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MEMORANDUM

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SUBJECT: Update to the Worker Exposure Scenarios Evaluated in 2012 Chloropicrin Risk Characterization Document

Workers are generally assumed to have an exposure duration of 8 hours/day for 5 days/week. The exposure durations for residential bystanders is assumed to be 24 hours/day for 7 days/week. However, in the final Risk Characterization Document (RCD) for chloropicrin dated November 14, 2012, adult human equivalent concentrations (HECs) and reference concentrations (RfCs) were calculated to evaluate seasonal and chronic exposure without distinguishing between the different exposure durations for workers and residential bystanders. As a result, workers should have had higher HECs and RfCs than bystanders since their exposure duration is shorter. Therefore, the subchronic and chronic HECs, RfCs and Margins of Exposure (MOEs) for workers have been revised as follows.

I. Revised Human Equivalent Concentrations and Reference Concentrations for Workers

The 90-day inhalation study in rats was selected as the definitive study for evaluating seasonal inhalation exposure with a critical NOEL of 120 ppb (810 $\mu\text{g}/\text{m}^3$) based on the BMCL_{05} for rhinitis in females (Chun and Kintigh, 1993) (Table 1). The definitive study for evaluating seasonal exposure and the bystander HECs and RfCs have not changed from the 2012 RCD. However, the subchronic HEC for workers increased with the revised exposure duration of 8 hours/day, 5 days/week. An adult breathing rate of 0.28 $\text{m}^3/\text{kg}/\text{day}$ was assumed for workers. Therefore, for workers the subchronic HEC is 310 ppb (2.1 mg/m^3) and the subchronic RfC is 3.1 ppb (21 $\mu\text{g}/\text{m}^3$).

The 78-wk inhalation study in mice was selected as the definitive study for evaluating chronic inhalation exposure to chloropicrin with a critical NOEL of 49 ppb (329 $\mu\text{g}/\text{m}^3$) based on the $\text{BMCL}_{2.5}$ for bronchiectasis in males and females (Burleigh-Flayer et al., 1995) (Table 1). The definitive study for evaluating chronic exposure and the bystanders HECs and RfCs have not changed from the 2012 RCD. However, the chronic HEC for workers has increased to 240 ppb



(1.6 mg/m³), assuming exposure was limited to 8 hours/day, 5 days/week. The chronic RfCs for workers also increased to 2.4 ppb (16 µg/m³).

Table 1. Revised Human Equivalent Concentrations and Reference Concentrations for Evaluating Seasonal and Chronic Exposure in Workers to Chloropicrin

Exposure Scenario	Critical Endpoints	HEC ^a		RfC	
		Children	Adults	Children	Adults
Seasonal	Rhinitis in female rats	<u>Bystander</u> 35 ppb	<u>Bystander</u> 73 ppb <u>Workers</u> 310 ppb	<u>Bystander</u> 0.35 ppb UF ^b =100	<u>Bystander</u> 0.73 ppb <u>Workers</u> 3.1 ppb UF=100
Chronic	Bronchiectasis in male and female mice	<u>Bystander</u> 27 ppb	<u>Bystander</u> 56 ppb <u>Worker</u> 240 ppb	<u>Bystander</u> 0.27 ppb UF=100	<u>Bystander</u> 0.56 ppb <u>Workers</u> 2.4 ppb UF=100

a HEC = BMDL x BR_a/BR_h x exposure_a/exposure_h. BR_a = 0.96 and 1.8 m³/k/day for rats and mice, respectively. BR_h = 0.59 and 0.28 m³/kg/day for children and adults, respectively. Exposure_a = 6 hrs/day, 5 days/wk for rats and mice. Exposure_h = 24 hrs/day, 7 days/wk for bystanders and 8 hrs/day, 5 days/wk for workers.

b UF = Uncertainty factor used to derive RfC.

II. Revised Margins of Exposure for Workers

II.A. Soil Fumigation

The revised seasonal margins of exposure (MOEs) for workers involved in soil fumigation are summarized in Table 2. The revised subchronic HEC of 310 ppb for workers¹ was used to calculate the MOEs. All of the seasonal MOEs for soil fumigation are greater than one (> 1). The lowest seasonal MOEs range from 6 – 8 were for driver, co-pilot, tarp splitters and removers with broadcast, tarped application when chloropicrin was used as one of the active ingredients. When chloropicrin was the sole active ingredient, all of the workers involved in broadcast, tarped application had MOEs less than 100. With other application methods, the driver, co-pilot or applicator also had MOEs less than 100. The only worker scenarios with MOEs greater than 100 were soil sealers or shapers with broadcast, non-tarped application, tarp punchers with bedded, tarped application, pipe-layers with bedded, non-tarped application, tarp punchers with drip irrigation, and applicators with hand-wand application of Pic-Brom 25. When chloropicrin was used as a warning agent at either 10.5% or less than 2%, the seasonal MOEs were generally

¹ Based on rhinitis in female rats and the seasonal exposure estimates found in Table 23, Chloropicrin Risk Characterization Document, Department of Pesticide Toxicology, November 14, 2012. Available at http://www.cdpr.ca.gov/docs/risk/rcd/chloropicrinrisk_2012.pdf

greater than 100. The exception was with broadcast, tarped application where the driver, co-pilot, tarp splitter, and tarp remover had MOEs less than 100.

Table 2. Revised Seasonal Margins of Exposure for Workers Involved in Soil Fumigation with Chloropicrin^a

Exposure Scenarios	Margin of Exposure		
	Active Ingredient >15%	Warning Agent 10.5%	Warning Agent <2%
Broadcast, tarped ^b			
Driver	8	72	380
Copilot	6	57	300
Shoveler	17	160	860
Tarp splitter	6	59	310
Tarp remover	6	59	310
Soil shaper	54	510	2,700
Soil shaper - Tri-Form 40/60	89	NA ^b	NA
Soil shaper - Tri-Con 33/67	80	NA	NA
Broadcast, non-tarped			
Driver	16	150	780
Soil sealer	36	340	1,800
Soil shaper - shallow	120	NA	NA
Soil shaper – shallow (Tri-Form 40/60)	200	NA	NA
Soil shaper - deep	190	1800	9,400
Soil shaper - deep (Tri-Form 40/60)	310	NA	NA
Soil shaper - deep (Tri-Con 33/67)	280	NA	NA
Bedded, tarped			
Driver	63	600	3,100
Copilot	50	470	2,500
Shoveler	87	830	4,300
Tarp puncher	620	5,900	16,000
Bedded, non-tarped			
Driver	13	NA	NA
Pipe layer	260	NA	NA
Pipe layer - Tri-Con 33/67	360	NA	NA
Drip irrigation			
Applicator - tarped	50	470	2,500
Tarp puncher	170	1,600	8,300
Applicator - non-tarped	37	NA	NA
Handwand replant			
Applicator	32	300	1,600
Applicator - Telone C-35	92	NA	NA
Applicator - Pic-Brom 25	130	NA	NA
Potting soil			
Tarp remover	NA	59	310

a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Subchronic HEC = 310 ppb for workers. Exposure estimates from Table 23 in 2012 RCD. Values rounded to two significant figures.

b NA = Not applicable

The annual exposures to chloropicrin for workers involved in soil fumigation were reevaluated using the revised chronic HEC of 240 ppb for workers.² The revised annual MOEs for these workers are summarized in Table 3. The annual MOEs were slightly larger than the seasonal MOEs. However, the same scenarios that had MOEs less than 100 with seasonal exposure also had MOEs less than 100 for annual exposure. As with seasonal exposure, the annual MOEs were lowest for drivers, co-pilots, tarp-splitters, and tarp removers with broadcast, tarped fumigation when chloropicrin was the active ingredient (MOE range = 11-14). When chloropicrin was used as a warning agent, either at 10.5% or less than 2%, the annual MOEs were all greater than 100.

II.B. Structural Fumigation

The revised MOEs for workers involved in structural fumigation are summarized in Table 4. The seasonal MOEs were estimated using the subchronic HEC of 310 ppb for workers.³ The seasonal MOEs ranged from 5 (for fumigators) to 20 (for tarp removers). The annual MOEs were calculated using the chronic HEC of 240 ppb for workers. The annual MOEs were similar to the seasonal MOEs ranging from 7 to 30.

Table 3. Revised Annual Margins of Exposure for Workers Involved in Soil Fumigation with Chloropicrin^a

Exposure Scenarios	Margin of Exposure		
	Active Ingredient >15%	Warning Agent 10.5%	Warning Agent <2%
Broadcast, tarped ^b			
Driver	14	130	690
Copilot	11	100	550
Shoveler	32	300	1,600
Tarp splitter	11	110	570
Tarp remover	11	110	570
Soil shaper	98	940	4,900
Soil shaper - Tri-Form 40/60	160	NA ^b	NA
Soil shaper - Tri-Con 33/67	150	NA	NA
Broadcast, non-tarped			
Driver	29	270	1,400
Soil sealer	66	620	3,300
Soil shaper - shallow	220	NA	NA
Soil shaper – shallow (Tri-Form 40/60)	360	NA	NA
Soil shaper - deep	350	3,300	17,000
Soil shaper - deep (Tri-Form 40/60)	580	NA	NA
Soil shaper - deep (Tri-Con 33/67)	520	NA	NA

² Based on bronchiectasis in male and female mice and the annual exposure estimates found in Table 24, Chloropicrin Risk Characterization Document, Department of Pesticide Toxicology, November 14, 2012. Available at http://www.cdpr.ca.gov/docs/risk/red/chloropicrinrisk_2012.pdf

³ Based on rhinitis in female rats and the seasonal exposure estimates from Table 26 of the 2012 RCD, *ibid*.

Exposure Scenarios, <i>continued</i>	Margin of Exposure		
	Active Ingredient >15%	Warning Agent 10.5%	Warning Agent <2%
Bedded, tarped			
Driver	110	1,100	5,800
Copilot	91	870	4,600
Shoveler	160	1,500	8,000
Tarp puncher	1,100	11,000	29,000
Bedded, non-tarped			
Driver	25	NA	NA
Pipe layer	480	NA	NA
Pipe layer - Tri-Con 33/67	670	NA	NA
Drip irrigation			
Applicator - tarped	91	870	4,600
Tarp puncher	310	2,900	15,200
Applicator - non-tarped	68	NA	NA
Handwand replant			
Applicator	98	930	4,900
Applicator - Telone C-35	280	NA	NA
Applicator - Pic-Brom 25	390	NA	NA
Potting soil			
Tarp remover	NA	130	710
<p>a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Chronic HEC = 240 ppb for workers. Exposure estimates from Table 24 in 2012 RCD. Values rounded to two significant figures.</p> <p>b NA = Not applicable</p>			

Table 4. Revised Seasonal and Chronic Margins of Exposure for Workers Involved in Structural Fumigation with Chloropicrin

Exposure Scenario	Margins of Exposure	
	Seasonal ^a	Annual ^b
Applicator	NA ^c	NA
Tarp Remover	20	30
Aerator	NA	NA
Fumigator	5	7
Reentry	9	13
<p>a Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Subchronic HEC = 310 ppb for workers. Exposure estimates from Table 26 in 2012 RCD. Values rounded to two significant figures.</p> <p>b Margin of Exposure (MOE) = NOEL or HEC / Exposure Dosage. NOEL= No-Observed-Effect Level. HEC = Human Equivalent Concentration. Chronic HEC = 240 ppb for workers. Exposure estimates from Table 26 in n 2012 RCD. Values rounded to two significant figures.</p> <p>c NA = Not applicable</p>		