# THIRD, UPDATED SAFETY EVALUATION: EMISSIONS FROM THE GAS-FLARE AND ENGINE AT THE ALPHA RIDGE LANDFILL

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This safety evaluation updates assessments that we have presented in December, 2011 (Green, 2011; Green & Zemba, 2011), March, 2012 (Green & Zemba, 2012a), and December, 2012 (Green & Zemba, 2012b) with regard to impacts from emissions to ambient air from the combustion of gas at the Alpha Ridge Landfill, in Marriottsville, Maryland.

By way of brief review: In the autumn of 2011, we were asked to evaluate whether burning gas from the Alpha Ridge Landfill in a proposed GE Jenbacher internal combustion engine would be safe. Based on gas composition data from the Landfill, and emissions test-data from gas combustion systems at other landfills, we determined that impacts to ambient air, and hence to public health, would be inconsequential (Green, 2011; Green & Zemba, 2011). Thus, the proposed combustion would be safe.

In response to community concerns, Howard County committed to testing the Alpha Ridge Landfill flare and, once installed on site, the proposed Jenbacher engine; and we committed to re-running our analyses based on these test data.

Test-data for the flare became available in March, 2012. We re-evaluated impacts to ambient air based on these data and found, as expected, that impacts remained inconsequential (Green & Zemba, 2012a).

Test-data from the Jenbacher engine became available after it commenced operating in the latter half of 2012 (Avogadro, 2012). As we described in December, 2012, our updated evaluation continued to indicate safety (Green and Zemba, 2012b).

Additional samples of the Jenbacher engine exhaust were collected in May, 2013. Test results were similar to previous testing of the engine, although most pollutants were detected at somewhat higher concentrations.

As shown below (Table 1), 24 *potentially* hazardous substances were detected in trace concentrations in the engine exhaust in the most recent testing, and most (20 of 24) were found at levels lower than we had assumed in our March, 2012 health evaluation update. Importantly, as indicated in Table 2, the modeled maximum impacts from all chemicals are still well within safe limits.

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**Table 1** Chemical emission rates based on tests of the Jenbacher engine at the Alpha Ridge Landfill, compared with levels assumed in our March, 2012 Safety Evaluation

| **Chemicals detected in Jenbacher engine exhaust testing at Alpha Ridge** | **Average emission rate measured in engine exhaust (µg/s)** | **Emission rate assumed in March 2012 Safety Evaluation (µg/s)** | **Ratio of measured to assumed rate** |
|---|---|---|---|
| Acetone | 832 | 75.1 | 11.1 |
| Benzene | 115 | 319 | 0.36 |
| Carbon Disulfide | 59.2 | 61.9 | 0.96 |
| Chlorobenzene | 2.27 | 5.54 | 0.41 |
| Chloromethane | 3.15 | 23.5 | 0.13 |
| 1,4-Dichlorobenzene | 6.3 | 12.2 | 0.52 |
| 1,4-Dioxane | 15.1 | 35.7 | 0.42 |
| Ethanol | 51.7 | 21.6 | 2.39 |
| Ethylbenzene | 4.03 | 30 | 0.13 |
| Freon 12 (Dichlorodifluoromethane) | 8.57 | 14.1 | 0.61 |
| Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane) | 2.27 | N/A | N/A |
| Heptane | 3.15 | 85.4 | 0.04 |
| Hexane | 41.6 | 28.1 | 1.48 |
| Isopropyl alcohol (2-Propanol) | 16.4 | 36.6 | 0.45 |
| Methylene chloride (Dichloromethane) | 11.8 | 54.4 | 0.22 |
| Methyl ethyl ketone (2-Butanone) | 20.2 | 43.2 | 0.47 |
| Naphthalene | 26.5 | N/A | N/A |
| Propene | 164 | 11.3 | 14.5 |
| 2,3,7,8-Tetrachlorodibenzo(*p*)dioxin toxic equivalents (2,3,7,8-TCDD TEQs; "dioxins and furans") | 0.00000949 | 0.0000703 | 0.13 |
| Tetrahydrofuran | 3.15 | 5.82 | 0.54 |
| Toluene | 54.2 | 103 | 0.53 |
| 1,2,4-Trimethylbenzene | 8.06 | 35.7 | 0.23 |
| Vinyl chloride | 2.27 | 2.25 | 1.01 |
| Xylenes (mixed isomers) | 16 | 291 | 0.055 |



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**Table 2** Modeled ambient air impacts due to emissions from the Jenbacher engine and flare at the Alpha Ridge Landfill. The *italicized* values reflect recent engine test results and are updated relative to our March, 2012 Safety Evaluation.

| **Emitted chemical** | **Maximum residential impact — micrograms per cubic meter of ambient air (µg/m³)** | **Harmless concentration (µg/m³)*** | **Is impact harmless?** |
|---|---|---|---|
| Acetone | *0.004* | 30,900 | Yes |
| Benzene | *0.0009* | 3 | Yes |
| Carbon disulfide | *0.0004* | 700 | Yes |
| Chlorobenzene | *0.00002* | 50 | Yes |
| Chloroethane | 0.00002 | 10,000 | Yes |
| Chloromethane | *0.00004* | 13 | Yes |
| Cumene (Isopropylbenzene) | 0.000004 | 400 | Yes |
| Cyclohexane | 0.00003 | 6,000 | Yes |
| Decane | 0.002 | 3,500 | Yes |
| 1,2-Dichlorobenzene | 0.0001 | 200 | Yes |
| 1,3-Dichlorobenzene | 0.00009 | 70 | Yes |
| 1,4-Dichlorobenzene | *0.00004* | 2 | Yes |
| 1,1-Dichloroethane | 0.00002 | 15 | Yes |
| cis-1,2-Dichloroethene | 0.00002 | 7 | Yes |
| trans-1,2-Dichloroethene | 0.00002 | 60 | Yes |
| 1,2-Dichloropropane | 0.00005 | 2 | Yes |
| 1,4-Dioxane | *0.0001* | 3 | Yes |
| Ethanol | *0.0003* | 430 | Yes |
| Ethylbenzene | *0.00005* | 9 | Yes |
| Ethylene dibromide (1,2-Dibromoethane) | 0.00004 | 0.04 | Yes |
| Freon 12 (Dichlorodifluoromethane) | *0.00006* | 100 | Yes |
| Freon 113 (1,1,2-Trichloro-1,2,2-Trifluoroethane) | 0.00003 | 30,000 | Yes |
| Freon 114 (1,2-Dichloro-1,1,2,2-tetrafluoroethane) | *0.00002* | 5,600 | Yes |
| Heptane | *0.0001* | 1,900 | Yes |



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**Table 2** Modeled ambient air impacts due to emissions from the Jenbacher engine and flare at the Alpha Ridge Landfill. The *italicized* values reflect recent engine test results and are updated relative to our March, 2012 Safety Evaluation.

| **Emitted chemical** | **Maximum residential impact — micrograms per cubic meter of ambient air (µg/m³)** | **Harmless concentration (µg/m³)*** | **Is impact harmless?** |
|---|---|---|---|
| Hexane | *0.0002* | 700 | Yes |
| Hydrogen sulfide | 0.001 | 2 | Yes |
| Isopropyl alcohol (2-Propanol) | *0.0001* | 7,000 | Yes |
| Methylcyclohexane | 0.0002 | 3,000 | Yes |
| Methylcyclopentane | 0.00008 | 1,400 | Yes |
| Methylene chloride (Dichloromethane) | *0.0001* | 600 | Yes |
| Methyl ethyl ketone (2-Butanone) | *0.0001* | 5,000 | Yes |
| Methyl isobutyl ketone (4-Methyl-2-pentanone) | 0.0004 | 3,000 | Yes |
| Methyl tert-butyl ether (MTBE) | 0.00002 | 90 | Yes |
| Naphthalene | *0.0001* | 1 | Yes |
| Nonane | 0.001 | 200 | Yes |
| Pentane | 0.00003 | 1,000 | Yes |
| Propene | *0.0008* | 3,000 | Yes |
| n-Propylbenzene | 0.000001 | 1,000 | Yes |
| 2,3,7,8-Tetrachlorodibenzo(*p*)dioxin toxic equivalents (2,3,7,8-TCDD TEQs; "dioxins and furans") | *0.0000000001* | 0.0000006 | Yes |
| 1,1,2,2-Tetrachloroethane | 0.0001 | 0.4 | Yes |
| Tetrachloroethylene | 0.00004 | 40 | Yes |
| Tetrahydrofuran | *0.00002* | 2,000 | Yes |
| Toluene | *0.0004* | 5,000 | Yes |
| 1,1,1-Trichloroethane | 0.00005 | 5,000 | Yes |
| 1,2,4-Trimethylbenzene | *0.00008* | 7 | Yes |
| Trichloroethylene | 0.00005 | 2 | Yes |
| 1,3,5-Trimethylbenzene | 0.0001 | 6 | Yes |



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**Table 2** Modeled ambient air impacts due to emissions from the Jenbacher engine and flare at the Alpha Ridge Landfill. The *italicized* values reflect recent engine test results and are updated relative to our March, 2012 Safety Evaluation.

| **Emitted chemical** | **Maximum residential impact — micrograms per cubic meter of ambient air ($\mu g/m^3$)** | **Harmless concentration ($\mu g/m^3$)*** | **Is impact harmless?** |
|---|---|---|---|
| Vinyl chloride | *0.00001* | 5 | Yes |
| Xylenes (mixed isomers) | *0.0004* | 100 | Yes |

* Harmless concentrations are derived, by health scientists at U.S. EPA and elsewhere, from dose-response data from epidemiologic studies and/or studies in laboratory animals, and incorporate ample margins of safety, such that they pose no significant risk to health.

Overall, then, this updated evaluation agrees with our earlier assessments in demonstrating no significant impacts to ambient air or to public health from combustion of gas at the Alpha Ridge Landfill.



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**References**

Avogadro (2012). Emissions Test Report for Evaluation of the Jenbacher Engine Outlet; Alpha Ridge Landfill; Marriottsville, Maryland, Test Dates: November 5-6, 2012 and November 9, 2012. Project 12-9179, Avogadro Environmental Corporation, Easton, PA.

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