



Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units

EPA-452/R-11-013
November 2011

**Supplement to the Non-Hg Case Study Chronic Inhalation Risk Assessment In Support of
the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units**

U.S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Research Triangle Park, NC

Introduction

A previous document¹ discussed the methods and results of the chronic inhalation risk assessment of hazardous air pollutants (HAPs) other than mercury from coal- and oil-fired electric utility steam generating units (EGUs) at sixteen case study facilities, which was performed in support of the “appropriate and necessary” finding for coal- and oil-fired EGUs. Several changes were made to the emissions estimates, dispersion modeling, and risk characterization of these facilities in response to public comments on the proposed rule, and this report documents those changes and their impact on the estimated risks from the case study facilities.

1. Emissions

In response to comments on the proposed rule, the emissions data used in the case studies were updated for several facilities in two ways. First, in response to comments that EPA’s methodology was not sufficiently refined, EPA used year-specific heat input for the modeled years 2005 through 2009, rather than the average 2007-2009 heat input for all years. Second, in response to comments that EPA’s approach to emission factor development should use outlier tests, EPA revised its calculations for emission factors to apply to those units that had not been tested in the ICR. Only the arsenic, chromium, and nickel emissions were recomputed for use in modeling because these pollutants were the key risk drivers for the case studies. Both of these updates were made only to the case study facilities that had estimated cancer risks near 1 in a million at proposal. The subsections below provide more information on these updates. In addition, the detailed calculations for the case study emissions at the unit level are provided in the spreadsheet “Case_Study_Emis_MATS_Final.xlsx,” which is included in the docket (EPA-HQ-OAR-2009-0234-2939).

1.1 Unit-Level Annual Heat Input

The preferred source of unit-level annual heat input data was EPA’s Clean Air Markets continuous emission monitoring (CEM) program. Unit-level annual heat input data for calendar years 2002-2010 were obtained for all units that report these data to EPA. Heat input data are important because emissions are proportional to heat input. The only facility without CEM data was the HECO Waiau facility (ORIS 766). This facility was contacted directly to obtain actual unit-specific annual heat input data. The year-specific heat input data used for the final rule are an improvement over the approach used at proposal, which used a multi-year average heat input for each modeled year.

Table 1 provides the total facility-level heat input for each year, as well as the average value. While the average value was not used for any calculations, it is provided for comparison to the value used at proposal. For three of the case study facilities remodeled for the final rule, the revised heat input is higher (Amerenue-Labadie, 0.3%; James River, 2.5%; and Conesville, 24%). For the rest of the facilities, the heat input is lower (Dominion – Yorktown, 12%; Chesapeake Energy Center, 8.8%, Heco Waiau, 2.5%; OG &E – Muskogee, 8.6%; PSHNH –

¹ Non-Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT “Appropriate and Necessary” Analysis, March 16, 2011. Docket ID No. EPA-HQ-OAR-2009-0234-2939. Available at www.regulations.gov.

Merrimack, 16%; and TVA Gallatin, 3.2%). While these facility-level changes give some indication of the impact on risk, because each unit at a facility can contribute differently to the risk, the unit-level heat input changes can give a somewhat different view of the changes. These unit-level changes are available in the case study emissions spreadsheet discussed above.

Table 1: Final case study heat input (MMBtu) compared to heat input used at proposal.

Facility	2005	2006	2007	2008	2009	Average	Proposed Rule
Amerenue-Labadie	168,514,660	170,157,435	182,401,603	165,591,139	166,226,274	170,578,222	171,126,775
City Utilities of Springfield - James River	16,452,496	15,943,500	13,610,535	15,181,310	11,968,020	14,631,172	14,997,208
Conesville	96,719,546	92,193,174	108,230,769	100,770,581	66,087,859	92,800,386	115,092,253
Dominion - Yorktown	40,366,974	21,700,400	29,638,959	22,409,846	19,286,905	26,680,617	23,447,200
Dominion Chesapeake Energy Center	41,070,023	37,711,371	40,777,823	36,222,677	35,255,050	38,207,389	34,853,246
Heco Waiiau	14,673,660	14,397,785	14,935,405	13,320,107	14,884,983	14,442,388	14,080,684
OG&E - Muskogee	106,454,236	104,916,428	87,737,665	104,566,459	92,434,936	99,221,945	90,739,465
PSHNNH - Merrimack	34,045,565	34,410,607	36,317,955	30,332,534	25,319,652	32,085,263	26,821,184
TVA Gallatin	73,113,053	74,908,225	77,474,644	79,699,781	64,123,359	73,863,812	71,515,151

1.2 Development of Emission Factors

For several of the case study facilities, emission factors were used as the best available alternative source of emissions information because appropriate facility-specific stack test data were not available to compute emissions. The case study facilities using emission factors that were not based on site-specific stack test data are Conesville (3% of the risk driver emissions), PSHNNH – Merrimack (35%), and all risk driver emissions at Chesapeake Bay Energy Center, Dominion – Yorktown, OG&E – Muskogee, and Amerenue-Labadie. The risk driver emissions are those emissions that contributed the most to the total facility risk. The emission factors used in these cases were recalculated based on revised methods that had not been used at the time of proposal, including the use of well-established, robust outlier checks (Dixon or Rosner tests), depending on the number of values and when more than three values were evaluated.

The complete documentation for the arsenic, chromium, and nickel emission factors is available in the docket in separate documents: [Coal_Fired_UTILITY_Boiler_Arsenic.pdf](#), [Coal_Fired_UTILITY_Boiler_Chromium.pdf](#), and [Coal_Fired_UTILITY_Boiler_Nickel.pdf](#). The same hexavalent chromium percentages of total chromium used at proposal were used for the final rule analysis (12% for coal units and 18% for oil units).

1.3 Emissions Estimates

Tables 2 through 4 give the estimated emissions for the facilities remodeled. These emissions estimates reflect the changes in heat inputs and emission factors described above. While the average values shown were not used in the modeling (the year-specific values were used), they are provided for comparison to the emissions values used at proposal. The detailed calculations and unit-level emissions are available in the case study emissions spreadsheet.

Table 2: Final case study arsenic emissions (tons/year) compared to emissions used at proposal.

Facility	2005	2006	2007	2008	2009	Average	Proposed Rule
Amerenue-Labadie	1.05E+00	1.06E+00	1.14E+00	1.03E+00	1.04E+00	1.07E+00	1.72E+00
City Utilities of Springfield -James River	1.96E-02	1.90E-02	1.63E-02	1.82E-02	1.43E-02	1.75E-02	1.78E-02
Conesville	1.65E-01	1.46E-01	1.76E-01	1.76E-01	1.13E-01	1.55E-01	3.26E-01
Dominion - Yorktown	2.29E-01	1.32E-01	1.73E-01	1.35E-01	1.17E-01	1.57E-01	2.09E-01
Dominion Chesapeake Energy Center	2.57E-01	2.36E-01	2.55E-01	2.26E-01	2.20E-01	2.39E-01	3.46E-01
Heco Waiiau	2.53E-02	2.50E-02	2.56E-02	2.30E-02	2.57E-02	2.49E-02	2.46E-02
OG&E -Muskogee	6.65E-01	6.56E-01	5.48E-01	6.54E-01	5.78E-01	6.20E-01	9.11E-01
PSHNNH -Merrimack	2.76E-01	2.79E-01	2.94E-01	2.46E-01	2.05E-01	2.60E-01	2.33E-01
TVA Gallatin	1.45E-02	1.49E-02	1.54E-02	1.58E-02	1.27E-02	1.47E-02	1.42E-02

Table 3: Final case study hexavalent chromium emissions (tons/year) compared to emissions used at proposal.

Facility	2005	2006	2007	2008	2009	Average	Proposed Rule
Amerenue-Labadie	4.94E-01	4.99E-01	5.35E-01	4.86E-01	4.88E-01	5.00E-01	5.77E-01
City Utilities of Springfield -James River	5.55E-01	5.42E-01	4.66E-01	5.24E-01	4.13E-01	5.00E-01	4.99E-01
Conesville	4.06E-01	2.85E-01	3.77E-01	4.53E-01	2.74E-01	3.59E-01	6.74E-01
Dominion - Yorktown	1.51E+00	2.84E-01	7.78E-01	3.67E-01	2.51E-01	6.37E-01	4.25E-01
Dominion Chesapeake Energy Center	1.20E-01	1.11E-01	1.20E-01	1.06E-01	1.03E-01	1.12E-01	1.27E-01
Heco Waiiau	2.86E-03	2.89E-03	2.86E-03	2.60E-03	2.91E-03	2.82E-03	2.87E-03
OG&E -Muskogee	3.12E-01	3.08E-01	2.57E-01	3.07E-01	2.71E-01	2.91E-01	3.06E-01
PSHNNH -Merrimack	3.69E-02	3.73E-02	3.94E-02	3.29E-02	2.75E-02	3.48E-02	4.77E-02
TVA Gallatin	1.16E+00	1.19E+00	1.23E+00	1.27E+00	1.02E+00	1.17E+00	1.14E+00

Table 4: Final case study nickel emissions (tons/year) compared to emissions used at proposal.

Facility	2005	2006	2007	2008	2009	Average	Proposed Rule
Amerenue-Labadie	2.31E+00	2.33E+00	2.50E+00	2.27E+00	2.28E+00	2.34E+00	4.21E+00
City Utilities of Springfield -James River	3.36E+00	3.27E+00	2.80E+00	3.15E+00	2.48E+00	3.01E+00	3.03E+00
Conesville	3.26E+00	2.59E+00	3.25E+00	3.55E+00	2.21E+00	2.97E+00	3.95E+00
Dominion - Yorktown	7.26E+01	1.18E+01	3.63E+01	1.59E+01	1.04E+01	2.94E+01	1.84E+01
Dominion Chesapeake Energy Center	5.63E-01	5.17E-01	5.59E-01	4.96E-01	4.83E-01	5.23E-01	8.89E-01
Heco Waiiau	3.96E+00	3.93E+00	4.01E+00	3.60E+00	4.02E+00	3.90E+00	3.87E+00
OG&E -Muskogee	1.46E+00	1.44E+00	1.20E+00	1.43E+00	1.27E+00	1.36E+00	2.23E+00
PSHNNH -Merrimack	1.55E-01	1.56E-01	1.65E-01	1.38E-01	1.15E-01	1.46E-01	2.85E-01
TVA Gallatin	5.48E+00	5.61E+00	5.80E+00	5.97E+00	4.80E+00	5.53E+00	5.35E+00

Annual emissions estimates for all case study facilities are given in Table 5, including estimates for facilities that have been revised as discussed above, and the same estimates used at the time of proposal for facilities without revised emissions estimates.

Table 5. Case study average annual emissions (2005-2009).

Facility	Location	Unit Type	Unit ID	As (TPY)	Cr ⁺⁶ (TPY)	Ni (TPY)
Xcel Bayfront	Ashland, WI	1 coal	5			
Cambria Cogen	Ebensburg, PA	2 coal	B1	1.00E-03	3.60E-02	2.20E-01
			B2	1.10E-03	7.80E-03	7.20E-02
SC&E Canadys	Canadys, SC	3 coal	CAN001	5.10E-02	1.90E-02	1.30E-01
			CAN002	4.90E-02	1.80E-02	1.30E-01
			CAN003	2.20E-02	2.40E-03	9.60E-02
Dominion Chesapeake Energy Center*	Chesapeake, VA	4 coal	Unit 1	4.1E-02	1.9E-02	8.9E-02
			Unit 2	4.4E-02	2.1E-02	9.6E-02
			Unit 3	6.5E-02	3.0E-02	1.4E-01
			Unit 4	9.0E-02	4.2E-02	2.0E-01
Conesville*	Conesville, OH	4 coal	3	4.6E-02	3.3E-01	1.8E+00
			4	4.7E-02	1.1E-02	5.1E-01
			5	3.2E-02	7.2E-03	3.5E-01
			6	3.0E-02	6.9E-03	3.3E-01
Exelon Cromby Generating Station	Phoenixville, PA	1 coal	Unit 1	6.60E-02	3.00E-03	1.80E-02
		1 oil	Unit 2	2.40E-03	6.00E-04	3.40E-01
TVA Gallatin*	Gallatin, TN	4 coal	1	3.5E-03	2.8E-01	1.3E+00
			2	3.4E-03	2.8E-01	1.3E+00
			3	3.9E-03	3.2E-01	1.5E+00
			4	3.8E-03	3.1E-01	1.4E+00
City Utilities of Springfield -James River*	Springfield, MO	3 coal	3	3.9E-03	1.0E-01	6.3E-01
			4	4.2E-03	3.8E-02	4.1E-01
			5	9.4E-03	3.6E-01	2.0E+00
Amerenuue-Labadie*	Labadie, MO	4 coal	1	2.4E-01	1.1E-01	5.4E-01
			2	2.7E-01	1.3E-01	5.9E-01
			3	2.7E-01	1.3E-01	6.0E-01
			4	2.8E-01	1.3E-01	6.1E-01
PSHNNH –Merrimack*	Bow, NH	2 coal	1	7.8E-02	1.0E-02	4.4E-02
			2	1.8E-01	2.4E-02	1.0E-01
Monticello Steam Electric Plant	Mount Pleasant, TX	3 coal	1	6.10E-02	1.16E-01	4.10E-01
			2	6.20E-02	1.17E-01	4.10E-01

Facility	Location	Unit Type	Unit ID	As (TPY)	Cr ⁺⁶ (TPY)	Ni (TPY)
			3	1.10E-01	1.98E-02	1.70E-01
OG&E –Muskogee*	Fort Gibson, OK	3 coal	4	2.0E-01	9.5E-02	4.4E-01
			5	2.0E-01	9.3E-02	4.4E-01
			6	2.2E-01	1.0E-01	4.8E-01
			GEN1	8.40E-04	3.10E-04	2.40E-03
Spruance Genco	Richmond, VA	8 coal	GEN2	9.00E-04	3.20E-04	8.30E-03
			GEN3	3.50E-03	5.60E-04	6.20E-03
			GEN4	2.40E-03	3.60E-04	4.10E-03
PSI Energy – Wabash River	West Terre Haute, IN	1 coal-gas	PG7221FA	1.30E-03	7.50E-04	5.00E-03
		2 coal	4	1.10E-01	4.50E-03	4.10E-02
			6	3.30E-01	1.40E-02	1.20E-01
Heco Waiiau*	Waiiau, HI	6 oil	W3	2.0E-03	2.1E-04	3.2E-01
			W4	2.0E-03	2.1E-04	3.0E-01
			W5	2.8E-03	2.9E-04	4.3E-01
			W6	2.1E-03	1.2E-04	3.2E-01
			W7	8.5E-03	1.2E-03	1.4E+00
			W8	7.5E-03	7.9E-04	1.2E+00
Dominion – Yorktown*	Yorktown, VA	2 coal	Units 1&2	1.2E-01	5.6E-02	2.6E-01
		1 oil	Unit 3	3.9E-02	5.8E-01	2.9E+01

* Facility was remodeled for the final rule. Facilities not remodeled for the final rule have the same annual emissions estimate for each year.

2. Dispersion Modeling

The methodology used for dispersion modeling of the case study facilities was discussed in more detail in the previous document.² The modeling was done using AERMOD, EPA’s preferred model for near-field dispersion. Table 6 provides the model scenario information used for the case study facilities. This information is unchanged from the proposed rule. Table 7 provides the stack parameters used for the final rule modeling.

Table 6. Model scenario information.

Facility	Downwash	Urban/rural (population)	Surface station	Upper air station
Xcel Bayfront	No	Rural	Ashland Kennedy Memorial Airport, WI	Minneapolis, MN
Cambria Cogen	Yes	Rural	Johnstown Cambria County Airport, PA	Pittsburgh, PA
SC&E Canadys	No	Rural	Charleston Intl. Airport, SC	Charleston Intl. Airport, SC
Dominion Chesapeake Energy Center*	No	Urban (200,000)	Norfolk Intl. Airport, VA	Washington Dulles, VA
Conesville*	No	Rural	Zanesville Municipal Airport, OH	Wilmington, OH
Exelon Cromby Generating Station	No	Rural	Philadelphia Intl. Airport, PA	Washington Dulles, VA
TVA Gallatin*	No	Rural	Nashville Intl. Airport, TN	Nashville Intl. Airport, TN
City Utilities of Springfield -James River*	No	Rural	Springfield Regional Airport, MO	Springfield Regional Airport, MO
Amerenue-Labadie*	No	Rural	St. Louis Lambert Intl. Airport, MO	Lincoln, IL
PSHNNH –Merrimack*	No	Rural	Concord Municipal Airport, NH	Albany, NY
Monticello Steam Electric Plant	No	Rural	Tyler Pounds Field, TX	Shreveport, LA
OG&E –Muskogee*	No	Rural	Muskogee Davis Field, OK	Norman, OK
Spruance Genco	No	Urban (200,000)	Richmond Intl. Airport, VA	Washington Dulles, VA
PSI Energy – Wabash River	No	Rural	Terre Haute Hulman Regional Airport, IN	Wilmington, OH
Heco Waiiau*	Yes	Urban (300,000)	Honolulu Intl Airport, HI	Lihue, HI
Dominion – Yorktown*	Yes	Rural	Newport News Intl. Airport, VA	Washington Dulles, VA

* Facility was remodeled for the final rule.

² Non-Hg Case Study Chronic Inhalation Risk Assessment for the Utility MACT “Appropriate and Necessary” Analysis, March 16, 2011. Docket ID No. EPA-HQ-OAR-2009-0234-2939. Available at www.regulations.gov.

Table 7. Stack parameter data.

Facility	Location	Unit Type	Unit ID	Lat	Long	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)
Xcel Bayfront	Ashland, WI	1 coal	5	46.5872	-90.9018	59.44	371.48	13.05	1.86
Cambria Cogen	Ebensburg, PA	2 coal	B1	40.4748	-78.703	70.10	466.48	27.83	2.29
			B2	40.4748	-78.703	70.10	466.48	27.83	2.29
SC&E Canadys	Canadys, SC	3 coal	CAN001	33.0646	-80.6235	60.96	415.37	11.00	4.88
			CAN002	33.0653	-80.6232	60.96	412.04	12.62	4.88
			CAN003	33.065	-80.6218	60.96	413.71	19.93	4.88
Dominion Chesapeake Energy Center*	Chesapeake, VA	4 coal	Unit 1	36.7705	-76.3012	53.34	430.35	17.37	3.97
			Unit 2	36.7706	-76.3011	53.34	429.25	17.37	3.97
			Unit 3	36.7709	-76.3009	60.96	407.05	17.98	3.97
			Unit 4	36.7712	-76.3008	60.96	427.05	21.34	4.27
Conesville*	Conesville, OH	4 coal	3	40.1648	-81.9044	137.16	416.48	10.31	5.33
			4	40.1862	-81.8787	243.84	416.48	25.30	7.93
			5	40.1856	-81.8798	243.84	324.82	23.90	7.93
			6	40.1856	-81.8798	243.84	324.82	23.90	7.93
Exelon Cromby Generating Station	Phoenixville, PA	1 coal	Unit 1	40.1524	-75.5303	91.44	388.71	17.92	4.27
		1 oil	Unit 2	40.152	-75.5304	91.44	388.71	17.11	4.27
TVA Gallatin*	Gallatin, TN	4 coal	1	36.3156	-86.4005	152.70	406.48	17.07	7.62
			2	36.3156	-86.4005	152.70	406.48	17.07	7.62
			3	36.3151	-86.4009	153.01	395.37	18.90	7.62
			4	36.3151	-86.4009	153.01	395.37	18.90	7.62
City Utilities of Springfield - James River*	Springfield, MO	3 coal	3	37.1084	-93.2602	60.96	427.59	9.45	3.65
			4	37.1084	-93.2598	60.96	427.59	10.06	3.65
			5	37.1084	-93.2605	106.68	433.15	27.70	3.12
Amerenue-Labadie*	Labadie, MO	4 coal	1	38.5626	-90.8381	213.36	436.21	32.66	6.25
			2	38.5621	-90.8377	213.36	424.21	30.32	6.25
			3	38.5614	-90.8371	213.36	413.54	31.96	6.25
			4	38.5614	-90.8371	213.40	446.93	34.83	6.25
PSHNH – Merrimack*	Bow, NH	2 coal	1	43.142	-71.4685	68.58	391.48	41.98	2.62
			2	43.1418	-71.4682	96.62	422.04	36.92	4.42

Facility	Location	Unit Type	Unit ID	Lat	Long	Stack Height (m)	Stack Temperature (K)	Stack Velocity (m/s)	Stack Diameter (m)
Monticello Steam Electric Plant	Mount Pleasant, TX	3 coal	1	33.0907	-95.0375	121.92	453.15	24.69	6.55
			2	33.0914	-95.038	121.92	453.15	24.69	6.55
			3	33.0923	-95.0378	140.21	354.26	26.52	2.44
OG&E – Muskogee*	Fort Gibson, OK	3 coal	4	35.7618	-95.2886	106.68	402.04	14.02	7.31
			5	35.7619	-95.288	106.68	402.04	14.02	7.31
			6	35.7621	-95.2872	152.40	402.04	25.13	6.55
Spruance Genco	Richmond, VA	8 coal	GEN1	37.4552	-77.4312	76.20	355.37	17.03	2.62
			GEN2	37.4555	-77.4309	76.20	355.37	17.03	2.62
			GEN3	37.4557	-77.4307	76.20	355.37	17.03	2.62
			GEN4	37.4559	-77.4304	76.20	355.37	17.03	2.62
PSI Energy – Wabash River	West Terre Haute, IN	1 coal-gas	PG7221FA	39.5303	-87.4256	68.58	452.59	19.17	5.49
		2 coal	4	39.5274	-87.4232	137.16	410.93	34.26	7.62
			6	39.5274	-87.4232	137.16	410.93	34.26	7.62
Heco Waiiau*	Waiiau, HI	6 oil	W3	21.3891	-157.9615	42.09	469.26	12.25	3.05
			W4	21.389	-157.9613	42.09	469.26	12.25	3.05
			W5	21.3888	-157.9612	41.91	414.26	12.25	2.74
			W6	21.3887	-157.961	41.91	414.26	12.25	2.74
			W7	21.3885	-157.9606	41.91	392.04	16.12	3.20
			W8	21.3884	-157.9603	41.91	392.04	16.12	3.20
Dominion – Yorktown*	Yorktown, VA	2 coal	Units 1&2	37.2154	-76.4622	98.80	417.35	22.60	4.90
		1 oil	Unit 3	37.2152	-76.4612	149.05	415.93	33.52	6.86

* Facility was remodeled for the final rule.

The list below discusses the inputs used in the modeling of the case study facilities for the final rule, and notes where there were differences compared to the proposed rule.

1. Each boiler or combination of boilers was modeled as an individual emission point in AERMOD, unchanged from the proposed rule analysis.
2. Hourly emissions for 2005-2009 were modeled explicitly for each emission point for arsenic, chromium (VI), and nickel. Five-year average concentrations were calculated within AERMOD. For the proposed rule analysis, a unit emission rate (1 gram per second) was used, and the resulting hourly concentrations were scaled using hourly heat input values to derive pollutant-specific 5-year average concentrations calculated outside of AERMOD. This methodology difference does not change the concentration estimates.
3. Building parameterization and surface characteristics were unchanged from the proposed rule analysis.
4. Some stack parameters changed because of new data received during the public comment period.
5. Current versions of AERMINUTE (11059) and AERMET (11059) were used, and the meteorological data used for the proposed rule analysis were reprocessed using these versions. Beta versions of AERMINUTE and AERMET were used for the proposed rule analysis.
6. Receptor locations (Census blocks within 20 km of the source) were unchanged from the proposed rule analysis. The current version of AERMAP (11103) was used to calculate source and receptor elevations, whereas version 09040 was used for the proposed rule analysis.
7. The current version of AERMOD (11103) was used. A beta version of AERMOD was used for the proposed rule analysis.

As noted above, updated versions of AERMAP, AERMINUTE, AERMET, and AERMOD were used in the modeling of the case study facilities for the final rule. The changes between versions 09040 and 11103 of AERMAP resulted in no differences in elevations of sources and receptors. The meteorological data used for the proposed rule were reprocessed using versions 11059 of AERMINUTE and AERMET, and processed along with the proposal emission inputs in version 11103 of AERMOD to compare differences due to AERMET and AERMOD changes. The differences in the modeled concentrations were insignificant between the beta and current versions of AERMET and AERMOD.

3. Chronic Inhalation Risk Assessment

For chronic inhalation exposures, we used the 5-year average ambient concentrations of HAP estimated from the refined dispersion modeling. The estimated ambient concentration at each nearby census block centroid was used as a surrogate for the chronic inhalation exposure concentration for all the people who reside in that census block. We assessed non-cancer health effects from chronic exposures by comparing the chronic inhalation exposure concentration to the Reference Concentration values. We calculated the maximum individual risk, or MIR, for each facility as the cancer risk associated with a continuous lifetime (24 hours per day, 7 days per week, and 52 weeks per year for a 70-year period) exposure to the maximum concentration at the centroid of an inhabited census block. Individual cancer risks were calculated by multiplying

the estimated lifetime exposure to the ambient concentration of each HAP (in micrograms per cubic meter) by its cancer unit risk estimate (URE), which is an upper bound estimate of an individual's probability of contracting cancer over a lifetime of exposure to a concentration of 1 microgram of the pollutant per cubic meter of air. We used URE values for arsenic and hexavalent chromium from EPA's Integrated Risk Information System (IRIS), which is a human health assessment program that evaluates quantitative and qualitative risk information on effects that may result from exposure to environmental contaminants. Unit risk estimates in IRIS have undergone both internal and external peer review.

In the preamble to the proposed rule, we discussed the reasons for using 65% of the IRIS URE for nickel subsulfide for all nickel compounds. In July 2011, we completed an external peer review (using three independent expert reviewers) of the methods used to evaluate the risks from nickel compounds emitted by EGUs in a report titled, "Methods to Develop Inhalation Cancer Risk Estimates for Chromium and Nickel Compounds."³ Based on the views of major scientific bodies such as the International Agency for Research on Cancer (IARC), the World Health Organization (WHO), and the European Union's Scientific Committee on Health and Environmental Risks (SCHER), and those of the expert peer reviewers who commented on our approaches to risk characterization of nickel compounds, we consider all nickel compounds to be carcinogenic as a group and do not consider nickel speciation or nickel solubility to be strong determinants of nickel carcinogenicity.

Based on this review, we decided to use 100 percent of the current IRIS URE for nickel subsulfide, rather than assuming that 65 percent of the total mass of emitted nickel might be nickel subsulfide, as used in previous analyses. We used the IRIS URE value because IRIS values are typically preferred for use in HAP risk assessments performed in support of air toxics regulations under the Clean Air Act.⁴ The IRIS values are preferred because they are developed in accordance with EPA risk assessment guidelines and because of the level of peer review IRIS values receive. We used 100 percent of the IRIS value because of the concerns about the potential carcinogenicity of all forms of nickel raised by the major national and international scientific bodies. Nevertheless, taking into account that there are potential differences in toxicity and/or carcinogenic potential across the different nickel compounds, and given that there have been two URE values derived for exposure to mixtures of nickel compounds that are 2-3 fold lower than the IRIS URE for nickel subsulfide⁵, the EPA also considers it reasonable to use a value that is 50 percent of the IRIS URE for nickel subsulfide for providing an estimate of the lower end of a plausible range of cancer potency values for different mixtures of nickel compounds.

The health reference values used in the assessment are given in Table 8.

³ Mercury and Air Toxics Standards Rule Docket, ID No. EPA-HQ-OAR-2009-0234. Available at www.regulations.gov.

⁴ <http://www.epa.gov/ttn/atw/toxsource/chronicpriority.html>

⁵ Two UREs (other than the current IRIS values) have been derived for nickel compounds: one developed by the California Department of Health Services (http://www.arb.ca.gov/toxics/id/summary/nickel_tech_b.pdf) and the other by the Texas Commission on Environmental Quality (<http://www.epa.gov/ttn/atw/nata1999/99pdfs/healtheffectsinfo.pdf>).

Table 8. Health reference values used in the assessment.

Pollutant	CAS Number	URE (1/μg/m3)	Source	RfC (mg/m³)	Source
Arsenic	7440382	4.3E-03	IRIS	0.000015	CalEPA
Chromium (VI)	18540299	0.012	IRIS	0.0001	IRIS
Nickel	7440020	0.00048	IRIS	0.00009	CalEPA
HCl	7647010			0.02	IRIS

3. Results.

The results of the assessment are given in Table 9. Based on estimated actual emissions, the highest estimated lifetime cancer risk from any of the sixteen case study facilities was 20 in a million, driven by nickel emissions from the one case study facility with only oil-fired EGUs. For the facilities with coal-fired EGUs, there were five with maximum cancer risks greater than 1 in a million (the highest was five in a million), four driven by hexavalent chromium, and one driven by nickel from an oil-fired EGU. There were also two facilities with coal-fired EGUs with cancer risks at 1 in a million. All of the facilities had non-cancer target-organ-specific hazard index (HI) values less than one, with a maximum HI value of 0.4 (also driven by nickel emissions from the one case study facility with only oil-fired EGUs).

The cancer risk estimates from this assessment indicate that the EGU source category would not be eligible for delisting under section 112(c)(9)(B)(i) of the CAA, which specifies that a category may be delisted only when the Administrator determines "... that no source in the category (or group of sources in the case of area sources) emits such hazardous air pollutants in quantities which may cause a lifetime risk of cancer greater than one in one million to the individual in the population who is most exposed to emissions of such pollutants from the source...." We note that, since these case studies do not cover all facilities in the category, and since our assessment does not include the potential for impacts from different EGU facilities to overlap one another (i.e., these case studies only look at facilities in isolation), the maximum risk estimates from the case studies may underestimate true maximum risks.

Table 9. Chronic inhalation risk assessment results.

Facility	Proposed Rule Assessment				Final Rule Assessment			
	Max Risk	Risk Driver	Max HI	HI Driver	Max risk	Risk Driver	Max HI	HI Driver
Xcel Bayfront	4.0x10 ⁻⁹	Formaldehyde	0.005	HCl	Not Remodeled			
Cambria Cogen	5.0x10 ⁻⁷	Chromium VI	0.003	Nickel	Not Remodeled			
SC&E Canadys	6.0x10 ⁻⁷	Arsenic	0.009	HCl	Not Remodeled			
Dominion Chesapeake Energy Center	3.0x10 ⁻⁶	Chromium VI	0.05	HCl	2x10 ⁻⁶	Chromium VI	0.05 ^a	HCl ^a
Conesville	3.0x10 ⁻⁶	Chromium VI	0.01	Nickel	2x10 ⁻⁶	Chromium VI	0.008	Nickel
Exelon Cromby Generating Station	3.0x10 ⁻⁷	Arsenic	0.008	Nickel	Not Remodeled			
TVA Gallatin	1.0x10 ⁻⁶	Chromium VI	0.006	Nickel	2x10 ⁻⁶	Chromium VI	0.007	Nickel
City Utilities of Springfield - James River	8.0x10 ⁻⁶	Chromium VI	0.04	Nickel	5x10 ⁻⁶	Chromium VI	0.03	Nickel
Amerenue-Labadie	8.0x10 ⁻⁷	Arsenic	0.006	Arsenic	7x10 ⁻⁷	Chromium VI	0.004	Arsenic
PSHNNH - Merrimack	1.0x10 ⁻⁶	Arsenic	0.01	Arsenic	1x10 ⁻⁶	Arsenic	0.01	Arsenic
Monticello Steam Electric Plant	6.0x10 ⁻⁷	Chromium VI	0.003	Arsenic	Not Remodeled			
OG&E - Muskogee	1.0x10 ⁻⁶	Arsenic	0.01	Arsenic	1x10 ⁻⁶	Chromium VI	0.008	Arsenic
Spruance Genco	8.0x10 ⁻⁸	Arsenic	0.007	HCl	Not Remodeled			
PSI Energy – Wabash River	1.0x10 ⁻⁷	Arsenic	0.001	Arsenic	Not Remodeled			
Heco Waiiau	1.0x10 ⁻⁵	Nickel	0.4	Nickel	2x10 ^{-5^b}	Nickel	0.4	Nickel
Dominion - Yorktown	1.0x10 ⁻⁶	Chromium VI	0.02	Nickel	2x10 ^{-6^b}	Nickel	0.03	Nickel

^a Although HCl was not included in the remodeling of this facility, HCl was the HI driver pollutant at proposal, and this is carried through for the final rule assessment.

^b Based on considering the emitted nickel to be 100% as potent a carcinogen as pure nickel subsulfide; if we consider the emitted nickel to be 50% as potent a carcinogen as nickel subsulfide (see text), estimated risks would be 1x10⁻⁵ for Heco Waiiau and 1x10⁻⁶ for Dominion - Yorktown.

United States
Environmental Protection
Agency

Office of Air Quality Planning and Standards
Research Triangle Park, NC

Publication No. EPA-452/R-11-013
November 2011
