# Boeing Comments on Radiological Background Study Technical Memorandum

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| Page 6-3 | The definition of minimum detectable concentration (MDC) is *"The theoretical amount of activity that would have to be in a sample, in order to be distinguishable from a sample with no activity."*<br>The lay reader would therefore conclude that a reported result less than the MDC would be indistinguishable from a sample with no activity, i.e. "non-detect." However inspection of the tables of results shows that many results that are less than the MDC are not assigned a U qualifier flag and are therefore identified as "detects." This, no doubt, follows the policy of using the critical level ($L_C$) as the detect/non-detect decision level (DL) rather than the detection level ($L_D$) upon which the MDC is based. In contrast, many laboratories use a U qualifier to identify if the reported result is less than the MDC. Using conventional counting statistics, the critical level ($L_C$) is usually approximately half the value of the detection level ($L_D$), thus it may be expected that results that are greater than half the MDC may be identified as "detects" and therefore not flagged with a U. However, many reported results that are significantly less than half the MDC are also identified as "detects" and not flagged with a U. This needs to be explained by EPA. Since EPA is using the critical level ($L_C$) as the detect/non-detect decision level, it would be more transparent to include the critical level ($L_C$) in the tables (expressed in units of activity) as well as the MDC, with a clear explanation for the lay reader as to the difference between these two criteria. |
| Page 6-4, Section 6-3<br><br>and<br><br>Table 55 | EPA references the 1993 McLaren Hart Study for previous background data, and cites 18 prior background samples. The McLaren Hart Study also included a Phase II reported in a 1995 report. The total number of background samples (excluding QC samples, agency and third party samples) for both phases was 53. The background data were …<br>Range — Mean +/- 1.96$\sigma$<br>Cs-137 — ND - 0.213 — 0.087 +/- 0.122<br>Sr-90 — ND - 0.13 — 0.052 +/- 0.061 |
| Table 1 | Southeast quadrant locations SE-4 and SE-5 gamma readings are considerably less than all other DTL locations. It appears as though the smaller Ludlum 44-2, 1" x 1" NaI was used instead of the larger Ludlum 44-20, 3" x 3" NaI in these two locations. |

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| Table 6. Antimony-125 | All samples are qualified as K, defined as *"Analyte present. Reported value may be biased high. Actual value is expected to be lower."* Several are qualified as B, defined as *"Analyte present, but not detected substantially above the level reported in laboratory or field blanks."* What does this mean and how is the lay reader supposed to interpret this data?<br>Most of the samples (including subsurface samples in all three locations) are reported within a relatively tight range of 0.1 to 0.2 pCi/g, well above the MDC, yet all below the $10^{-6}$ AG PRG. The highest value of 2.63E-1 pCi/g was a subsurface sample. The relatively uniform concentrations, even among subsurface samples, would normally be indicative of primordial radionuclides rather than airborne deposition from SSFL or weapons testing, yet we know that Sb-125 does not occur in nature. These data appear to be possibly the result of spectral interference, similar to the cause for rejecting the results for barium-133, californium-249, silver-108, and silver-108m (see page 1-2). |
| Table 7. Barium-137m | Barium-137m is the 2.55 minute half-life, immediate daughter of cesium-137. The activity of Ba-137m therefore should be identical to that of Cs-137. The Ba-137m AG PRG is approximately 100,000,000 times larger than the Cs-137 AG PRG. Therefore all Ba-137m data is substantially below the AG PRG. It is therefore recommended that Barium-137m not be included in the AOC look-up table. |
| Table 10. Cadmium-113m | MDC is approximately a million times higher than the 1E-6 AG PRG. Five alleged detects, 4 of which are in subsurface soils. This would imply the AG risk from these detects is close to unity. Does EPA believe that these detects are real or are misidentification due to spectral interference? |

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| Table 11. Cesium-134 | With the exception of 8 no-detects, all samples are reported as K or BK (*"Analyte present. Reported value may be biased high. Actual value is expected to be lower" and "Analyte present, but not detected substantially above the level reported in laboratory or field blanks."* ) . Nevertheless, these results remain "detects." Does EPA believe these detects are real?<br><br>Cesium-134 has a 2.1 year half life compared to the 30 year half life of cesium-137. Cesium-134 has an effective fission yield similar to cesium-137. Therefore in the ~30 years since the last reactor operated at SSFL, cesium-134 will have decayed by a factor $2^{15}$ / 2 = 16,400 more than cesium-137. Fallout cesium-134 would have decayed by a lager factor since above ground nuclear testing terminated longer than thirty years ago. Why, then, is cesium-134 reported at levels about $1/10^{th}$ that of cesium-137? Does EPA believe these cesium-134 detects are real or misidentification due to spectral interference? |
| Table 12. Cesium-137 | Surface cesium-137 in the RBRAs appears to average approximately 0.1 pCi/g (visual inspection) with a maximum of 0.18 pCi/g, very similar to the prior McLaren-Hart background average (0.087 pCi/g) and maximum (0.213 pCi/g). Subsurface results were lower and generally non-detect as expected for fall-out radionuclides. The maximum of 0.32 pCi/g was actually at a DTL site. The average background cesium-137 is therefore approximately 8 times the 1E-6 AG PRG. Therefore the AG risk of background cesium-137 is approximately 8E-6. The MDC is approximately 6 times 1E-6 AG PRG. |
| Table 13. Cobalt-60 | Almost all cobalt-60 samples are non-detect, with several Bs and Ks and one subsurface detect at 0.0126 pCi/g. The MDC is approximately 10 times 1E-6 AG PRG. |
| Table 14. Europium-152 | Why is the reported result for LR-13-SU of 4E-3 pCi/g identified as a detect when it is more that a factor of 6 times less than the MDC of 2.48E-2 pCi/g? Why is the reported result for BP-17-SUR of 4.89E-3 pCi/g identified as a detect when it is more that a factor of 5 times less than the MDC of 2.8E-2 pCi/g? Most samples are non-detect and the several detects are all < 1E-6 AG PRG. |
| Table 15. Europium-154 | Most samples are non-detect and the several detects are < 1E-6 AG PRG. |

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| Table 16. Europium-155 | All except one sample are flagged as a K detect. Surface and subsurface sample results are remarkably uniform at approximately 0.1 pCi/g, 30 times less than the 1E-6 AG PRG. Does EPA believe these are real detects or misidentification due to spectral interference? |
| Table 17. Holmium-166m | Holmium-166m appears to be detected in the E-3 to E-2 range for both surface and subsurface soils. It does not therefore appear to be airborne deposited? Does EPA believe these are real detects or misidentification due to spectral interference? |
| Table 20. Neptunium-237 | Most results have E-2 or E-3 exponents (both positive and negative) and somewhat less than the MDC. Subsurface samples have similar results to surface samples. Does EPA believe these are real detects or misidentification due to spectral interference? |
| Table 22. Niobium-94 | Most results have E-3 exponents similar to the value of the MDC. Subsurface samples have similar results to surface samples. Does EPA believe these are real detects or misidentification due to spectral interference? |
| Table 23. Potassium-40 | K-40 results average 25 pC/g which is 500 times higher than the 1E-6 AG PRG. Therefore the AG risk of background potassium-40 is approximately 5E-4. |
| Table 25. Radium-228 | Ra-228 results are approximately 1000 times higher than the 1E-6 AG PRG. Therefore the AG risk of background radium-228 is approximately 1E-3. |
| Table 26. Radon-220 | Since Rn-220 is a short half life gas, did the lab prepare counting samples in sealed containers and allow for in-growth. |
| Table 27. Radon-222 | Since Rn-222 is a short half life gas, did the lab prepare counting samples in sealed containers and allow for in-growth. |
| Table 28. Sodium-22 | There are perhaps a dozen detects in both surface and subsurface soil, all less that the 1E-6 AG PRG. Does EPA believe these are real detects or misidentification due to spectral interference? |

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| Table 29. Tellurium-129m | All samples are qualified as K, defined as *"Analyte present. Reported value may be biased high. Actual value is expected to be lower."* Several are qualified as B, defined as *"Analyte present, but not detected substantially above the level reported in laboratory or field blanks."* What does this mean and how is the lay reader supposed to interpret this data?<br>Most of the samples (including subsurface samples in all three locations) are reported within a relatively tight range of 0.02 to 0.05 pCi/g, well above the MDC, yet all below the $10^{-6}$ AG PRG. The highest value of 6.07E-2 pCi/g was a subsurface sample. Does EPA believe these are real detects or misidentification due to spectral interference? |
| Table 43. Thorium-228 | Th-228 averages approximately 2 pCi/g which is 60 times higher than the 1E-6 AG PRG. Therefore the AG risk of background thorium-228 is approximately 6E-5. |
| Table 45. Thorium-230 | Th-230 averages approximately 1 pCi/g which is 100 times higher than the 1E-6 AG PRG. Therefore the AG risk of background thorium-230 is approximately 1E-4. |
| Table 47. Thorium-232 | Th-232 averages approximately 1 pCi/g which is 100 times higher than the 1E-6 AG PRG. Therefore the AG risk of background thorium-232 is approximately 1E-4. |
| Table 48. Uranium-233/234 | U-233/234 averages approximately 1 pCi/g which is 500 times higher than the 1E-6 AG PRG. Therefore the AG risk of background uranium-233/234 is approximately 5E-4. |
| Table 49. Uranium-235/236 | U-235/236 averages approximately 0.05 pCi/g which is 25 times higher than the 1E-6 AG PRG. Therefore the AG risk of background uranium-235/236 is approximately 2.5E-5. |
| Table 50. Uranium-238 | U-238 averages approximately 1 pCi/g which is 600 times higher than the 1E-6 AG PRG. Therefore the AG risk of background uranium-238 is approximately 6E-4. |

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| Table 52. Strontium-90 | Surface strontium-90 in the RBRA appears to average approximately 0.03 pCi/g (visual inspection) with a maximum of 0.084 pCi/g, slightly lower than the prior, McLaren-Hart background average (0.052 pCi/g) and maximum (0.13 pCi/g) . Subsurface results were lower and generally non-detect as expected for fall-out radionuclides. The maximum of 0.129 pCi/g was actually at a DTL site and was identical to the prior McLaren-Hart maximum (0.13 pCi/g). The average background strontium-90 is therefore approximately 20 times the 1E-6 AG PRG. Therefore the AG risk of background strontium-90 is approximately 2E-5. The MDC is approximately 10 times 1E-6 AG PRG. |
| Table 53. Tritium | Small number of results identified as detects, though all less than the MDC. The MDC is 40 times the 1E-6 AG PRG. |
| Table 54. Carbon-14 | Six results identified as detects though all less than the MDC. The MDC is over 50,000 times higher than the 1E-6 AG PRG. This would imply that the MDC is not capable of distinguishing carbon-14 AG risks at levels lower than 5%. |
| | Summing the theoretical agricultural risk for the major primordial background radionuclides presented in the tables (including uranium, thorium, potassium-40, and radium-228 but excluding radium-226 since these data are missing) gives approximately 0.003 or 3E-3.<br><br>Uranium-233/234 0.000500<br>Uranium-235/236 0.000025<br>Uranium-238 0.000600<br>Thorium-228 0.000060<br>Thorium-230 0.000100<br>Thorium-232 0.000100<br>Radium-228 0.001000<br>Potassium-40 0.000500<br>**Total 0.002885**<br><br>Summing the theoretical agricultural risk for the anthropogenic background cesium-137 and strontium-90 gives approximately 0.00003 or 3E-5.<br><br>Cesium-137 0.000008<br>Strontium-90 0.000020<br>**Total 0.000028** |