



## Appendix G

# Radiological Airborne Emissions at Oak Ridge National Laboratory

This appendix presents annual radioactive airborne emissions for ORNL in 2021. All data were determined to be statistically different from zero at the 95 percent confidence level. Any number not statistically different from zero was not included in the emission calculation. Because measuring a radionuclide requires counting random radioactive emissions from a sample, the same result may not be obtained if the sample is analyzed repeatedly. This deviation is referred to as the “counting uncertainty.” Statistical significance at the 95 percent confidence level means that there is a 5 percent chance that the results could be erroneous.

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup>

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total		
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911	X-8915
<sup>223</sup> Ac	B	unspecified									3.97E-13	3.97E-13
<sup>225</sup> Ac	M	particulate									3.39E-07	3.39E-07
<sup>227</sup> Ac	M	particulate									1.4E-08	1.4E-08
<sup>108</sup> Ag	B	unspecified									1.82E-18	1.82E-18
<sup>108m</sup> Ag	M	particulate									1.9E-17	1.9E-17
<sup>109m</sup> Ag	B	unspecified									6.31E-12	6.31E-12
<sup>110</sup> Ag	B	unspecified									2.1E-10	2.1E-10
<sup>110m</sup> Ag	M	particulate									2.97E-08	2.97E-08
<sup>111</sup> Ag	M	particulate									1.65E-10	1.65E-10
<sup>112</sup> Ag	M	particulate									3.95E-09	3.95E-09
<sup>26</sup> Al	M	particulate									2.99E-06	2.99E-06
<sup>241</sup> Am	M	particulate	3.40E-08	6.03E-07					7.60E-10		9.22E-06	9.86E-06
<sup>241</sup> Am	F	particulate			1.14E-07		4.95E-09	5.38E-07			7.64E-10	6.58E-07
<sup>242</sup> Am	M	particulate									1.52E-08	1.52E-08
<sup>242m</sup> Am	M	particulate									1.52E-08	1.52E-08
<sup>243</sup> Am	M	particulate									7.56E-08	7.56E-08
<sup>244</sup> Am	M	particulate									3.03E-29	3.03E-29
<sup>37</sup> Ar	B	unspecified									4.6E-04	4.6E-04
<sup>39</sup> Ar	B	unspecified									9.96E-05	9.96E-05
<sup>41</sup> Ar	B	unspecified						1.39E+03	1.80E+03			3.19E+03
<sup>42</sup> Ar	B	unspecified									2.85E-10	2.85E-10
<sup>73</sup> As	M	particulate									1.92E-16	1.92E-16
<sup>74</sup> As	M	particulate									4.21E-14	4.21E-14
<sup>195</sup> Au	M	particulate									4.57E-16	4.57E-16
<sup>199</sup> Au	M	particulate									1.14E-10	1.14E-10
<sup>133</sup> Ba	M	particulate									3.41E-12	3.41E-12
<sup>137m</sup> Ba	B	unspecified									1.13E-03	1.13E-03
<sup>139</sup> Ba	M	particulate							6.36E-01			6.36E-01
<sup>140</sup> Ba	M	particulate							6.40E-04		5.22E-10	6.4E-04
<sup>10</sup> Be	M	particulate									5.69E-13	5.69E-13

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack							Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911			X-8915
<sup>7</sup> Be	M	particulate	5.71E-07	6.18E-08							6.41E-06	7.04E-06
<sup>7</sup> Be	S	particulate			5.29E-06		4.60E-08				2.76E-06	8.1E-06
<sup>206</sup> Bi	M	particulate									3.23E-11	3.23E-11
<sup>207</sup> Bi	M	particulate									6.28E-16	6.28E-16
<sup>208</sup> Bi	B	unspecified									8.67E-17	8.67E-17
<sup>210</sup> Bi	M	particulate									2.26E-16	2.26E-16
<sup>210m</sup> Bi	M	particulate									4.0E-17	4.0E-17
<sup>211</sup> Bi	B	unspecified									5.82E-11	5.82E-11
<sup>212</sup> Bi	M	particulate									5.02E-10	5.02E-10
<sup>249</sup> Bk	M	particulate									7.0E-11	7.0E-11
<sup>82</sup> Br	M	particulate									5.05E-11	5.05E-11
<sup>11</sup> C	G	dioxide								2.00E+04		2.00E+04
<sup>14</sup> C	M	particulate									1.43E-07	1.43E-07
<sup>41</sup> Ca	M	particulate									7.05E-09	7.05E-09
<sup>45</sup> Ca	M	particulate									4.35E-06	4.35E-06
<sup>109</sup> Cd	M	particulate									4.95E-11	4.95E-11
<sup>113</sup> Cd	M	particulate									1.86E-26	1.86E-26
<sup>113m</sup> Cd	M	particulate									2.3E-07	2.3E-07
<sup>115</sup> Cd	M	particulate									1.43E-09	1.43E-09
<sup>115m</sup> Cd	M	particulate									6.98E-12	6.98E-12
<sup>133m</sup> Ce	B	unspecified									3.19E-14	3.19E-14
<sup>134</sup> Ce	M	particulate									2.77E-09	2.77E-09
<sup>139</sup> Ce	M	particulate									1.72E-08	1.72E-08
<sup>141</sup> Ce	M	particulate									2.7E-06	2.7E-06
<sup>143</sup> Ce	M	particulate									1.08E-09	1.08E-09
<sup>144</sup> Ce	M	particulate									2.3E-05	2.3E-05
<sup>249</sup> Cf	M	particulate									5.36E-16	5.36E-16
<sup>250</sup> Cf	M	particulate									7.69E-16	7.69E-16
<sup>251</sup> Cf	M	particulate									3.89E-18	3.89E-18
<sup>252</sup> Cf	F	particulate									5.62E-10	5.62E-10
<sup>252</sup> Cf	M	particulate						1.02E-08			2.29E-08	3.31E-08
<sup>36</sup> Cl	M	particulate									1.38E-10	1.38E-10

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack							Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911			X-8915
<sup>241</sup> Cm	M	particulate									5.73E-53	5.73E-53
<sup>242</sup> Cm	M	particulate									6.72E-09	6.72E-09
<sup>243</sup> Cm	F	particulate			2.71E-09		1.79E-08	2.35E-08			2.4E-10	4.43E-08
<sup>243</sup> Cm	M	particulate	1.25E-07	6.15E-09		8.75E-11			5.20E-10		9.19E-07	1.05E-06
<sup>244</sup> Cm	M	particulate	1.25E-07	6.15E-09		8.75E-11			5.20E-10		1.0E-05	1.02E-05
<sup>244</sup> Cm	F	particulate			2.71E-09		1.79E-08	2.35E-08			2.4E-10	4.43E-08
<sup>245</sup> Cm	M	particulate									1.42E-08	1.42E-08
<sup>246</sup> Cm	M	particulate									1.41E-08	1.41E-08
<sup>247</sup> Cm	M	particulate									1.59E-11	1.59E-11
<sup>248</sup> Cm	M	particulate									4.65E-09	4.65E-09
<sup>56</sup> Co	M	particulate									2.03E-09	2.03E-09
<sup>57</sup> Co	M	particulate									2.38E-07	2.38E-07
<sup>58</sup> Co	M	particulate									4.21E-05	4.21E-05
<sup>60</sup> Co	M	particulate									2.21E-04	2.21E-04
<sup>60</sup> Co	S	particulate						1.75E-07				1.75E-07
<sup>60m</sup> Co	M	particulate									7.33E-13	7.33E-13
<sup>51</sup> Cr	M	particulate									5.41E-04	5.41E-04
<sup>131</sup> Cs	F	particulate									1.21E-12	1.21E-12
<sup>132</sup> Cs	F	particulate									2.84E-17	2.84E-17
<sup>134</sup> Cs	F	particulate									1.36E-04	1.36E-04
<sup>135</sup> Cs	F	particulate									3.14E-09	3.14E-09
<sup>136</sup> Cs	F	particulate									7.86E-10	7.86E-10
<sup>137</sup> Cs	F	particulate	5.21E-07	3.93E-06		7.65E-08			9.20E-06		1.46E-03	1.48E-03
<sup>137</sup> Cs	S	particulate			1.42E-05		4.74E-08				6.38E-06	2.06E-05
<sup>138</sup> Cs	F	particulate							2.50E+03			2.50E+03
<sup>64</sup> Cu	M	particulate									4.2E-13	4.2E-13
<sup>159</sup> Dy	M	particulate									7.34E-16	7.34E-16
<sup>169</sup> Er	M	particulate									5.95E-08	5.95E-08
<sup>253</sup> Es	M	particulate									1.31E-77	1.31E-77
<sup>152</sup> Eu	M	particulate									7.42E-07	7.42E-07
<sup>154</sup> Eu	M	particulate									3.6E-05	3.6E-05
<sup>155</sup> Eu	M	particulate									1.43E-05	1.43E-05

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack							Total Minor Sources	ORNL Total
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911		
<sup>156</sup> Eu	M	particulate								2.13E-09	2.13E-09
<sup>55</sup> Fe	M	particulate								5.8E-04	5.8E-04
<sup>59</sup> Fe	M	particulate								1.84E-05	1.84E-05
<sup>60</sup> Fe	M	particulate								4.55E-13	4.55E-13
<sup>68</sup> Ga	M	particulate								1.32E-10	1.32E-10
<sup>148</sup> Gd	M	particulate								1.08E-07	1.08E-07
<sup>151</sup> Gd	M	particulate								5.9E-12	5.9E-12
<sup>152</sup> Gd	M	particulate								2.78E-25	2.78E-25
<sup>153</sup> Gd	M	particulate								7.79E-06	7.79E-06
<sup>159</sup> Gd	M	particulate								2.56E-15	2.56E-15
<sup>68</sup> Ge	M	particulate								7.37E-12	7.37E-12
<sup>71</sup> Ge	M	particulate								2.58E-10	2.58E-10
<sup>3</sup> H	V	vapor	1.99E-03		8.56E-01	1.25E-02	6.70E-01	6.58E+01	9.67E+02	2.47E-01	1.03E+03
<sup>172</sup> Hf	M	particulate								1.05E-08	1.05E-08
<sup>175</sup> Hf	M	particulate								4.14E-06	4.14E-06
<sup>178m</sup> Hf	M	particulate								4.17E-08	4.17E-08
<sup>179m</sup> Hf	M	particulate								1.52E-08	1.52E-08
<sup>181</sup> Hf	M	particulate								1.05E-04	1.05E-04
<sup>182</sup> Hf	M	particulate								2.77E-12	2.77E-12
<sup>203</sup> Hg	M	inorganic								2.29E-09	2.29E-09
<sup>163</sup> Ho	B	unspecified								6.41E-14	6.41E-14
<sup>166m</sup> Ho	M	particulate								1.94E-12	1.94E-12
<sup>124</sup> I	F	particulate								2.8E-10	2.8E-10
<sup>125</sup> I	F	particulate								2.89E-15	2.89E-15
<sup>126</sup> I	F	particulate			9.27E-04	8.28E-04				8.4E-09	1.76E-03
<sup>129</sup> I	F	particulate								1.1E-05	1.1E-05
<sup>131</sup> I	F	particulate			4.14E-03	1.24E-02		7.41E-02		4.44E-09	9.06E-02
<sup>132</sup> I	F	particulate				2.48E-02		4.57E-01			4.82E-01
<sup>132</sup> I	M	particulate			4.06E-03						4.06E-03
<sup>133</sup> I	F	particulate						2.99E-01		2.46E-09	2.99E-01
<sup>134</sup> I	F	particulate						6.43E-02			6.43E-02
<sup>135</sup> I	F	particulate						9.98E-01			9.98E-01

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911
<sup>113m</sup> In	M	particulate								2.77E-06	2.77E-06
<sup>114</sup> In	B	unspecified								3.13E-07	3.13E-07
<sup>114m</sup> In	M	particulate								2.98E-07	2.98E-07
<sup>115</sup> In	M	particulate								3.72E-25	3.72E-25
<sup>115m</sup> In	M	particulate								1.51E-17	1.51E-17
<sup>191m</sup> Ir	B	unspecified								1.7E-09	1.7E-09
<sup>192</sup> Ir	M	particulate								9.7E-08	9.7E-08
<sup>192m</sup> Ir	B	unspecified								2.36E-17	2.36E-17
<sup>194</sup> Ir	M	particulate								2.83E-10	2.83E-10
<sup>194m</sup> Ir	M	particulate								7.21E-10	7.21E-10
<sup>40</sup> K	M	particulate								3.33E-07	3.33E-07
<sup>42</sup> K	M	particulate								2.95E-10	2.95E-10
<sup>81</sup> Kr	B	unspecified								1.09E-12	1.09E-12
<sup>83m</sup> Kr	B	unspecified								7.89E-07	7.89E-07
<sup>85</sup> Kr	B	unspecified						1.57E+02		2.72E+02	4.29E+02
<sup>85m</sup> Kr	B	unspecified						1.32E+01	2.40E+03		2.41E+03
<sup>87</sup> Kr	B	unspecified						7.75E+01	4.01E+03		4.09E+03
<sup>88</sup> Kr	B	unspecified						5.69E+01	1.44E+02		2.01E+02
<sup>89</sup> Kr	B	unspecified						4.51E+01			4.51E+01
<sup>137</sup> La	M	particulate								1.16E-19	1.16E-19
<sup>140</sup> La	M	particulate						2.54E-02		3.74E-09	2.54E-02
<sup>173</sup> Lu	M	particulate								1.0E-09	1.0E-09
<sup>174</sup> Lu	M	particulate								7.41E-09	7.41E-09
<sup>174m</sup> Lu	M	particulate								2.16E-11	2.16E-11
<sup>176</sup> Lu	M	particulate								2.89E-15	2.89E-15
<sup>177</sup> Lu	M	particulate								2.97E-10	2.97E-10
<sup>177m</sup> Lu	M	particulate								2.64E-08	2.64E-08
<sup>53</sup> Mn	M	particulate								1.31E-12	1.31E-12
<sup>54</sup> Mn	M	particulate								3.94E-05	3.94E-05
<sup>93</sup> Mo	M	particulate								1.75E-06	1.75E-06
<sup>99</sup> Mo	M	particulate								2.66E-07	2.66E-07
<sup>13</sup> N	B	unspecified							4.30E+02		4.30E+02

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911
<sup>22</sup> Na	M	particulate								3.73E-08	3.73E-08
<sup>91</sup> Nb	B	unspecified								9.38E-08	9.38E-08
<sup>91m</sup> Nb	B	unspecified								1.12E-06	1.12E-06
<sup>92</sup> Nb	B	unspecified								1.31E-14	1.31E-14
<sup>92m</sup> Nb	B	unspecified								1.8E-08	1.8E-08
<sup>93m</sup> Nb	M	particulate								1.8E-06	1.8E-06
<sup>94</sup> Nb	M	particulate								6.77E-08	6.77E-08
<sup>95</sup> Nb	M	particulate								3.8E-04	3.8E-04
<sup>95m</sup> Nb	M	particulate								2.55E-06	2.55E-06
<sup>96</sup> Nb	M	particulate								1.43E-11	1.43E-11
<sup>97</sup> Nb	M	particulate								1.67E-09	1.67E-09
<sup>147</sup> Nd	M	particulate								6.91E-09	6.91E-09
<sup>59</sup> Ni	M	particulate								3.02E-07	3.02E-07
<sup>63</sup> Ni	M	particulate								4.39E-05	4.39E-05
<sup>237</sup> Np	M	particulate								8.13E-08	8.13E-08
<sup>238</sup> Np	M	particulate								3.28E-16	3.28E-16
<sup>239</sup> Np	M	particulate								6.99E-08	6.99E-08
<sup>240</sup> Np	M	particulate								2.32E-26	2.32E-26
<sup>240m</sup> Np	B	unspecified								1.93E-23	1.93E-23
<sup>185</sup> Os	M	particulate								2.14E-09	2.14E-09
<sup>191</sup> Os	M	particulate				3.89E-02				2.3E-09	3.89E-02
<sup>194</sup> Os	M	particulate								2.88E-10	2.88E-10
<sup>32</sup> P	M	particulate								1.52E-06	1.52E-06
<sup>33</sup> P	M	particulate								4.73E-09	4.73E-09
<sup>228</sup> Pa	M	particulate								3.32E-09	3.32E-09
<sup>230</sup> Pa	M	particulate								5.2E-10	5.2E-10
<sup>231</sup> Pa	M	particulate								6.47E-16	6.47E-16
<sup>232</sup> Pa	M	particulate								7.17E-10	7.17E-10
<sup>233</sup> Pa	M	particulate								7.8E-09	7.8E-09
<sup>234</sup> Pa	M	particulate								4.59E-16	4.59E-16
<sup>234m</sup> Pa	B	unspecified								5.17E-13	5.17E-13
<sup>205</sup> Pb	M	particulate								1.83E-17	1.83E-17

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911
<sup>210</sup> Pb	M	particulate								2.89E-15	2.89E-15
<sup>212</sup> Pb	M	particulate	4.48E-01	3.64E-01		2.71E-02			3.74E-02	1.74E-15	8.77E-01
<sup>212</sup> Pb	S	particulate			2.26E+01		3.36E-01			1.08E-01	2.3E+01
<sup>214</sup> Pb	M	particulate				2.24E-03					2.24E-03
<sup>214</sup> Pb	S	particulate			4.08E-01						4.08E-01
<sup>103</sup> Pd	M	particulate								2.19E-17	2.19E-17
<sup>107</sup> Pd	M	particulate								6.57E-14	6.57E-14
<sup>143</sup> Pm	M	particulate								2.89E-15	2.89E-15
<sup>145</sup> Pm	M	particulate								2.66E-08	2.66E-08
<sup>146</sup> Pm	M	particulate								1.02E-08	1.02E-08
<sup>147</sup> Pm	M	particulate								3.22E-04	3.22E-04
<sup>148</sup> Pm	M	particulate								1.13E-08	1.13E-08
<sup>148m</sup> Pm	M	particulate								9.93E-09	9.93E-09
<sup>210</sup> Po	B	inorganic								4.64E-10	4.64E-10
<sup>212</sup> Po	B	unspecified								1.11E-15	1.11E-15
<sup>216</sup> Po	B	unspecified								1.74E-15	1.74E-15
<sup>143</sup> Pr	M	particulate								3.22E-07	3.22E-07
<sup>144</sup> Pr	M	particulate								2.22E-05	2.22E-05
<sup>144m</sup> Pr	B	unspecified								1.06E-10	1.06E-10
<sup>193</sup> Pt	M	particulate								2.93E-09	2.93E-09
<sup>232</sup> Pu	B	unspecified								1.48E-15	1.48E-15
<sup>236</sup> Pu	M	particulate								1.07E-13	1.07E-13
<sup>237</sup> Pu	M	particulate								2.48E-17	2.48E-17
<sup>238</sup> Pu	M	particulate	1.33E-08	5.29E-08		4.80E-09			4.09E-08	1.32E-06	1.43E-06
<sup>238</sup> Pu	F	particulate			2.69E-08		4.10E-09	1.47E-07		1.98E-09	1.8E-07
<sup>239</sup> Pu	M	particulate	2.47E-08	2.62E-07		9.90E-10			7.50E-09	3.8E-05	3.83E-05
<sup>239</sup> Pu	F	particulate			3.00E-07		5.70E-09	1.37E-07		1.43E-06	1.88E-06
<sup>240</sup> Pu	F	particulate			3.00E-07		5.70E-09	1.37E-07		6.76E-10	4.43E-07
<sup>240</sup> Pu	M	particulate	2.47E-08	2.62E-07		9.90E-10			7.50E-09	2.04E-05	2.07E-05
<sup>241</sup> Pu	M	particulate								3.76E-06	3.76E-06
<sup>242</sup> Pu	M	particulate								4.03E-09	4.03E-09
<sup>243</sup> Pu	M	particulate								7.12E-19	7.12E-19



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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911
<sup>244</sup> Pu	M	particulate								1.05E-15	1.05E-15
<sup>223</sup> Ra	M	particulate								5.32E-08	5.32E-08
<sup>224</sup> Ra	M	particulate								7.53E-10	7.53E-10
<sup>226</sup> Ra	M	particulate								4.21E-09	4.21E-09
<sup>228</sup> Ra	M	particulate								3.76E-14	3.76E-14
<sup>83</sup> Rb	M	particulate								5.9E-12	5.9E-12
<sup>84</sup> Rb	M	particulate								1.56E-13	1.56E-13
<sup>86</sup> Rb	M	particulate								5.13E-08	5.13E-08
<sup>87</sup> Rb	M	particulate								2.65E-17	2.65E-17
<sup>183</sup> Re	B	unspecified								3.35E-11	3.35E-11
<sup>184</sup> Re	M	particulate								3.35E-09	3.35E-09
<sup>184m</sup> Re	M	particulate								3.27E-09	3.27E-09
<sup>186</sup> Re	M	particulate								3.39E-05	3.39E-05
<sup>186m</sup> Re	M	particulate								2.48E-12	2.48E-12
<sup>187</sup> Re	M	particulate								1.68E-18	1.68E-18
<sup>188</sup> Re	M	particulate								1.8E-04	1.8E-04
<sup>102</sup> Rh	M	particulate								7.14E-09	7.14E-09
<sup>102m</sup> Rh	M	particulate								2.4E-15	2.4E-15
<sup>103m</sup> Rh	M	particulate								5.88E-06	5.88E-06
<sup>105</sup> Rh	M	particulate								1.5E-09	1.5E-09
<sup>106</sup> Rh	B	unspecified								2.76E-05	2.76E-05
<sup>219</sup> Rn	B	unspecified								3.8E-11	3.8E-11
<sup>220</sup> Rn	B	unspecified								1.74E-15	1.74E-15
<sup>222</sup> Rn	B	unspecified								3.74E-09	3.74E-09
<sup>103</sup> Ru	M	particulate								5.96E-06	5.96E-06
<sup>106</sup> Ru	M	particulate								2.81E-05	2.81E-05
<sup>35</sup> S	M	particulate								5.6E-07	5.6E-07
<sup>120m</sup> Sb	M	particulate								2.69E-10	2.69E-10
<sup>122</sup> Sb	M	particulate				4.78E-03				4.42E-11	4.78E-03
<sup>124</sup> Sb	M	particulate				1.30E-02				3.82E-07	1.30E-02
<sup>125</sup> Sb	M	particulate				1.31E-03				1.98E-05	1.33E-03
<sup>126</sup> Sb	M	particulate				2.16E-02				6.89E-10	2.16E-02

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack						Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880			X-7911
<sup>126m</sup> Sb	M	particulate								3.0E-09	3.0E-09
<sup>127</sup> Sb	M	particulate								8.13E-10	8.13E-10
<sup>44</sup> Sc	M	particulate								3.88E-09	3.88E-09
<sup>46</sup> Sc	M	particulate								3.93E-06	3.93E-06
<sup>47</sup> Sc	M	particulate								8.0E-10	8.0E-10
<sup>75</sup> Se	F	particulate				2.82E-08				1.2E-10	2.83E-08
<sup>75</sup> Se	S	particulate			4.14E-04						4.14E-04
<sup>79</sup> Se	F	particulate								1.24E-09	1.24E-09
<sup>32</sup> Si	M	particulate								1.81E-10	1.81E-10
<sup>145</sup> Sm	M	particulate								1.47E-12	1.47E-12
<sup>147</sup> Sm	M	particulate								1.87E-18	1.87E-18
<sup>151</sup> Sm	M	particulate								1.8E-06	1.8E-06
<sup>113</sup> Sn	M	particulate								2.91E-06	2.91E-06
<sup>117m</sup> Sn	M	particulate								8.01E-08	8.01E-08
<sup>119m</sup> Sn	M	particulate								2.66E-07	2.66E-07
<sup>121</sup> Sn	M	particulate								5.8E-09	5.8E-09
<sup>121m</sup> Sn	M	particulate								7.12E-09	7.12E-09
<sup>123</sup> Sn	M	particulate								5.06E-09	5.06E-09
<sup>123m</sup> Sn	M	particulate								3.35E-12	3.35E-12
<sup>125</sup> Sn	M	particulate								1.65E-09	1.65E-09
<sup>126</sup> Sn	M	particulate								3.0E-09	3.0E-09
<sup>128</sup> Sn	M	particulate								2.3E-16	2.3E-16
<sup>85</sup> Sr	M	particulate								6.55E-12	6.55E-12
<sup>89</sup> Sr	S	particulate			2.97E-06		1.61E-08			1.15E-07	3.1E-06
<sup>89</sup> Sr	M	particulate	9.40E-08	1.27E-06		2.08E-08			1.34E-05	2.4E-06	1.72E-05
<sup>90</sup> Sr	M	particulate	9.40E-08	1.27E-06		2.08E-08			1.34E-05	1.11E-03	1.13E-03
<sup>90</sup> Sr	S	particulate			2.97E-06		1.61E-08	1.16E-06		1.72E-06	5.86E-06
<sup>91</sup> Sr	M	particulate								1.29E-09	1.29E-09
<sup>179</sup> Ta	M	particulate								1.77E-08	1.77E-08
<sup>182</sup> Ta	M	particulate								1.69E-05	1.69E-05
<sup>182m</sup> Ta	M	particulate								9.0E-11	9.0E-11
<sup>183</sup> Ta	M	particulate								2.35E-07	2.35E-07

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack							Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911			X-8915
<sup>158</sup> Tb	M	particulate									6.46E-13	6.46E-13
<sup>160</sup> Tb	M	particulate									1.39E-07	1.39E-07
<sup>161</sup> Tb	M	particulate									3.13E-09	3.13E-09
<sup>96</sup> Tc	M	particulate									1.53E-10	1.53E-10
<sup>97</sup> Tc	M	particulate									4.75E-15	4.75E-15
<sup>97m</sup> Tc	M	particulate									2.05E-10	2.05E-10
<sup>98</sup> Tc	M	particulate									3.62E-19	3.62E-19
<sup>99</sup> Tc	M	particulate									4.2E-07	4.2E-07
<sup>99</sup> Tc	S	particulate						1.66E-06				1.66E-06
<sup>99m</sup> Tc	M	particulate									1.89E-07	1.89E-07
<sup>121</sup> Te	M	particulate									9.51E-05	9.51E-05
<sup>121m</sup> Te	M	particulate									4.87E-12	4.87E-12
<sup>123</sup> Te	M	particulate									8.79E-25	8.79E-25
<sup>123m</sup> Te	M	particulate									2.23E-08	2.23E-08
<sup>125m</sup> Te	M	particulate									4.76E-06	4.76E-06
<sup>127</sup> Te	M	particulate									7.5E-11	7.5E-11
<sup>127m</sup> Te	M	particulate									7.34E-11	7.34E-11
<sup>129</sup> Te	M	particulate									3.71E-12	3.71E-12
<sup>129m</sup> Te	M	particulate									1.39E-11	1.39E-11
<sup>131m</sup> Te	M	particulate									9.74E-10	9.74E-10
<sup>132</sup> Te	M	particulate									9.6E-10	9.6E-10
<sup>227</sup> Th	S	particulate									7.67E-12	7.67E-12
<sup>228</sup> Th	S	particulate	9.89E-09	1.86E-08	2.49E-08	1.67E-09	4.89E-09		2.15E-08		8.12E-08	1.63E-07
<sup>229</sup> Th	S	particulate									6.66E-12	6.66E-12
<sup>230</sup> Th	S	particulate	1.92E-09	3.91E-09		8.94E-10			1.35E-08		1.42E-08	3.44E-08
<sup>230</sup> Th	F	particulate				1.35E-08		1.36E-09			1.8E-09	1.67E-08
<sup>231</sup> Th	S	particulate									9.87E-15	9.87E-15
<sup>232</sup> Th	S	particulate	2.66E-09	5.60E-09		1.56E-09			2.19E-08		7.42E-08	1.06E-07
<sup>232</sup> Th	F	particulate				2.27E-03		1.57E-09			2.53E-09	2.27E-03
<sup>234</sup> Th	S	particulate									3.28E-12	3.28E-12
<sup>44</sup> Ti	M	particulate									3.97E-09	3.97E-09
<sup>204</sup> Tl	M	particulate									1.0E-14	1.0E-14

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Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack								Total Minor Sources	ORNL Total
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915		
208Tl	B	unspecified									2.39E-14	2.39E-14
168Tm	B	unspecified									2.14E-14	2.14E-14
170Tm	M	particulate									5.9E-07	5.9E-07
171Tm	M	particulate									6.63E-05	6.63E-05
172Tm	M	particulate									4.86E-11	4.86E-11
232U	M	particulate									4.93E-13	4.93E-13
233U	S	particulate			3.49E-08		9.05E-09				4.02E-09	4.79E-08
233U	M	particulate	3.23E-08	1.57E-07		9.65E-10			2.35E-08		1.60E-08	2.29E-07
234U	M	particulate	3.23E-08	1.57E-07		9.65E-10			2.35E-08		2.37E-05	2.39E-05
234U	S	particulate			3.49E-08		9.05E-09				4.02E-09	4.79E-08
235U	M	particulate	2.56E-10	2.74E-09					1.06E-09		2.02E-04	2.02E-04
235U	S	particulate			4.33E-09		3.74E-10				5.47E-10	5.25E-09
236U	M	particulate									1.46E-11	1.46E-11
237U	M	particulate									7.91E-13	7.91E-13
238U	M	particulate	3.11E-09	2.94E-08		1.41E-09			2.09E-08		1.51E-02	1.51E-02
238U	S	particulate			2.46E-08		2.10E-09				3.94E-09	3.06E-08
240U	M	particulate									5.86E-19	5.86E-19
48V	M	particulate									9.0E-11	9.0E-11
49V	M	particulate									2.24E-07	2.24E-07
176W	M	particulate									2.32E-06	2.32E-06
181W	M	particulate									4.61E-05	4.61E-05
185W	M	particulate									3.2E-03	3.2E-03
187W	M	particulate									9.15E-12	9.15E-12
188W	M	particulate									2.17E-04	2.17E-04
127Xe	B	unspecified								4.10E+01	2.07E-24	4.10E+01
129mXe	B	unspecified									3.5E-17	3.5E-17
131mXe	B	unspecified							1.82E+02		1.54E-05	1.82E+02
133Xe	B	unspecified			7.08E-05	2.80E-06			1.11E+01		3.12E-08	1.11E+01
133mXe	B	unspecified							3.35E+01			3.35E+01
135Xe	B	unspecified							8.07E+01			8.07E+01
135mXe	B	unspecified							7.89E+01			7.89E+01
137Xe	B	unspecified							2.11E+02			2.11E+02

Table G.1. Radiological airborne emissions from all sources at ORNL, 2021 (Ci)<sup>a</sup> (continued)

Isotope	Inhalation Form <sup>b</sup>	Chemical Form	Stack							Total Minor Sources	ORNL Total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911			X-8915
<sup>138</sup> Xe	B	unspecified								4.73E+02		4.73E+02
<sup>87</sup> Y	M	particulate									4.94E-11	4.94E-11
<sup>88</sup> Y	M	particulate									3.05E-06	3.05E-06
<sup>88</sup> Y	F	particulate							3.06E-07			3.06E-07
<sup>89m</sup> Y	B	unspecified									1.72E-09	1.72E-09
<sup>90</sup> Y	M	particulate									2.27E-03	2.27E-03
<sup>91</sup> Y	M	particulate									9.23E-06	9.23E-06
<sup>169</sup> Yb	M	particulate									2.26E-09	2.26E-09
<sup>175</sup> Yb	M	particulate									2.26E-10	2.26E-10
<sup>65</sup> Zn	M	particulate									9.98E-06	9.98E-06
<sup>88</sup> Zr	M	particulate									1.31E-09	1.31E-09
<sup>89</sup> Zr	M	particulate									7.99E-09	7.99E-09
<sup>93</sup> Zr	M	particulate									2.9E-08	2.9E-08
<sup>95</sup> Zr	M	particulate									2.48E-04	2.48E-04
<sup>97</sup> Zr	M	particulate									1.95E-09	1.95E-09
<b>Totals</b>			<b>4.50E-01</b>	<b>3.64E-01</b>	<b>2.39E+01</b>	<b>1.59E-01</b>	<b>1.01E+00</b>	<b>4.31E-06</b>	<b>5.38E+03</b>	<b>2.98E+04</b>	<b>2.72E+02</b>	<b>3.55E+04</b>

<sup>a</sup> Emissions given in curies (Ci). 1 Ci = 3.7E+10 Bq

<sup>b</sup> The designation of F, M, and S refers to the lung clearance type—Fast (F), Moderate (M), and Slow (S) for the given radionuclide. G stands for gaseous, V stands for vapor, and B stands for Blank, unspecified form.

**Acronym:**

ORNL = Oak Ridge National Laboratory