poles and cross-arms. FRC poles are engineered for a specific configuration of cross-trees and other attachments. Post installation modification of this is not possible in most situations. FRC poles may also be more susceptible to UV radiation, which in hot dry climates can lead to delamination of FRC layers and weakening of the overall structure (USEPA, 2008b). FRC-based poles are also only available in lengths under 55 feet which may prohibit some applications depending on terrain (WPC, 2014). Wood Preservative Industry reports (Aqua-e-Ter, 2012) also provide lifecycle analysis which suggest the energy demand requirements to produce FRC poles are greater than treated wood alternatives and that FRC poles will

have a greater carbon footprint than treated wood, however this is likely to be offset by lower toxicity, and lower disposal costs (ACAT/IPEN 2014).

Untreated wood alternatives

121. Alongside the non-wood alternatives to PCP-treated wood it is also possible to make use of alternative wood types with greater resistance to attack by fungi and pests. Hardwood varieties can have a viable service life of up to 25 years in US without the need for chemical treatment (USEPA, 2008b). The main issue for greater use of hardwood varieties will be the availability of viable stock which will vary globally. Decay-resistant woods such as cedar, and hardwoods may be used without chemical treatment (UNECE 2010). These woods have greater mechanical strength than chemically-treated softwoods, although initial purchase cost is more expensive than chemically treated woods. Switching to hardwood varieties that have greater resistance to attack by pests would likely have adverse effects, both economically with additional cost of wood but also on forestry and local ecosystems with the need to meet demand for wood (USEPA, 2008b). The use of hardwood varieties will have varying efficacy based on climatic conditions, application and availability of suitable stock. This is offset by the enhanced benefits of reduced chemical use and emission to environment compared to PCP.

Heat treatment of wood

122. This approach uses thermal treatment of wood near or above 200°C in low oxygen conditions to make it resistant to decay while maintaining dimensional stability. Principal uses are restricted to above ground non-structural uses such as siding, decking, flooring, garden furniture, playground furniture, window and door frames, and indoor furniture. Therefore, heat treated wood is not a viable alternative to current uses of PCP (i.e. in ground, ground contact, water contact and structural). The treatment process varies according to the wood species and no chemicals are required. Six major processes are available including Thermo Wood (Finland), Plato Wood (Netherlands), Retification (France), Bois perdure (France) Westwood (USA, Canada, and Russia), and Oil heat treatment (Germany) (ECRD, 2001). A comparison of production costs among the various methods indicates a range from 65 – 160 €/m3 (Wang Undated).

123. Burying utility lines is considered an option where aesthetic or weather conditions preclude above-ground power distribution systems (IPEN/ACAT). However, it isn't clear if chemical treatments of the lines are required to prevent decay and pest problems. It is also not clear whether there are additional costs and maintenance issues with burying the lines.

2.3.4 Summary of alternatives

124. The preceding chapters have provided a summary description of the key chemical and non-chemical alternatives. Within North America, chemical alternatives such as CCA and creosote are already in mass production, while new alternatives such as copper naphthenate and ACZA are growing in popularity. The preceding chapter also highlights that the chemical alternatives on the market have their own strengths and weaknesses and may not be directly interchangeable with PCP for specific applications. This is also true for non-chemical alternatives. Furthermore due to their different structural properties, non-chemical alternatives will often not be feasible as replacing individual component poles within established wood pole transmission lines. Table 4 provides a cost comparison provided within the USA EPA assessment of alternatives for PCP (US-EPA, 2008b).

125. As a separate matter the ICC (ICC, 2014a) states the use of Na-PCP and that alternatives to Na-PCP will take a minimum of 8-10 years to develop, produce and manufacture at competitive price rates to the existing Na-PCP product. Within New Zealand Na-PCP was used primarily as an anti-sap stain rather than preservative and was phased out in the 1980s, with a number of viable alternatives market ready (New Zealand 2014). The data in Table 4 suggest that, based on costs, the use of PCP, CCA, Creosote and Copper Naphthenate are broadly similarly with ACZA approximately $20 per pole more expensive. The costs for ACQ are significantly higher than the other products due to the issue of corrosivity and need for stainless steel fittings. This issue may be countered with the use of micronized ACQ. No costs are provided for copper azoles although they are expected to be more expensive than PCP.

126. Table 5 displays the costs quoted for non-chemical alternatives per pole and take into account full production and installation costs as well as maintenance. While non-chemical alternatives require lower maintenance than treated wood, the initial installation costs are such that these savings do not off-set additional up-front costs (USEPA, 2008b). When the anticipated longer service life is included, the costs are competitive. This position is based on a case study of a large power distribution utility that found that the 480 installed steel poles out of over 200,000 non-steel utility poles it maintains save

the utility 10-20% in lifecycle costs compared with a comparable 480 chemically-treated wood poles(Steel market development institute 2011).

Table 4 Summary of costs quoted in the US-EPA (2008) for chemical alternatives

Chemical Alternatives – cost based on 'per utility pole' treated basis							
PCP	CCA*	Creosote	Copper Naphthenate	ACZA	ACQ**	Copper Azoles	Sodium Borates***
$199	$197	$198	$200	$220	$240 - $287	-	-

* Cost includes $20 for softening agents

** Cost includes the requirement for stainless steel fittings at $37 - $75 per pole.

*** Note that Sodium Borates would not be suitable as a PCP alternative because they are a non-fixed preservative.

Table 5 Summary of costs quoted in the US-EPA (2008) for non-chemical alternatives

Non-Chemical Alternatives – cost based on 'per utility pole' basis for production, installation and maintenance costs			
Treated Wood	Spun Concrete	Steel*	Fiberglass Reinforced Composite
$800	$1750	$1370	$1650

* The Alaska Community Action on Toxics note a separate study by SCS Global (2013) which suggests steel poles are of comparative price to treated wood when assessed for full life span and reduced maintenance costs.

2.4 Summary of information on impacts on society of implementing possible control measures

2.4.1 Health, including public, environmental and occupational health

127. The risk profile documents human health and environmental concerns associated with PCP and PCA which are reported to be that PCP and PCA are highly toxic to aquatic species and moderately toxic to terrestrial species. Also a number of sub-lethal effects have been witnessed with the potential to cause harm to aquatic and terrestrial species. Effects within birds show the greatest degree of variability from non-toxic to highly toxic. In mallard and pheasant, sub-lethal effects include reduced numbers of hatchlings, while within the aquatic compartment sub-lethal effects include damage to reproduction, survival and growth. For humans PCP has been detected in the blood, urine, seminal fluid, breast milk and adipose tissue of humans which demonstrates exposure, and therefore potential hazard to foetuses, infants and adults. Additionally, compared to other chlorinated compounds, PCP is one of the most dominant contaminants measured in blood plasma and a number of epidemiological and industrial health studies, primarily based on inhalation and dermal exposure, have made associations with a variety of cancers. (Further information can be identified in UNEP/POPS/POPRC.9/13/Add.3,ACAT/IPEN, 2014, and USEPA 2008a). The persistent nature of PCP and PCA means that the effects of releases could be long lasting, though as indicated in the risk profile where long -term monitoring data exists, concentrations of PCP and PCA are decreasing in air and biota

128. A study by the Centre of Public Health Research in Wellington, New Zealand, (CPHR, 2007) concluded that several decades after use and exposure of PCP ceased, some adverse health effects (both physical and neuropsychological) are still present in some former timber workers exposed to PCP and also elevated blood serum levels of dioxins still persist.

129. Based on the evidence reviewed, the ACAT/IPEN (2014) response claims that listing PCP under the Stockholm Convention would have positive human health and environmental impacts. Sweden's (2014) response also highlights that controlling the use of PCP contributes to reducing emissions of dioxins and furans (see for more information Sweden EPA, 2009).

130. The Canadian Re-evaluation Decision on PCP (PMRA, 2011) identified potential health risks in some occupational tasks within wood-treatment facilities. However, it noted that it was likely that risks had been overestimated due to the fact that the assessment was based on exposure estimates which pre-dated industry's widespread adoption of risk reduction measures. As such it concluded that currently registered uses of PCP are acceptable provided new risk-reduction measures and adequate controls are implemented in such facilities. . The USEPA Re-evaluation Decision on PCP similarly concludes that PCP containing products are eligible for re-registration, provided that risk mitigation measures are adopted. In addition, USA and Canada's response to Annex F notes that alternatives are not without health and environmental risks (see section 2.3). Therefore, substitution of one or more of

these alternatives for PCP may or may not result in significant reduction of overall risks of concern (USA 2014b).

131. Adoption of alternatives particularly non-chemical alternatives will reduce exposure to PCP associated with the manufacture, use, and disposal of PCP. The implementation of effective alternatives will reduce potential risks to humans and the environment.

132. A newly published study by the U.S. National Toxicology Program (September 2014) in the Report on Carcinogens determined that PCP and by-products of its synthesis are "reasonably anticipated to be a human carcinogen.(US Dept. HHSS 2014) USEPA indicate at POPRC 10 that this new classification wont modify the decision taken in 2008. EPA takes into consideration new information as part of the registration review process.

133. Canada also notes that while further limiting the currently registered uses of PCP and moving to alternatives may decrease PCP and PCA releases to the environment, it is unclear if this will result in a net environmental and health risk reduction. Canada reports that current contributions of PCA/PCP from registered uses have not been well characterised relative to other historical global uses or sources of release of PCA (e.g. metabolism of HCB), and therefore it is not possible to predict whether existing or additional control measures on Canadian uses will result in meaningful health or environmental impacts. In particular, Canada points out that air monitoring data of PCA at the Canadian High Arctic station of Alert (Nunavut) from 1993-2011 show a steep decline in PCA concentrations since 2003 in spite of continued, and slightly increasing, levels of PCP use in Canada (see section 2 and Canada, 2014). However, the observed decline of PCA in the Arctic is likely to be reflective of a global decline in use of PCP and not necessarily correlated with use in Canada.

2.4.2 Agriculture, aquaculture and forestry

134. Although uses in agriculture (e.g. herbicide, defoliant or bactericide) have largely been eliminated due to the availability and viability of alternatives, banning PCP under the Convention would ensure greater transparency and compliance to ensure elimination of any remaining uses. This would entail health and environmental benefits for agricultural lands, aquaculture waters and food products by preventing further contamination with PCP and associated dioxins and furans (ACAT/IPEN 2014). However, the USA counters that the significance of any benefits to human health and the environment would need to be carefully assessed and compared to the increased use of alternatives (USA 2014b).

135. Furthermore, the ACAT/IPEN (2014) response states that replacing the use of wood-treated poles with non-chemical alternative materials will contribute to conserving forests and forest ecosystems. However, other Parties and observers (Canada, 2014 and ICC, 2014) claim that PCPextends the service life of treated wood, which also contributes to forest conservation. In addition, PCPTF-KMG (2014) notes that forests are planted specifically for the production of wood of high value suitable for utility poles and that these forests also contribute to carbon sequestration.

2.4.3 Biota

136. The Risk Profile (UNEP/POPS/POPRC.9/13/Add.3) documents that PCP and PCA are very highly toxic to aquatic organisms, even though reported environmental monitoring concentrations are generally lower than those levels expected to cause an environmental effect particularly in remote areas, Howeverthe risk profile concludes that given the widespread distribution of PCP/PCA, that measurable levels of PCP/PCA are frequently found in biota and that PCP and PCA have an endocrine mode of action, environmental effects cannot be excluded. The risk profile also indicates that PCP has been shown to adversely affect the immune system in several animal species. Neurotoxic effects have also been reported in in vitro systems, as in vivo changes in brain tissue, and from neurofunctional tests in animals. The ACAT/IPEN (2014) response expects positive impacts on biota and biodiversity if the use of PCP is banned.

137. However it is also noted by the above observers that the various chemical alternatives containing copper also present hazards to aquatic species. Some of the other chemical alternatives discussed above may release harmful substances that have adverse effects on invertebrates, fish and wildlife (e.g. creosote releases bioaccumulative PAHs and CCA releases carcinogenic substances such as arsenic, as well as copper, which is toxic to aquatic organisms).

138. Regarding non-chemical alternatives, increased risks of animal electrocution requires adequate insulation for metallic and other conducting materials (USEPA, 2008b). These risks can be effectively mitigated.

2.4.4 Economic aspects

139. Several countries where PCP and its salts and esters are currently used expect negative economic impacts if PCP is listed under the Convention. In particular, Canada indicates that prohibition will negatively affect the heavy-duty wood treatment industry that uses PCP (currently 9 plants in different locations use the substance) and emphasises the widespread use of PCP in wood utility poles in Canada. At a replacement cost of around $2,000 per pole, they suggest that there is a large economic benefit to extending the service life of utility poles. Canada reports that the annual turnover of PCP ("penta") treated poles sold in Canada is 38-45 million CAD whereas the value of "penta" poles treated in Canada and exported to the USA annually is 72-80 million CAD. Also Canada highlights the importance of PCP as an alternative to creosote for railway ties due to uncertainty with the future availability of creosote, which is tied with steel production. Finally, it notes that while the amount of PCP used to treat wood for the other registered uses is not as large, certain uses such as wood for bridges and other construction uses can be valuable in terms of extending the service life of important wooden infrastructures (Canada, 2014).

140. For the ICC, Na-PCP is necessary for preserving wood and hence to forest conservation in India. They note that it will take a minimum of 8-10 years to develop, produce and popularise cost effective substitutes to Na-PCP in India. In this regard, ICC highlights the socio-economic importance of the wood industry in a country where the demand for timber is estimated to increase from 58 million m3 in 2005 to 153 million m3 in 2020 (ICC, 2014).

141. The views expressed by ACAT/IPEN (2014) indicate potential economic benefits for some producers and users of alternatives. Although alternative materials can have higher costs upfront (e.g. steel or concrete), their potentially longer life expectancy and their reduced ratio of poles needed per km can make them cost-competitive in some situations (see section 2.3.3 for more details). ACAT/IPEN (2014) also consider that the economic effects of banning production are not expected to be significant due to the fact that PCP is only produced by a single company headquartered in the USA, with a manufacturing facility in Mexico and a formulating facility in the USA (KMG 2014). (ACAT/IPEN, 2014). However, the USA (2014c) counters that with an estimated 130–135 million preservative-treated wood utility poles in service in the USA (USEPA 2008b) it is likely that significant impacts would be identified for chemical users because of the large number of utility companies using wood poles, and the cost associated with their replacement and disposal.

2.4.5 Movement towards sustainable development

142. According to ACAT/IPEN, elimination of PCP is consistent with the Strategic Approach to International Chemicals Management (SAICM), adopted in 2006, that emerged from the Johannesburg World Summit on Sustainable Development (2002). SAICM makes the essential link between chemical safety, sustainable development, and poverty reduction. The Global Plan of Action of SAICM contains specific measures to support risk reduction that include prioritising safe and effective alternatives for persistent, bioaccumulative, and toxic substances (ACAT/IPEN, 2014).

143. Canada values the contribution of PCP to the sustainable use of renewable forestry resources, due to its wood preservation properties, which can extend the average service-life of a wood pole up to 70 years (Canada, 2014 based on Mankowski et al, 2002) and recently concluded that PCP is acceptable for continued registration.

2.4.6 Social costs (employment etc.)

144. Social impacts may occur as a consequence of positive or negative economic impacts in countries where PCP and its salts and esters are currently used. In view of the replacement of PCP with alternatives in a large number of countries, ACAT/IPEN (2014) expects that there should be few social costs associated with the elimination of PCP.

145. Negative social impacts are expected for those countries producing and using the substance (e.g. Mexico, USA, Canada), assuming that facilities would need to cease production. In particular, the production plant in Mexico employs over 50 people and is reported to have been an important member of the local community for over a quarter of a century (KMG, 2014). However there could be distributional effects, as increased employment might occur with use of the alternatives, but potentially in different locations/countries.

2.5 Other considerations

2.5.1 Access to information and public education

146. In Bulgaria, information on PCP is available on the website of the Ministry of health for biocides (http://www.mh.government.bg) and on website of the Bulgarian Food Safety Agency for plant protection products (http://www.babh.government.bg).

147. In the Netherlands, companies that import products that may contain PCP are informed through the website: http://www.antwoordvoorbedrijven.nl/regel/pentachloorfenol. The Netherlands Food and Consumer Product Safety Authority informs the general public on the regulation concerning PCP in clothes and textiles: https://www.vwa.nl/onderwerpen/consumentenartikelen/dossier/kleding-en-textiel/eisen-produceren-en-verhandelen-kleding-en-textiel/chemische-eisen-textiel-en-leer.

148. US EPA's Office of Pesticide Programs regulates PCP as a wood preservative in the USA. All publicly available documents on PCP's registration are available at: http://www.epa.gov/oppsrrd1/reregistration/pentachlorophenol/.

149. In Canada, several documents on PCP providing information on required control measures and on best management practices when working with wood preservatives are publicly available online at the websites of Canada's Pest Management Regulatory Agency ((http://www.hc-sc.gc.ca/ahc-asc/branch-dirgen/pmra-arla/index-eng.php) and Environment Canada (through the publications catalogue https://www.ec.gc.ca/default.asp?lang=En&n=FD9B0E51-1).

2.5.2 Status of control and monitoring capacity

150. In Canada, the PMRA is responsible, in partnership with other regulators, for promoting compliance with the conditions of use for PCP through the development of strategies/programmes, education activities and enforcement action in situations of non-compliance. PCP wood preservation facilities are required to be in compliance with Environment Canada's TRD (Environment Canada, 2004b) which recommend routine workplace, biological and environmental monitoring. In addition, the Canadian Wood Preservation Certification Authority (CWPCA) operates a third party certification programme to ensure that certified plants fulfill the requirements outlined by the TRD (Canada, 2014).

151. Air monitoring of PCA is undertaken at the Canadian High Arctic station of Alert since 1993 and is ongoing (Hung, 2014, unpublished). In addition, Canada currently collects air samples in the Great Lakes Basin, which has recently begun to be screened for PCA (Canada 2014).

152. Data on PCP releases are available in the US EPA's Toxics Release Inventory (TRI) http://www.epa.gov/tri/tridata/. According to reported data in 2012, a total of 234,240 pounds (106,259 kg) of PCP were released to the environment, but 99% of these were released to hazardous waste landfills regulated by the Resource Conservation Recovery Act (RCRA) (USA, 2014). The UK notes the importance of volatilisation from treated wood in-use (as this may not have been included in the above data): such releases were estimated to be 300, 000 kg in 2012 in the UK alone.

153. Monitoring PCP in water is conducted in the EU according to the European Water Framework Directive (2000/60/EC), which identifies PCP as a Priority Substance. In addition, PCP concentrations in sludge and effluent water are monitored annually since 2004 by the Swedish EPA (Sweden, 2014). PCP is also included within the European Pollutant Release and Transfer Register (E-PRTR) Regulation (EC No. 166/2006), which requires all EU-based installations with environmental permits under the Integrated Pollution Prevention and Control (IPPC) regime to make a assessment of their emissions to air, land and water and to report these annually to Member State competent authorities (PRTR 2006). Typically these assessments are made up of a mixture of monitoring, modelling and calculated estimates.

154. Control and monitoring institutions in Bulgaria include: the Bulgarian Food Safety Agency for authorization and registration or re-registration of Plant Protection Products; the Ministry of Health for authorization of Biocides; the Ministry of Environment and Water for the control of placing on the market and use of Chemicals and Mixtures and the State Customs Agency on the control imports and exports (Bulgaria, 2014).

155. In Serbia, data collection and monitoring regarding air and water pollutants is managed by the Serbian Environmental Protection Agency. Surface water and groundwater monitoring results from 2012 revealed that in all monthly samples collected from the Danube the PCP concentration was below 0.01μg/l (Serbia, 2014).

156. Sri Lanka has a system to control the importation of all pesticides including POP pesticides under the Control of Pesticides Act No. 33 of 1980, which is managed by the Office of the Registrar of Pesticides. Specific custom codes have been identified under the Import and Export Control Act No. 01 of 1969 to control PCP and its salts and esters at the entry point (Sri Lanka 2014).

3. Synthesis of information

3.1 Summary of risk profile information

157. Pentachlorophenol (PCP) is an organochlorine compound primarily used as oil based wood preservative. Since its introduction in the 1930s it has also been used as a biocide, pesticide, insecticide, disinfectant, defoliant, anti-sapstain agent, anti-microbial agent and is used in the production of the ester pentachlorophenyl laurate (PCP-L). The salt sodium pentachlorophenate (Na-PCP) has been used for similar purposes as PCP and readily dissociates to PCP. PCA is not used as a commercial chemical or pesticide and is not intentionally released directly into the environment. It can be produced through the transformation of PCP and other chemicals, such as hexachlorobenzene (HCB) Quintozine (PCNB) and lindane, in the environment. The relationship between PCP and PCA including degradation pathways are complex, and PCP is not the only source of PCA. For the purposes of the proposal to add these substances to the Stockholm Convention, PCP and PCA should be considered together as PCP and its salts and esters.

158. PCP and PCA are hepatotoxic, carcinogenic, immunotoxic, neurotoxic and toxic to the reproduction. It should be noted that some of these hazards can be induced by an endocrine mode of action and there is a lack of scientific consensus related to the existence of a threshold for this mode of action. Due to the concentration of PCP/PCA observed in humans, adverse effects for human health related to the toxicities listed above cannot be excluded.

159. PCP and PCA are very highly toxic to aquatic organisms. Reported environmental monitoring concentrations are generally lower than those levels expected to cause an environmental effect particularly in remote areas. However, given the widespread distribution of PCP/PCA, that measurable levels of PCP/PCA are frequently found in biota, and that PCP and PCA have an endocrine mode of action, environmental effects cannot be excluded.

160. PCA is partially soluble in water and is likely to be immobile to slightly mobile in soils and partition to sediment in aquatic systems. It is expected to volatilise from moist soil and aquatic systems based on its Henry's law constant but, under laboratory conditions, volatility was observed from water, but not from soil. PCA meets the Annex D criteria for bioaccumulation. PCA is likely to undergo long-range transport to remote locations as evidenced by the predicted and observed volatility in laboratory studies, as well as detection in air and snow in remote locations.

161. PCP and PCA are detected in air, water, soil and biota throughout the world, including in remote regions, which suggests mobility and potential for long-range transport. PCA is more dominant than PCP in air whereas PCP is found in higher concentrations than PCA in soil, sediment and sludge. In biota, PCA and PCP concentrations are comparable. Where long-term monitoring data exists, concentrations of PCP and PCA are decreasing in air and biota.

162. PCP manufacturing, use, and disposal are sources of dioxins and furans.

163. PCP and PCA are likely, as a result of their long-range environmental transport, to lead to significant adverse human health and/or environmental effects, such that global action is warranted.

3.2 Summary of risk management evaluation information

164. PCP is produced by one manufacturer at a production facility in Mexico (6,600 t/per annum), which is then formulated into a manufacturing concentrate at a formulation facility in the USA (7,000 t/per annum). In addition, 1,500 t/per annum of Na-PCP is produced and consumed in India (for use in wood treatments only). The main share of the PCP market is in North America.

165. PCP has had multiple uses in the past which have now been phased out. The primary remaining use is in preservation of wood from damage by fungi and pests, particularly for use in utility poles and cross-arms, with minor uses for railway ties (cross ties or 'sleepers') and outdoor construction materials.

166. The use of PCP for wood treatment has already been banned or heavily restricted by a large number of nations including Indonesia, Ecuador, Morocco, Australia, Sri Lanka and New Zealand, as well as EU Member States. However use of PCP as a heavy duty wood preservative remains significant in the US and Canada. In these countries alternative chemical treatments based around copper arsenates and creosote are widely used in some situations; while non-chemical alternative

materials such as concrete and steel are also manufactured and used within some infrastructure networks both there and elsewhere.

167. A number of chemical alternatives (such as chromated copper arsenate, creosote, copper naphthenate, ammonium copper zinc arsenate and silicone polymers) exist and are broadly comparable in price and application process to PCP. However, alternative products are not directly interchangeable, some of them may have toxicity concerns (e.g., CCA and creosote) and will have specific strengths and weaknesses for any given application.

168. Non-chemical alternatives to PCP treated wood are available, and may have longer life spans in certain circumstances, reduced maintenance costs, pest/fire resistance and standardised specifications (which is less achievable with wood as it is a natural product). Initial costs for manufacture and installation are significantly higher than treated wood, although other costs may be lower (e.g. freight costs). It should also be noted that concrete and steel products can be recycled whereas PCP treated timber must be treated as hazardous waste at disposal.

169. Different life-cycle analyses have drawn different conclusions, with some showing that lifetime costs and environmental profile are better and others showing them as worse than treated wood, with no clear resolution. Evidence has been provided to demonstrate that in parts of the USA some utility companies have begun to use/integrate steel utility poles which are lighter than wood (meaning reduced freight costs) and provide durability and strength. However opposing opinion highlights the increased conductivity of steel structures and requirement for protection against surface corrosion (typically through galvanization) as well as the increased risk of damage to steel structures during transport and installation (USEPA, 2008b and PC PTF-KMG, 2014).

3.3 Possible risk management measures

170. Consistent with Decision POPRC-9/3, PCP and its related compounds warrant global action. Listing of PCP in Annex A would be consistent with the POPs properties of this intentionally produced substance. The suggested options for possible control measures are assessed in section 2.1 in detail and can be summarised as follows:

(a) *PCP may be listed in Annex A*

Listing of PCP in Annex A would send a clear signal that production and use of PCP must be phased out. Such a listing may also have implications for countries joining the Convention for this substance, in light of ongoing uses for which no alternatives have been developed. Specific exemptions for certain critical uses, where there are no approprate alternatives under local conditions, could be difficult to develop or apply, however, given the general time limit of five years, with a possible extension applicable to specific exemptions, among other reasons.

This option could be exercised by all Parties, in which case they would need to register the exemption. This would also imply that any restrictions with regard to time would appear in a new Part of Annex A. The information that has been supplied indicates that for some uses, such deadlines could be difficult to determine at present

(b) *Annex A without specific exemptions*. The fact that the vast majority of countries worldwide have already replaced PCP also for its use as wood treatment gives a good indication that the total prohibition of its use is technically feasible. Prohibition of sales and use of PCP would reduce and eventually eliminate releases of PCP to the environment (over a long period of time, given ongoing releases from articles in use). A prohibition without specific exemptions could be facilitated if a transitional period is given to countries where some uses are still considered critical. It would require replacement of PCP by available chemical alternatives or alternative materials in critical uses such as utility poles. However, it is important to note that, at present, some alternatives present technical feasibility issues (e.g. linked to climate conditions) and there seems to be no consensus on whether there would be a net health/environmental benefit from using different alternatives to PCP in some applications. It could be appropriate to include an exemption under the Convention for production of PCP limited to the specific use exemption. It may also be relevant to provide guidance on criteria for the selection of alternatives to PCP, in order to discourage the replacement of PCP with other environmentally harmful substances;

(c) *Annex A with specific exemptions*. Although this option will not result in immediate elimination of PCP, it could provide a phase-out period and overcome the identified technical feasibility concerns with immediate prohibition by specifying *specific exemptions*, such as use in industrial wood preservation for utility poles and cross-arms, with other uses not being possible. As it is time-limited, further investigation and registration of alternatives, and such restriction could also be linked to requirements for control of releases and emissions. This approach obliges Parties to register their intention to produce/use PCP for such a purpose. A restriction could significantly reduce the costs associated with replacement, allowing it to be undertaken at a slower pace in countries where use is still considered to be critical. However, there would be less immediate reduction in environmental and human exposure to PCP than with inclusion in Annex A without exemption. There is a lack of clarity of net benefit of human health and environment when switching to the identified alternatives;

(d) *PCP may be listed in Annex B with acceptable purposes*

> In addition to conditions described above under Annex A specific exemptions the listing of PCP in Annex B would allow for some acceptable purposes due to the present uncertainty surrounding the availability of alternatives for critical uses over the next five to ten years,

(e) Linked with the above point, restrictions could also be linked *to measures to control emissions*. Requirements for control of discharges and emissions could take various forms, and ideally would be targeted at all of the life-cycle stages where these emissions can occur. The Canadian TRDs provides an example of technically feasible means to control emissions from industrial facilities, whereas the Industrial Treated Wood Users Guidance Document (Environment Canada, 2004a) includes measures to control releases from use and disposal of wood;

(f) Stockpiles and wastes containing PCP would be subject to the provisions in Article 6. Pressure-treated wood at the end of its service-life will still contain some PCP and needs to be disposed of according to obligations under Article 6. As incineration can lead to the unintentional production of dioxins, the provisions of Annex C of the Convention are likely to be of relevance;

(g) In addition, the labelling or branding of PCP-treated wood should help to facilitate proper environmentally sound management of stockpiles and wastes in full compliance with Article 6 of the Convention;

(h) The unintentional formation of impurities such as dioxins and furans during PCP manufacture should already be addressed by the inclusion of these substances in Annex C (unintentional releases). However, PCP is also considered as a by-product similar to polychlorinated biphenyls (PCBs) or pentachlorobenzene, therefore the inclusion of PCP itself in this Annex, as unintentional production could be seen as relevant even if it is not the main source identified in the risk profile. On top of the above, parties could also consider implementing *maximum residue levels* in water, soil, sediment or food. Adherence to such levels could help to limit human and environmental exposure to PCP, and hence provide additional benefits. There may be a need for remediation of land contaminated with historical uses of PCP in this context, as undertaken in several countries (at often substantial cost). Technical assistance for analysis & remediation costs to developing countries or countries with economies in transition could be explored.

171. Overall, the suggested control measure is that PCP and its related compounds should be listed under the Convention. This would be consistent with the POP properties of this intentionally produced substance and would send a clear signal that phasing out production and use of PCP is desirable. The Committee does not recommend listing of PCP, its salts and esters in Annex C.

4. Concluding statement

172. The Committee decided that PCP, its salts and esters including its transformation product PCA are likely, as a result of long-range environmental transport, to lead to significant adverse effects on human health and/or the environment such that global action is warranted.

173. Having prepared a risk management evaluation and considered the management options the Persistent Organic Pollutants Review Committee recommends, in accordance with paragraph 9 of Article 8 of the Convention, that PCP and its salts and esters be considered by the Conference of the Parties to the Stockholm Convention for listing and specifying the related control measures under the Stockholm Convention in Annex A as described below:

i. No specific exemption should be given to salts and esters of pentachlorophenol;

ii. Production of pentacholorophenol shall be restricted only for uses of industrial wood preservation purposes for the treatment of utility poles and cross-arms;

iii. The uses described in paragraph (ii) above are allowed subject to the following conditions that:

    i. Treatment facilities are subject to risk management/best management practices to minimize human and environmental PCP exposures.
    ii. Parties making use of specific exemptions/acceptable purposes shall establish maximum residue levels in water, soil, sediment or biota and implement monitoring programmes.

iv. Articles treated with pentachlorophenol should not be reused for purposes other than those exempted;

v. Parties that produce and/or use pentachlorophenol shall take into account, as appropriate, guidance such as that given in the relevant parts of the general guidance on best available techniques and best environmental practices given in Part V of Annex C of the Convention.

174. Additionally parties should ensure that guidance documentation on best practice to prevent emission of pentachlorophenol during its production and use is publically available. An example of such guidance is Environment Canada's Recommendations for the Design and Operation of Wood Preservation Facilities.

175. With the goal of reducing and ultimately eliminating the production and/or use of these chemicals, the Conference of the Parties shall encourage:

(a) Each Party using these chemicals to take action to phase out uses when suitable alternatives substances or methods are available;

(b) Each Party using and/or producing these chemicals to develop and implement an action plan as part of the implementation plan specified in Article 7 of the Convention;

(c) The Parties, within their capabilities, to promote research on and development of safe alternative chemical and non-chemical products and processes, methods and strategies for Parties using these chemicals, relevant to the conditions of those Parties. Factors to be promoted when considering alternatives or combinations of alternatives shall include the human health risks and environmental implications of such alternatives.

176. The Committee considered that the articles treated with PCP and its salts and esters should not be used for domestic or residential purposes, e.g. residential and public buildings.

177. Measures should be implemented that the articles treated with PCP can be easily identified by labelling or other means throughout its life cycle.

178. The Committee does not recommend listing of PCP, its salts and esters in Annex C.

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Appendix

Named active substances for wood treatment within the EU under EC528/2012

Named active substance	CAS number	EU use restrictions
4,5-Dichloro- 2-octyl-2H-isothiazol-3- one (DCOIT)	64359-81-5	Directive 2011/66/EU of 1 July 2011
Alkyl (C12-16) dimethylbenzyl ammonium chloride - C12-16 ADBAC	68424-85-1	Directive 2013/7/EU of 21 February 2013
Basic copper carbonate	12069-69-1	Directive 2012/2/EU of 9 February 2012
Boric acid	10043-35-3	Directive 2009/94/EC of 31 July 2009
Boric oxide	1303-86-2	Directive 2009/98/EC of 4 August 2009
Bifenthrin	82657-04-3	Directive 2011/10/EU of 8 February 2011
Chlorfenapyr	122453-73-0	Directive 2013/27/EU of 17 May 2013
Clothianidin	210880-92-5	Directive 2008/15/EC of 15 February 2008
Copper (II) oxide/ Copper hydroxide	1317-38-0/ 20427-59-2	Directive 2012/2/EU of 9 February 2012
Creosote	8001-58-9	Directive 2011/71/EU of 26 July 2011 Authorisation will only be granted if deemed that no viable appropriate alternative is available. Those Authorities allowing such products in their territory shall report no later than 31 July 2016 to the Commission justifying their conclusion that there are no appropriate alternatives and indicating how the development of alternatives is promoted.
Cypermethrin	52315-07-8	Regulation (EU) No 945/2013 of 2 October 2013
Dazomet	533-74-4	Directive 2010/50/EU of 10 August 2010 The EU level risk assessment addresses only professional use outdoors for the remedial treatment of wooden poles, such as transmission poles, by insertion of granules. If applicants at Member State level wish to seek authorisation for uses not covered at the EU level the authority must assess these uses with concern to protect risks to human populations and the environment.
Dichlofluanid	1085-98-9	Directive 2007/20/EC of 3 April 2007
DDACarbonate	894406-76-9	Directive 2012/22/EU of 22 August 2012
Didecyldimethylammonium Chloride (DDAC)	7173-51-5	Directive 2013/4/EU of 14 February 2013
Disodium octaborate tetrahydrate	12280-03-4	Directive 2009/96/EC of 31 July 2009
Disodium tetraborate (all species)	12267-73-1/ 1303-96-4/ 1330-43-4/	Directive 2009/91/EC of 31 July 2009
Etofenprox	80844-07-1	Directive 2008/16/EC of 15 February 2008
Fenoxycarb	72490-01-8	Directive 2011/12/EU of 8 February 2011
Fenpropimorph	67564-91-4	Directive 2009/86/EC of 29 July 2009
Flufenoxuron	101463-69-8	Directive 2012/20/EU of 6 July 2012
Hydrogen cyanide	74-90-8	Directive 2012/42/EU of 26 November 2012
IPBC	55406-53-6	Directive 2008/79/EC of 28 July 2008
K-HDO	66603-10-9	Directive 2008/80/EC of 28 July 2008
Propiconazole	60207-90-1	Directive 2008/78/EC of 25 July 2008
Sulfuryl fluoride	2699-79-8	Directive 2006/140/EC of 20 December 2006
Tebuconazole	107534-96-3	Directive 2008/86/EC of 5 September 2008 Under the EU regulation for placing biocidal products on the market (EC 528/2012); Tebuconazole has been identified as a candidate who meets Persistent, Bioaccumulative and Toxic (PBT) criteria. Considered a candidate for substitution with phase out of active use.
Thiabendazole	148-79-8	Directive 2008/85/EC of 5 September 2008
Thiacloprid	111988-49-9	Directive 2009/88/EC of 30 July 2009
Thiamethoxam	153719-23-4	Directive 2008/77/EC of 25 July 2008
Tolylfluanid	731-27-1	Directive 2009/151/EC of 27 November 2009

Source: http://ec.europa.eu/environment/chemicals/biocides/active-substances/approved-substances_en.htm

LEGAL SERVICES

DIVISION OF LEGAL AND RESEARCH SERVICES
LEGISLATIVE AFFAIRS AGENCY
STATE OF ALASKA

(907) 465-3867 or 465-2450
FAX (907) 465-2029
Mail Stop 3101

State Capitol
Juneau, Alaska 99801-1182
Deliveries to: 129 6th St., Rm. 329

MEMORANDUM February 13, 2018

SUBJECT: Definition of Person (CSSB 176( );
Work Order No. 30-LS1332\D)

TO: Senator Cathy Giessel
Attn: Akis Gialopsos

FROM: Emily Nauman Emily
Legislative Counsel

Please find the above-listed work order attached. Because "person" is not defined for purposes of AS 09.65.243, if not defined in this section, the definition of "person" under AS 01.10.060(a)(8) would apply. That paragraph states "person includes a corporation, company, partnership, firm, association, organization, business trust, or society, as well as a natural person." Note that differs from the definition of "person" in AS 46.03.900(18), which applies to all of AS 46.03, including AS 46.03.822. AS 46.03.900(18) defines "person" to mean "any individual, public or private corporation, political subdivision, government agency, municipality, industry, copartnership, association, firm, trust, estate, or any other entity whatsoever." To avoid confusion, I added language to the bill, at sec. 09.65.243(b), that adopts the definition of "person" that appears in AS 46.03.900 for purposes of proposed sec. 09.65.243. This ensures that no person currently subject to liability under AS 46.03.822 is excluded from the exemption under sec. 09.65.243. Because the term "person" as defined under AS 46.03.900(18) includes the state, the term has been removed from sec. 09.65.243(a).

If I may be of further assistance, please advise.

ELN:dls
18-056.dls

Attachment

SB 173 testimony

Senate Resources Committee

February 12, 2018

Good afternoon.

My name is Phil Steyer. I am the director of government relations for Chugach Electric Association. I am here today to note Chugach's support for clarifying in state statute that a utility that installs and uses treated wooden poles is not liable for trace amounts of preservative that may be transferred to the ground.

Chugach is an Anchorage-based, member-owned electric cooperative providing service to approximately 68,000 members at nearly 84,000 metered-locations. Chugach's service territory runs from the Anchorage Bowl to the northern Kenai Peninsula and from Whittier to Tyonek.

Chugach has nearly 900 miles of overhead distribution line on its system supported by treated wooden poles.

Chugach appreciates the sponsor's effort to clarify this issue and the committee's attention to it today.

Thank you.

Cook Inletkeeper
3734 Ben Walters Lane
Homer, Alaska 99603

CLEAN WATER · HEALTHY SALMON
INLETKEEPER

p. 907.235.4068
f. 907.235.4069
www.inletkeeper.org

VIA EMAIL ONLY
(Senator.Cathy.Giessel@akleg.gov)

February 14, 2018

Cathy Giessel, Chair
Alaska Senate Resources Committee
State Capital Room 427
Juneau, AK 99801

Re: Senate Bill 173

Dear Madam Chair:

Please accept these brief comments on SB 173 from Cook Inletkeeper, a public interest group representing over 8000 Alaskans concerned about clean water and healthy fish habitat.

SB 173 was introduced on February 2 and referred to only one committee in the Senate, the Senate Resources Committee. It had its first hearing February 12, and today will be its second hearing, with no public testimony to be taken and with the possibility the Committee will report the bill out today.

Based on testimony heard at the February 12 hearing, there are over 250,000 utility poles treated with pentachlorophenol across Alaska. Pentachlorophenol is a highly toxic, bioaccumulative substance which has been banned in many countries across the globe.

In response to the pervasive problem of contaminated utility poles across the state, HB 173 does one thing – it absolves utilities and other potentially responsible parties from liability.

Surprisingly, SB 173 comes with a zero fiscal note, which begs the question: if SB 173 absolves responsible parties from clean-up liabilities, who will address the considerable toxic pollution left behind by more than 250,000 contaminated utility poles across the state?

Because that question remains unanswered, Inletkeeper urges the Senate Resources Committee to take a step back, and consider amendments which could address the problem of ongoing, widespread toxic pollution across the state. For example, the Committee should consider a series of Best Management Practices (BMP) – similar to BMP's embraced by Vermont – to mitigate the possible migration of pentachlorophenol, and to explore possible less toxic alternatives.

Alaskans are increasingly concerned about wild salmon habitat, and the state government's willingness and ability to protect it. Throughout the Cook Inlet watershed – in the Mat Su Valley, in Anchorage, and on the Kenai Peninsula – many contaminated poles are sited in or around wetlands that support our wild salmon.

When talking about the decline of our salmon habitat, we often hear about the phenomenon of the "death by a thousand cuts," where seemingly small, individual events have largescale cumulative effects that pollute our waters and degrade our fish habitat. In the case of SB 173 as currently written, it's more like "death by 250,000 cuts."

We applaud the bill sponsor and the Committee for recognizing this long-standing problem. We urge you, however, to slow down, and to formulate a more thoughtful solution that does not simply leave hundreds of thousands of contaminated sites strewn across the state, with little or no potential for clean-up.

Thank you for your attention to these comments, and feel free to contact me with any questions at bob@inletkeeper.org or 907.299.3277.

Yours for Cook Inlet,

Bob Shavelson
Inletkeeper

Pentachlorophenol

87-86-5

Hazard Summary

Pentachlorophenol was once one of the most widely used biocides in the United States, but it is now a restricted use pesticide and is no longer available to the general public. It was primarily used as a wood preservative. Pentachlorophenol is extremely toxic to humans from acute (short-term) ingestion and inhalation exposure. Acute inhalation exposures in humans have resulted in neurological, blood, and liver effects, and eye irritation. Chronic (long-term) exposure to pentachlorophenol by inhalation in humans has resulted in effects on the respiratory tract, blood, kidney, liver, immune system, eyes, nose, and skin. Human studies are inconclusive regarding pentachlorophenol exposure and reproductive effects. Human studies suggest an association between exposure to pentachlorophenol and cancer. Oral animal studies have reported increases in liver tumors and two uncommon tumor types. EPA has classified pentachlorophenol as a Group B2, probable human carcinogen.

Please Note: The main sources of information for this fact sheet are EPA's Integrated Risk Information System (IRIS) (2), which contains information on oral chronic toxicity of pentachlorophenol and the RfD and the carcinogenic effects of pentachlorophenol including the unit cancer risk for oral exposure, and the Agency for Toxic Substances and Disease Registry's (ATSDR's) Toxicological Profile for Pentachlorophenol. (1)

Uses

- Pentachlorophenol was once one of the most widely used biocides in the United States, but it is now a restricted use pesticide and is no longer available to the general public. (1)
- The principal use for pentachlorophenol is as a wood preservative; it is also used for the formulation of fungicidal and insecticidal solutions and for incorporation into other pesticide products. (1)

Sources and Potential Exposure

- Exposure to pentachlorophenol in the indoor air of pressure-treated log homes brushed with pentachlorophenol has been measured at 0.0005 to 0.01 parts per billion (ppb), and levels in the air of industrially dipped, non-pressure-treated log homes have been measured at 0.034 to 0.0104 ppb. Levels in outdoor air are much lower, and the general population is estimated to breathe in about 0.063 milligrams per day (mg/day). (1)
- Workers at wood treatment facilities and lumber mills are estimated to breathe in about 10.5 to 154 mg/day, and workers who handle treated lumber can absorb about 35 mg/day through the skin. (1)
- Pentachlorophenol has been detected at low levels in drinking water and food. (1)
- Exposure may also occur through dermal contact with pentachlorophenol or with wood products treated with pentachlorophenol. (1)

Assessing Personal Exposure

- Pentachlorophenol and its breakdown products can be measured in blood, urine, and tissues. (1)

Health Hazard Information

Acute Effects:

- Pentachlorophenol is extremely toxic when ingested by humans. (2)
- Acute inhalation exposure to pentachlorophenol in humans may result in effects on the cardiovascular system, blood, liver (jaundice), and eyes (visual damage and irritation). (1,3)
- Neurological effects reported following exposure of humans to high levels of pentachlorophenol include lethargy, tachypnea, tachycardia, delerium, and convulsions. (1)
- Animal studies have reported effects on the cardiovascular system, blood, liver, immune system, and central nervous system (CNS) from acute oral exposure to pentachlorophenol. (1)
- Tests involving acute exposure of rats and mice have shown pentachlorophenol to have high toxicity from inhalation exposure and extreme toxicity from oral exposure. (1,4)

Chronic Effects (Noncancer):

- Chronic exposure by inhalation to pentachlorophenol in humans has resulted in inflammation of the upper respiratory tract and bronchitis, blood effects such as aplastic anemia, effects on the kidney and liver, immunological effects, and irritation of the eyes, nose, and skin. (1,3)
- Chronic oral exposure to pentachlorophenol in animals has resulted in effects on the liver, kidney, blood, endocrine, immune system, and CNS. (1,2,5)
- EPA has not established a Reference Concentration (RfC) for pentachlorophenol. (2)
- The Reference Dose (RfD) for pentachlorophenol is 0.03 milligrams per kilogram body weight per day (mg/kg/d) based on liver and kidney pathology in rats. The RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily oral exposure to the human population (including sensitive subgroups) that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk but rather a reference point to gauge the potential effects. At exposures increasingly greater than the RfD, the potential for adverse health effects increases. Lifetime exposure above the RfD does not imply that an adverse health effect would necessarily occur. (2)
- EPA has high confidence in the study on which the RfD is based because a moderate number of animals/sex were used in each of three doses, a comprehensive analysis of parameters was conducted, and a reproductive study was also performed; medium confidence in the supporting database because only one chronic study is available; and, consequently, medium confidence in the RfD. (2)
- The California Environmental Protection Agency (CalEPA) has calculated a chronic inhalation reference exposure level of 0.1 milligrams per cubic meter (mg/m^3) based on a route to route extrapolation of EPA's RfD. (9)

Reproductive/Developmental Effects:

- One study reported that 22 out of 90 women with histories of spontaneous abortions, unexplained infertility, or menstrual disorders were found to have elevated blood levels of pentachlorophenol and/or lindane. However, a direct causal relationship with pentachlorophenol exposure cannot be inferred from this study due to the presence of lindane in the blood and other possible confounding factors. (1)
- Oral animal studies suggest that exposure to pentachlorophenol decreases the survival of the offspring in rats. Other oral animal studies have found evidence that pentachlorophenol produces maternal toxicity (depressed maternal body weight), but does not cause birth defects. (1,2)

Cancer Risk:

- Case reports suggest a possible association between inhalation pentachlorophenol exposure and cancer (Hodgkins disease, soft tissue sarcoma, and acute leukemia); however, concommittent exposure to other toxic substances may have contributed to the reported carcinogenic effects. (1)
- Oral animal studies have reported increases in liver tumors (hepatocellular adenomas and carcinomas) and two uncommon tumors (adrenal medulla pheochromocytomas, hemangiosarcomas, and hemangiomas) in mice. (1,2)
- EPA has classified pentachlorophenol as a Group B2, probable human carcinogen. (2)

- EPA uses mathematical models, based on animal studies, to estimate the probability of a person developing cancer from ingesting water containing a specified concentration of a chemical. EPA calculated an oral unit risk estimate of 3×10^{-6} (µg/L)$^{-1}$. EPA estimates that, if an individual were to ingest water containing pentachlorophenol at an average concentration of 0.3 µg/L over his or her entire lifetime, that person would theoretically have no more than a one-in-a-million increased chance of developing cancer as a direct result of ingesting water containing this chemical. Similarly, EPA estimates that ingesting water containing 3.0 µg/L would result in not greater than a one-in-hundred thousand increased chance of developing cancer, and water containing 30 µg/L would result in not greater than a one-in-ten thousand increased chance of developing cancer. For a detailed discussion of confidence in the potency estimates, please see IRIS. (2)
- EPA has also calculated an oral cancer slope factor (CSF) of 0.12 (mg/kg/d)$^{-1}$. (2)

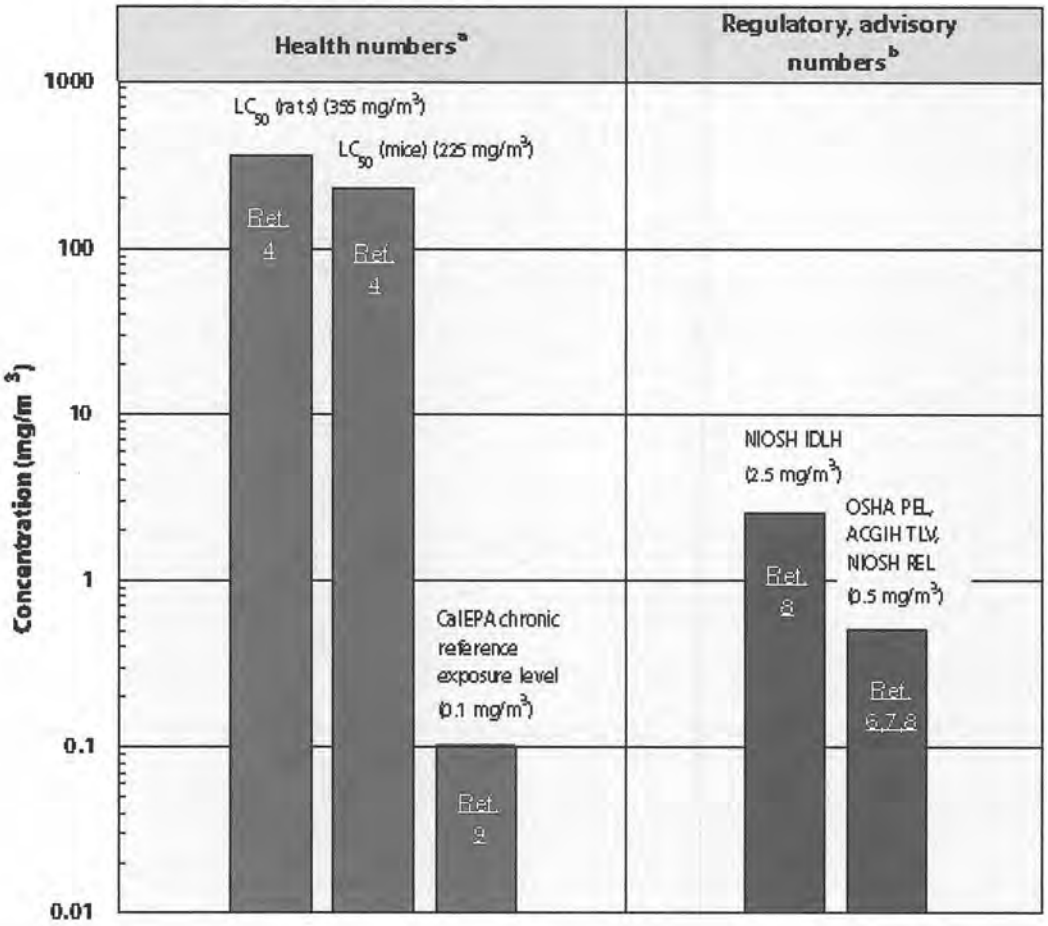
Physical Properties

- Pentachlorophenol exists as colorless or white crystals (when pure) with a sharp, phenolic odor when hot, but very little odor at room temperature. (1)
- The odor threshold for pentachlorophenol is approximately 12 parts per million (ppm). (1)
- Impure pentachlorophenol is dark gray to brown and exists as dust, beads, or flakes. (1)
- The chemical formula for pentachlorophenol is C_6HCl_5O, and its molecular weight is 266.35 g/mol. (1)
- The vapor pressure for pentachlorophenol is 0.00011 mm Hg at 25 °C, and it has a log octanol/water partition coefficient (log K_{ow}) of 5.01. (1)

Conversion Factors:
To convert concentrations in air (at 25 °C) from ppm to mg/m^3: mg/m^3 = (ppm) × (molecular weight of the compound)/(24.45). For pentachlorophenol: 1 ppm = 10.9 mg/m^3. To convert concentrations in air from µg/m^3 to mg/m^3: mg/m^3 = (µg/m^3) × (1 mg/1,000 µg).

Health Data from Inhalation Exposure

Pentachlorophenol



ACGIH TLV--American Conference of Governmental and Industrial Hygienists' threshold limit value expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effects.

LC_{50} (Lethal Concentration $_{50}$)--A calculated concentration of a chemical in air to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

NIOSH IDLH -- National Institute of Occupational Safety and Health's immediately dangerous to life or health concentration; NIOSH recommended exposure limit to ensure that a worker can escape from an exposure condition that is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from the environment.

NIOSH REL--NIOSH's recommended exposure limit; NIOSH-recommended exposure limit for an 8- or 10-h time-weighted-average exposure and/or ceiling.

OSHA PEL--Occupational Safety and Health Administration's permissible exposure limit expressed as a time-weighted average; the concentration of a substance to which most workers can be exposed without adverse effect averaged over a normal 8-h workday or a 40-h workweek.

The health and regulatory values cited in this factsheet were obtained in December 1999.

[a] Health numbers are toxicological numbers from animal testing or risk assessment values developed by EPA.

[b] Regulatory numbers are values that have been incorporated in Government regulations, while advisory numbers are nonregulatory values provided by the Government or other groups as advice. OSHA numbers are regulatory, whereas NIOSH and ACGIH numbers are advisory.

References

Summary created in April 1992, updated in January 2000

1. Agency for Toxic Substances and Disease Registry (ATSDR). Toxicological Profile for Pentachlorophenol (Update) (Draft). Public Health Service, U.S. Department of Health and Human Services, Atlanta, GA. 1999.
2. U.S. Environmental Protection Agency. Integrated Risk Information System (IRIS) on Pentachlorophenol. National Center for Environmental Assessment, Office of Research and Development, Washington, DC. 1999.
3. U.S. Department of Health and Human Services. Hazardous Substances Data Bank (HSDB, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
4. U.S. Department of Health and Human Services. Registry of Toxic Effects of Chemical Substances (RTECS, online database). National Toxicology Information Program, National Library of Medicine, Bethesda, MD. 1993.
5. U.S. Environmental Protection Agency. Health Effects Assessment for Pentachlorophenol. EPA/540/1-86/043. Environmental Criteria and Assessment Office, Office of Health and Environmental Assessment, Office of Research and Development, Cincinnati, OH. 1988.
6. Occupational Safety and Health Administration (OSHA). Occupational Safety and Health Standards, Toxic and Hazardous Substances. Code of Federal Regulations 29 CFR 1910.1000. 1998.
7. American Conference of Governmental Industrial Hygienists (ACGIH). 1999 TLVs and BEIs. Threshold Limit Values for Chemical Substances and Physical Agents. Biological Exposure Indices. Cincinnati, OH. 1999.
8. National Institute for Occupational Safety and Health (NIOSH). Pocket Guide to Chemical Hazards. U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention. Cincinnati, OH. 1997.
9. California Environmental Protection Agency (CalEPA). Technical Support Document for the Determination of Noncancer Chronic Reference Exposure Levels. Draft for Public Comment. Office of Environmental Health Hazard Assessment, Berkeley, CA. 1997.

Health	3
Fire	0
Reactivity	0
Personal Protection	E

Material Safety Data Sheet
Pentachlorophenol MSDS

Section 1: Chemical Product and Company Identification

Product Name: Pentachlorophenol

Catalog Codes: SLP3943, SLP1126

CAS#: 87-86-5

RTECS: SM6300000

TSCA: TSCA 8(b) inventory: Pentachlorophenol

CI#: Not available.

Synonym:

Chemical Name: Not available.

Chemical Formula: C6Cl5OH

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396

US Sales: **1-800-901-7247**
International Sales: **1-281-441-4400**

Order Online: ScienceLab.com

CHEMTREC (24HR Emergency Telephone), call:
1-800-424-9300

International CHEMTREC, call: 1-703-527-3887

For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

Composition:

Name	CAS #	% by Weight
Pentachlorophenol	87-86-5	100

Toxicological Data on Ingredients: Pentachlorophenol: ORAL (LD50): Acute: 27 mg/kg [Rat]. 117 mg/kg [Mouse]. VAPOR (LC50): Acute: 502 ppm 4 hour(s) [Rat].

Section 3: Hazards Identification

Potential Acute Health Effects:
Very hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation. Slightly hazardous in case of skin contact (corrosive, sensitizer). Severe over-exposure can result in death. Inflammation of the eye is characterized by redness, watering, and itching. Skin inflammation is characterized by itching, scaling, reddening, or, occasionally, blistering.

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: Not available. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance is toxic to blood, kidneys, lungs, the nervous system, liver, mucous membranes. Repeated or prolonged exposure to the substance can produce target organs damage. Repeated exposure to an highly toxic material may produce general deterioration of health by an accumulation in one or many human organs.

Section 4: First Aid Measures

Eye Contact:
Check for and remove any contact lenses. Immediately flush eyes with running water for at least 15 minutes, keeping eyelids open. Cold water may be used. Do not use an eye ointment. Seek medical attention.

Skin Contact:
After contact with skin, wash immediately with plenty of water. Gently and thoroughly wash the contaminated skin with running water and non-abrasive soap. Be particularly careful to clean folds, crevices, creases and groin. Cover the irritated skin with an emollient. If irritation persists, seek medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation: Allow the victim to rest in a well ventilated area. Seek immediate medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek medical attention.

Ingestion:
Do not induce vomiting. Examine the lips and mouth to ascertain whether the tissues are damaged, a possible indication that the toxic material was ingested; the absence of such signs, however, is not conclusive. Loosen tight clothing such as a collar, tie, belt or waistband. If the victim is not breathing, perform mouth-to-mouth resuscitation. Seek immediate medical attention.

Serious Ingestion: Not available.

Section 5: Fire and Explosion Data

Flammability of the Product: Non-flammable.

Auto-Ignition Temperature: Not applicable.

Flash Points: Not applicable.

Flammable Limits: Not applicable.

Products of Combustion: Not available.

Fire Hazards in Presence of Various Substances: Not applicable.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions: Not applicable.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards: Not available.

Section 6: Accidental Release Measures

Small Spill: Use appropriate tools to put the spilled solid in a convenient waste disposal container.

Large Spill:
Use a shovel to put the material into a convenient waste disposal container. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep locked up Keep container dry. Do not ingest. Do not breathe dust. Never add water to this product In case of insufficient ventilation, wear suitable respiratory equipment If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes

Storage:
Keep container tightly closed. Keep in a cool, well-ventilated place. Highly toxic or infectious materials should be stored in a separate locked safety storage cabinet or room.

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits. If user operations generate dust, fume or mist, use ventilation to keep exposure to airborne contaminants below the exposure limit.

Personal Protection:
Splash goggles. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Dust respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:
TWA: 0.5 (mg/m3) from ACGIH Consult local authorities for acceptable exposure limits.

Section 9: Physical and Chemical Properties

Physical state and appearance: Solid.

Odor: Pungent. (Strong.)

Taste: Not available.

Molecular Weight: 266.34 g/mole

Color: White.

pH (1% soln/water): Not available.

Boiling Point: Decomposes. (310°C or 590°F)

Melting Point: 188°C (370.4°F)

Critical Temperature: Not available.

Specific Gravity: 1.987 (Water = 1)

Vapor Pressure: Not applicable.

Vapor Density: 9.2 (Air = 1)

Volatility: Not available.

Odor Threshold: Not available.

Water/Oil Dist. Coeff.: Not available.

Ionicity (in Water): Not available.

Dispersion Properties: Not available.

Solubility: Very slightly soluble in cold water.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Not available.

Incompatibility with various substances: Not available.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity: Not available.

Special Remarks on Corrosivity: Not available.

Polymerization: No.

Section 11: Toxicological Information

Routes of Entry: Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 27 mg/kg [Rat]. Acute toxicity of the vapor (LC50): 502 ppm 4 hour(s) [Rat].

Chronic Effects on Humans: The substance is toxic to blood, kidneys, lungs, the nervous system, liver, mucous membranes.

Other Toxic Effects on Humans:
Very hazardous in case of skin contact (irritant), of ingestion. Hazardous in case of skin contact (permeator), of inhalation. Slightly hazardous in case of skin contact (corrosive, sensitizer).

Special Remarks on Toxicity to Animals: Not available.

Special Remarks on Chronic Effects on Humans: Not available.

Special Remarks on other Toxic Effects on Humans: Not available.

Section 12: Ecological Information

Ecotoxicity: Not available.

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are more toxic.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:

Section 14: Transport Information

DOT Classification: CLASS 6.1: Poisonous material.

Identification: : Chlorophenol, solid : UN2020 PG: III

Special Provisions for Transport: Marine Pollutant

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Pentachlorophenol California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer which would require a warning under the statute: Pentachlorophenol Pennsylvania RTK: Pentachlorophenol Massachusetts RTK: Pentachlorophenol TSCA 8(b) inventory: Pentachlorophenol SARA 313 toxic chemical notification and release reporting: Pentachlorophenol

Other Regulations: OSHA: Hazardous by definition of Hazard Communication Standard (29 CFR 1910.1200).

Other Classifications:

WHMIS (Canada):
CLASS D-1A: Material causing immediate and serious toxic effects (VERY TOXIC). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):
R38- Irritating to skin. R41- Risk of serious damage to eyes. R48/20- Harmful: danger of serious damage to health by prolonged exposure through inhalation. R48/25- Toxic: danger of serious damage to health in case of prolonged exposure if swallowed.

HMIS (U.S.A.):

Health Hazard: 3

Fire Hazard: 0

Reactivity: 0

Personal Protection: E

National Fire Protection Association (U.S.A.):

Health: 3

Flammability: 0

Reactivity: 0

Specific hazard:

Protective Equipment:
Gloves. Lab coat. Dust respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.

Other Special Considerations: Not available.

Created: 10/10/2005 11:12 AM

Last Updated: 05/21/2013 12:00 PM

Pentachlorophenol Contamination of Private Drinking Water From Treated Utility Poles

Lee Karlsson, MScPH, Lori Cragin, PhD, MS, Gail Center, BS, Cary Giguere, BS, Jeff Comstock, BS, Linda Boccuzzo, MS, and Austin Sumner, MD, MPH

In 2009, after resident calls regarding an odor, the Vermont Department of Health and state partners responded to 2 scenarios of private drinking water contamination from utility poles treated with pentachlorophenol (PCP), an organochlorine wood preservative used in the United States. Public health professionals should consider PCP contamination of private water if they receive calls about a chemical or gasoline-like odor with concurrent history of nearby utility pole replacement. (*Am J Public Health.* 2013;103:276–277. doi:10.2105/AJPH.2012.300910)

Pentachlorophenol (PCP) is an organochlorine wood preservative used to treat utility poles in the United States. It is applied to pine poles by vacuum pressure treatment at a manufacturing facility with binding agents from hydrocarbons, including diesel fuel and kerosene. About 36 million PCP-treated poles are in service across the United States (60% of the total 60 million treated utility poles).[1]

The US Environmental Protection Agency (EPA) maximum contaminant level (MCL) for PCP in drinking water is 0.001 milligrams per liter.[2] The odor threshold for PCP in water is 0.857 milligrams per liter at 30°C (86°F).[3] A PCP concentration in drinking water could be above the MCL but below the odor threshold, thus the odor property is not necessarily protective.

PCP is absorbed by oral, dermal, and inhalation routes.[4] It does not build up in the body, and its elimination half-life is 33 hours, primarily in urine.[4] Dose, duration of exposure, individual traits, and presence of other contaminants influence health effects.[5] Effects of PCP exposure can range from skin, eye, and respiratory irritation; hepatotoxicity, including elevation of serum alkaline phosphatase, aspartate aminotransferase, and lactate dehydrogenase; kidney toxicity, including albuminuria, glycosuria, aminoaciduria, and elevated blood urea nitrogen; to impaired oxidative phosphorylation and hyperthermia, which can result in death.[6,7] PCP is classified by the EPA as likely to be carcinogenic to humans.[8]

METHODS

We reviewed state records and literature and interviewed Vermont Department of Environmental Conservation and Agency of Agriculture partners about 2 separate scenarios of private drinking water contamination.

The first scenario occurred in June 2009. The Vermont Department of Health (VDH) received a call from a Vermont resident about an odor in her private drinking water. On the basis of a chemical-like odor, history of a new utility pole upgradient of the water source, and VDH's knowledge of PCP, VDH advised the caller not to ingest, have dermal exposure to, or inhale vapors of the water. The source was a shallow dug well, and the pole was likely in contact with the water table (Figure 1).

In July 2009, VDH received a similar call from a Vermont resident in a different location also concerned about an odor in his private drinking water. Three utility poles had recently been replaced upgradient of a private spring. On the basis of a chemical-like odor, history of new utility poles near the water source, and similarity to the first scenario, VDH again advised the resident not to ingest, have dermal exposure to, or inhale vapors of the water.

RESULTS

After the first call, VDH notified the Vermont Agency of Agriculture, Food, and Markets, which took tap water samples in June 2009. The water had a PCP concentration of 2.06 milligrams per liter, and a subsequent sample had a concentration of 1.15 milligrams per liter, respectively about 2000 and 1000 times the EPA maximum contaminant level (0.001 mg/L). In response, the Vermont Department of Environmental Conservation and the utility company were contacted to coordinate cleanup.

In July 2009, the utility company replaced the pole with a nontreated cedar pole and paid for a new 705-foot drilled well, which tested negative for PCP. The old well was converted to a monitoring well.

After the second call, a tap water sample was taken; it had a PCP concentration of 0.007 milligrams per liter, and a subsequent sample had a concentration of 0.002 milligrams per liter, both also above the EPA maximum contaminant level (0.001 mg/L).

In August, the utility company replaced the poles with nontreated cedar poles and paid for a point-of-entry charcoal filtration system. PCP was not detected in tap water samples taken after filtration. Samples collected directly from the spring had diminishing PCP, with none detected after October 2009.

DISCUSSION

Treated utility pole placement near private water sources can increase the likelihood of drinking water contamination. One possible explanation for PCP-contaminated drinking water in Vermont is an increase in placement of utility poles near road rights-of-way rather than forest rights-of-way because fewer outages occur, and repairs and replacements are easier, making service more reliable.

The Federal Insecticide, Fungicide, and Rodenticide Act authorized the EPA to regulate the sale and use of pesticides. However, the act has a treated article exemption.[9] The Code of Federal Regulations defines exemption character as an article or substance treated with or containing a pesticide to protect the article or substance itself,[10] which creates a regulatory dilemma. Placement of PCP-treated poles is not considered a pesticide application and does not fall under the regulatory authority of the act as enforced by states and the EPA. Other environmental laws are not applicable to PCP-treated poles. In 2011, a California federal court held that PCP-contaminated discharges from utility poles into the environment via storm water runoff or dust were not actionable or in violation of the Clean Water Act or the Resource Conservation and Recovery Act.[11]

FIGURE 1—First scenario: pentachlorophenol-treated pole near contaminated well.

Vermont introduced legislation in January 2012 that proposed regulation of both the siting of treated utility poles near drinking water sources and the reapplication of treatments.[12]

We recommend the following actions:

- Consider PCP contamination of private water if a chemical or gasoline-like odor is concurrent with a history of nearby utility pole placement.
- Require manufacturers to provide placement guidelines in End User Information or Handling Sheets.
- Develop policies and procedures to restrict installation of treated utility poles in areas near wells.
- Use safer alternatives, such as nontreated cedar poles, cement or metal poles, burial of wires, or less toxic wood preservatives.
- Remove the Federal Insecticide, Fungicide, and Rodenticide Act treated-article exemption for utility poles. ■

About the Authors

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Contributors

L. Karlsson interpreted data and regulations and drafted and revised the article. L. Cragin assisted in data interpretation and revised the article. G. Center led investigations, interpreted data, and revised the article. C. Giguere led investigations and data collection, analyzed and interpreted data and regulations, and revised the article. J. Comstock led investigations and data collection, analyzed and interpreted data and regulations, and revised the article. L. Boccuzzo coordinated cross-agency investigation and collaboration and revised the article. A. Sumner assisted in coordinating cross-agency collaboration and revised the article.

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Note. The findings and conclusions in this article are those of the authors and do not necessarily represent the views of Centers for Disease Control and Prevention.

Human Participant Protection

No human participant protections was required because no human participants were used in this research.

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9. Federal Insecticide, Fungicide, and Rodenticide Act, 7 USC 136w § 25 (b)(2). 1996.

10. Exemptions for pesticides of a character not requiring FIFRA regulation: treated articles or substances. 40 CFR 152 § 152.25.

11. *Ecological Rights Found. v. Pac. Gas & Elec. Co.* 803 F. Supp. 2d 1056 (S.D. Ala. 2011).

12. H. 525, An act relating to the siting and regulation of utility poles treated with wood preservatives, 6 V.S.A. §1113 (2012).

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February 15, 2018

The Honorable Cathy Giessel
Chair, Senate Resources Committee
State Capital Room 427
Juneau, AK 99801

Dear Senator Giessel:

RE: Senate Bill 173

Thank you again for the opportunity to testify last Monday, February 12. Homer Electric Association, Inc. (HEA), along with our sister utilities across Alaska, are pleased the Resources Committee is thoroughly vetting SB 173. In addition to last Monday's testimony, HEA would like to provide an additional brief comment relating to SB 173. HEA feels there is critically important information that seems to be lost in the discussion of this bill.

SB 173 does not diminish pesticide use regulation in Alaska; in actuality, the draft bill supports it. The bill is narrowly written to ensure that public utility poles in Alaska are regulated as pesticide use and not spills. Federal law governing spills makes an important distinction that is currently missing from Alaska law. Federal law recognizes that when used as intended, an approved pesticide product should be regulated as a pesticide use, and not as a spill liability.

Penta treated utility pole installation, use, and removal will continue to be regulated under Alaska pesticide use and solid waste disposal regulations. SB 173 is protective of both the environment and Alaskan consumers. The bill maintains the state's authority to regulate utility poles as pesticide use, but eliminates the unreasonable cost burden on Alaskan consumers that would result from assigning spill liability to every utility pole in Alaska.

Should you have any further questions or require additional information, please feel free to contact me by phone at 907-283-2312 or by email at bjanorschke@homerelectric.com.

Thank you in advance for your consideration.

Sincerely,

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Transmitted via Email

February 15, 2018

Cathy Giessel, Chair, and Members of the Senate Resources Committee
Alaska Senate Resources Committee
State Capitol Room 427
Juneau, Alaska 99801

Re: Senate Bill 173

Dear Madam Chair and Members of the Committee:

Thank you for your consideration of these comments on SB 173 prepared by Alaska Community Action on Toxics. Alaska Community Action on Toxics is a statewide non-profit public interest environmental health research and advocacy organization dedicated to protecting environmental and public health.

We understand that the Senate Resources Committee may take action on an amended version of SB 173 on February 16. SB 173 would eliminate the assumption of liability and remediation costs for utilities and other potentially responsible parties associated with contamination from utility poles treated with pentachlorophenol (PCP), a highly hazardous pesticide. We ask that the Committee delay action on this bill in order to allow time for the careful consideration of the implications and possible solutions to the problem of contamination resulting from the use and disposal of the estimated 250,000 of treated utility poles distributed throughout the State of Alaska. A considerable number of these poles are located in proximity to schools, homes, drinking water sources, and in sensitive wetland habitats. There have been no studies to investigate contamination and possible exposures from treated utility poles in Alaska, with one exception, a study conducted by the U.S. Fish and Wildlife Service in the Kenai National Wildlife Refuge.

As far as we know, the only study of contamination from treated utility poles in Alaska was conducted within the Kenai National Wildlife Refuge. In a letter to the Alaska Department of Environmental Conservation (January 22, 2016), the Refuge Manager stated: "Results reveal that the majority of poles treated with PCP, both historically (1950s) and more recently (within the last 20 years) have contaminated surrounding soils with concerning levels of PCP and dioxins/furans." Evidence that contamination associated with poles from the 1950s is indicative of the persistence of this toxic pesticide. The Alaska Department of Environmental Conservation sent a letter to the Homer Electric Association (May 6, 2016) in reference to the US Fish and Wildlife Service findings, stating: "The laboratory results document concentrations of PCP, dioxins and furans significantly above the state soil cleanup levels."

In a study published in the American Journal of Public Health,[1] researchers in Vermont found that treated utility poles contaminated a drinking water source with PCP levels up to 2,000 times the EPA maximum contaminant level. The authors noted that treated utility pole placement in the vicinity of water sources increases the likelihood of drinking water contamination. They recommended the implementation of placement guidelines, best management practices, policies and procedures to restrict installation of treated utility poles near drinking water sources, and the use of safer alternatives.

Pentachlorophenol, a persistent and bioaccumulative toxic pesticide, is associated with adverse health effects including damage to the developing brain and nervous system, impairment of memory and learning, disruption to thyroid function, immune suppression, infertility, and increased risk of certain cancers such as non-Hodgkin lymphoma. In September 2014, the U.S, National Toxicology Program re-classified PCP "as reasonably anticipated to be a human carcinogen."[2] Regulatory controls and restrictions of this unmanageable substance have proven inadequate in protecting children from harmful exposures. In a scientific paper published in the medical journal Lancet, PCP is included among the industrial chemicals known to cause brain toxicity and neurological symptoms in humans, noting that the substance affects the brain and exerts toxicity to brain cells.[3] In 2015, pentachlorophenol was banned under the legally binding provisions of the international Stockholm Convention on Persistent Organic Pollutants (POPs treaty) because of its persistence, toxicity, bioaccumulation, and long-range transport. The expert committee of scientists to the Stockholm Convention stated that global action is warranted on pentachlorophenol because of its long-range environmental transport, as well as its significant adverse human health and environmental effects.

Emissions from PCP-treated wooden poles are one of the main sources of dioxins and furans, which contaminate soils and groundwater beneath PCP-treated utility poles. Dioxins and furans are among the most toxic and persistent synthetic chemicals, and produced as by-products in the manufacturing of PCP and treatment of utility poles. PCP treated poles and wood are important sources and significant reservoir of dioxins and furans that present a hazard for environmental and human exposure due to documented contamination of groundwater, soils, and foods. Bulle et al. 2010[4] concluded that emissions from PCP-treated wooden poles in service are one of the main sources of dioxins and furans. Lorber et al. 2002[5] concluded that the size of the dioxin reservoir in PCP-treated utility poles and that even low release rates from these poles have

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potential for significant environmental releases. This study underscores the importance of utility poles as sources for dioxins.

We recommend that the Committee delay action on this bill to allow for thorough discussion of possible amendments that are focused on solutions to the problem of pentachlorophenol (and dioxin/furan) contamination associated with utility poles in Alaska. These could include the convening of a public task force to address the issue and/or a requirement for the development and implementation of best management practices (BMP) – as has been done in Vermont – to mitigate contamination and to pursue the substitution of safer, cost effective alternatives. We are encouraged about the viability and availability of cost effective alternatives to the use of PCP-treated wood, particularly non-chemical material substitutions for utility poles. Industry has evolved and innovated over the past several years toward using alternative materials such as fiberglass composite, recycled steel, concrete, and undergrounding of wire that are comparable or superior to PCP-treated wood in terms of strength, cost, and longevity. These do not have to be disposed or treated as hazardous waste, so there are clear cost and environmental benefits of using these safer materials.

Thank you for your consideration of our comments.

Sincerely,
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