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June 5, 1997
In reply refer to 97RC3192

BOEING

Tom Kelley
U. S. Environmental Protection Agency
Region IX
75 Hawthorne Street
San Francisco, CA 94105

Subject: SSFL Area IV Radiological Characterization Survey - Response to Comments

Reference:
1. Letter from Julie Anderson to Jerry Gaylord, "Area IV Characterization Study and Rocketdyne Letter 97RC1766", 002914RC, April 8, 1997.
2. Memo from Gregg Dempsey to Tom Kelly, "Area IV Radiological Characterization Study".
3. Letter from Joseph Lyou to Jerry Gaylord, "Comments on Environmental Monitoring Activities at the Rocketdyne Santa Susana Field Laboratory", 002808RC, April 7, 1997.

Dear Mr. Kelly:

Enclosed are responses to the written comments on the Area IV Radiological Characterization Survey submitted by references 1 through 3.

Responses to the comments on the RCRA Facility Investigation submitted in reference 3 will be transmitted to EPA and Dr. Lyou at a later date.

We anticipate meeting with you, Greg Dempsey and Joe Lyou on June 11th in Las Vegas to discuss the comments and responses.

If you have any questions, please contact the undersigned at (818) 586-6140 or philip.d.rutherford@boeing.com.

Very truly yours,

BOEING

Phil Rutherford, Manager
Environmental Remediation

PR:bc

cc with enclosures: Greg Dempsey - US EPA
Joe Lyou - Committee to Bridge the Gap
Hannibal Joma - DOE/OAK

(SHEA-000781)

Responses to Comments of the Area IV Survey.

Comments by Dr. Lyou, Executive Director, Committee to Bridge the Gap
Letter, Lyou to Gaylord, 7 April 1997

Key Issue: Background.

1. There could be many different choices of a background data set for comparison with SSFL Area IV radiation measurements. Since the purpose of the comparison was to determine if Rocketdyne operations had affected the radiation exposure rate in Area IV, compared to background, this is an important question. The best background set would be taken in an identical environment, with the same rocks, meadows, vegetation, situation, elevation, weather, and location. Since such an exact match is not possible in practice, we made considerable effort to make the background measurements match Area IV as well as possible, while excluding any areas that might even be suspected of showing any Area IV impact. Thus, nearby locations listed in the MultiMedia Study with names such as Radioactive Materials Disposal Watershed and Sodium Burn Pit Watershed, while sufficiently distant to avoid any radiation from on-site, were eliminated from the background comparison set. These measurements were not taken on-site, and furthermore, they were not included in the background set. Not only were the multimedia locations close to the boundary of SSFL not used as background locations for comparison in the Area IV report, but neither were any other of the measured locations on BBI or SMMC land used for background in this report.

The comment suggests that SSFL is a large radiation source that dissipates with distance such that only the most distant background locations should be utilized as background. This is not correct. The lowest gamma exposure readings in the entire collection of data are actually in Area IV. The exposure rate at these locations is less because the soil contains significantly less natural radioactivity. Likewise, the most distant locations have soil that is distinctly different, much less naturally radioactive than the nearer locations and than Area IV. It is misleading to attempt to use background data that is different from the region being tested. See also response to comment no. 4.

Another set of data presented in section 5.3 of the 1995 Annual Site Environmental Report (RI/RD96-140) demonstrates that SSFL is not acting as a large radiation source whose effects can be felt at large distances. Each year radiation levels are measured using Aluminum Oxide TLDs placed on-site and at employees residences off-site. These TLDs accumulate total annual exposure (as opposed to a 1-minute measurement) and have higher sensitivity than NaI detectors. Figure 1 shows the average annual exposure at SSFL (selected sites at Area IV) and at off-site locations varying from 4.4 miles to 47 miles from SSFL and at differing directions from SSFL. The off-site locations include Simi Valley (2 sites), West Hills, Calabasas, DeSoto facility, Chatsworth, Northridge, Thousand Oaks, Moorpark, Somis, Saugus, North Hollywood, Burbank, Quartz Hill and

Lancaster. It is apparent that there is no trend of decreasing radiation exposure with distance from SSFL . The average annual exposure is 181 mrem/year with an observed range of +/- 30 mrem/year.

2. Different values are given in the text (page 22) and in Table 10 for the variability of the U. S. average background Cs-137 activity. In the text, the variability was listed as a "2-sigma" spread, while the Table listed just 1 sigma, the standard deviation.

Key Issue: 15 mR/yr annual dose limit.

3. The action level of 4-5 μR/hr above background is completely consistent with the NRC rule for research reactors that establishes 5 μR/hr above background as an acceptable level for release of a decommissioned facility. This rule recognizes that a person does not stay in one place very long and so uses an occupancy factor of 1/3 in estimating that a person would receive only 15 mrem per year from a localized spot of 5 μR/hr above background. An assumption that the person stays in the radiation field for 24 hours a day, 365 days a year, to calculate a hypothetical annual dose of 35 to 44 mR/yr is not appropriate. The display of the individual grid readings in the figures of Appendix B clearly shows that in none of the areas are there locations exceeding the allowable release limit of 5 μR/hr above background. This limit was considered during the planning of the survey and led to the choice of an action level for a part of the survey that assured identifying areas that might exceed the limit.

The action level did not represent the sensitivity of the instrument, which is approximately 1.2 μR/hr above background.

The conversion of counts-per-minute from the NaI(Tl) gamma detector used in the field surveys to micro-rem-per-hour was based on readings taken with a High Pressure Ion Chamber (HPIC), which is generally accepted to provide a standard response to radiation in the range encountered in environmental surveys. For the highest accuracy, the radiation spectrum is considered to be reasonably similar throughout the area being surveyed. Since much of the radiation consists of gamma radiation that has been scattered as it passes through the soil or the air and so no longer has the distinctive distribution that might be observed with a gamma-ray spectrometer for a small sample, this assumption is met for the areas measured in this survey. The response of the NaI(Tl) detector used for the field survey is actually greater for surface contamination than it is for natural radioactivity distributed in the soil, and this exaggerates the reading for any area with surface contamination. This response was measured three times daily, relative to a primary exposure-rate instrument, a Reuter-Stokes High Pressure Ion Chamber.

Key Issue: Biased Background.

4. While all background measurements were made off-site, those measurements that had been made near the boundary, or anywhere on the BBI and SMMC property, were omitted. Measurements made in Tapia Park and Tapia Park Ravine were exceptionally

low and the soil analyses showed that this was so because the radioactive elements potassium, thorium, and uranium that are naturally present in the soil of our locale were barely present in the Tapia soil. Therefore, the Tapia data, and for the same reason, Wildwood Park and Wildwood Park Ravine data, were dropped from the background data set. They were eliminated because the concentration of natural radioactivity in the soil was grossly different and not at all typical of the Simi Hills soil, not because they produced low exposure rate readings. They did produce low readings because they were deficient in natural radioactivity. This was revealed in the graphical tests used to inspect the data before use. These differences are shown in the bargraph in Figure 2, where the Wildwood and Tapia soil analyses show lower amounts of K-40, one of the major natural sources of gamma radiation, and lower gamma exposure rates. Clearly, different soils make different backgrounds. The statistical comparison requires that similar environments be used.

Background radiation is not simply the lowest exposure rate that can be found, it is the radiation that would have been in Area IV if Rocketdyne had never done nuclear work.

5. The tests show that there is no significant difference between Area IV and the off-site areas identified as background, except for the abnormally low radioactivity in the Tapia Park and Wildwood Park soil and the resulting low exposure rates there. That was the point of the test: if there is "no significant difference" between the two sets of data, the areas might as well be considered to be the same. The tests show that SSFL Area IV is essentially the same, on average, as the off-site areas. This is a test of average conditions and shows that the small and low-level contaminated areas identified at Area IV have no significant effect on the average radiation of the SSFL. To maintain consistency with the prior statistical tests of survey data used in the McLaren/Hart MultiMedia Study, the same phrasing was used to describe the objective of the statistical tests .

As discussed in the text (page 56), the Behrens-Fisher modified t-test is resistant to bias introduced by departures from normalcy (a Gaussian distribution). Since this report was intended to provide information to the public on the condition of SSFL Area IV, rather than to be a statistics exercise, the details of the other tests performed, the F-test, single-sided tests, and Tippet's test, were not presented. The F-test showed that all the analytical (soil sample) sets were different, off-site from Area IV, but that the sets of exposure rate measurements matched quite well. That is displayed graphically by the distribution plots in Figure F-10, where it can be seen that the two sets of data are Gaussian (the thin straight line) over a long range, and the standard deviations ("Sigma =") are essentially identical.

6. Table D-2, referred to in the text on page 58 was combined into Table D-1. Reference to Table D-2 was a typographical error. All the data values are listed in Table D-1.

Key Issue: 18% of soil samples higher than background

7. The key point here is that with two complimentary kinds of radiation surveys, and 5 additional random and non-random criteria used for selecting soil sample locations (see responses to Paragraph 1 of Mr. Dempsey's comments) we were able to effectively cover all of Area IV. The effectiveness of the survey was demonstrated by the fact that we did find 3 previously unknown areas of local contamination requiring remediation. The further fact that all other measurements, both radiation exposure and soil sampling, were either equivalent to, or slightly above local background, yet well within US background and well below regulatory cleanup levels demonstrates that there is no widespread contamination at SSFL requiring remediation or posing a health threat to workers and/or the public.

Key Issue: "Rocketdyne failed to identify..."

8. The location described is the Building T064 SideYard. The contamination resulted from leakage from an irradiated fuel element shipping cask stored outside of the building.

9. The values used as representing "U. S. background" are listed in Table 10, as described in the text. References to the sources of data are given.

The DOE limits for Sr-90 and Pu-239 are 36 and 34 pCi/g, respectively, while the EPA/NRC limits are 12 and 423. Thus, the EPA/NRC limits provide for 35 times as much Pu-239 as Sr-90, while the DOE limits are essentially equal. While it might be thought that the greater dose of Pu-239 by inhalation might require a lower limit, the dose from Sr-90 by eating food grown on-site is somewhat greater and so the limits are quite similar. See Figure 3 which shows the relative dose contribution of Pu and Sr for different pathways.

Key Issue: "contamination in cleaned up areas."

10. The elevated concentrations of radioactivity found at or near previously remediated areas, as listed in Table 6, are well below the acceptable limits. Those measurements confirm the successful remediation of those areas.

Key Issue: "questionable statistical techniques"

11. The purpose of statistical tests is to make sense of large numbers of measurements. However, that is only part of the story of the survey. Having found that, on the average, SSFL differs only slightly from the surrounding territory, it is valid to ask if there are specific areas in Area IV that represent a threat to public health and safety. Not only do the 10,479 individual measurements of exposure rate show that there is no threat, this question has been answered by government inspectors from all the agencies involved: there is no threat to the public. In addition, with the exception of the three locations

undergoing remediation, all of the separate measurements of radioactivity in soil show levels that are far below the allowable limits.

The statistical tests in question were not a major part of this survey. The survey was intended to discover locations of possible contamination. The statistical comparisons of averages over large areas is of secondary importance. Therefore, Appendix F was not made into a treatise on statistics, by including power curves and the many other statistical complications that might be discussed. The results of the statistical tests are quite reasonable, clearly evident in the many figures shown, and no amount of statistical sophistication could make them much more or less. The standard deviations are given for each and every data set, throughout Appendix B, in Appendix D, where the laboratory uncertainties are given for each analytical result, in Appendix E for the background locations, and in the figures of Appendix F. Those figures supplement the numerology of the statistical table by providing clear evidence of the similarity and small differences between the various sets.

The comment states that a one-tailed 0.10 alpha-level test would have been more appropriate than a two-tailed 0.05 alpha-level test, because "there is no theoretical reason for 'background' measurements to be higher than Area IV measurements." But that is the problem that the statistical tests were intended to address. Since most of the radioactivity occurring in soil is naturally occurring there is actually no "theoretical" reason for thinking that Area IV would be more radioactive than off-site areas. Some of the radioactivity is from atmospheric fallout that is dispersed all over the world, and all over our local area. The concentration of this radioactivity, consisting of Sr-90, Cs-137, Pu-238 and -239, is very variable and depends on the deposition patterns and subsequent action, human and natural, on the soil surface. Lesser or greater amounts may be present in Area IV or in the background locations. In that sense, background areas are "contaminated" by fallout. Nearly everywhere is, but at very low levels, as the analytical results show. The statistical tests were not used to identify areas that might need remediation activities. The three areas identified by this survey for remediation were identified on the basis of individual measurements. The statistical tests apply to the quality of a large area as a whole. Two-tailed tests are appropriate when there are no pre-conceived notions about the "proper" outcome.

Comments by Julie Anderson, Director, Waste Management Division, EPA Region IX
Letter, Anderson to Gaylord, 8 April 1997

We used residual soil contamination criteria that had been approved by DOE and DHS/RHB based on an annual dose limit of 15 mrem ("Proposed Sitewide Release Criteria for remediation of Facilities at the SSFL," Rocketdyne Document N001SRR140127, 8/22/96). This is based on a health-effects risk level of 3×10^{-4}. We do not use the CERCLA risk levels of 10^{-6} to 10^{-4} since SSFL is not a NPL site. This Area IV survey was not regulatory driven but was voluntarily initiated by Rocketdyne/ETEC and DOE.

We didn't use 15 millirem per year as a screening level. The survey reported what was found.

The sample that showed 8500 pCi/L tritium was taken by us to be confirmation of the prediction in the Tritium Report (RI/RD 92-196) that the reactor operation in T010 produced H-3 in the surrounding soil. It might be proper to follow up on this with several soil samples taken around and under the location of T010. The groundwater diffusion calculations showed that the maximum of the concentration should be off-site, and we found the seepage on BBI land at about 11,000 pCi/L, which is somewhat higher than this 8,500 ±430, in agreement with the calculations.

Comments by Gregg Dempsey, Director, Center for Environmental Restoration, Monitoring and Emergency Response
Letter, Anderson to Gaylord, 8 April 1997

Paragraph 1.

It is true that "a hidden source buried near the center of the grid" could be missed. That was why we designed a complementary surface survey of all land in between the grid locations. This surface survey successfully found the natural uranium deposit, and the two areas of contamination near T064. The report stressed the complementary nature of the grid survey and the walk-about. We specifically look for subsurface contamination in the only places it can occur without leaving a surface trace: for example, in leach fields. That is done by digging, not by any kind of surface survey. The only absolute way to prove that buried sources do not exist is to dig and screen all the soil on the site, everywhere, down to bedrock.

It should be stressed that neither the grid exposure measurements nor the walk-about surface survey were the only criteria used for soil sampling. In reality, only 12 locations were sampled as a result of elevated exposure measurements. Elevated radiation was only one of six criteria for sampling soil; others included proximity to the Sodium Disposal Facility (28 samples), proximity to radiological buildings (38 samples), drainage areas (37 samples), leachfields (10 samples), and random sampling of each of the six topographical areas (22 samples). Sampling according to these criteria was a mixture of random sampling and non-random sampling whichever was the most appropriate. It should be noted that the off-site McLaren-Hart study (whose objective was the same as this study) did not do any radiation mapping or surface surveys, it only performed random and non-random soil sampling at selected locations.

Paragraph 2.

The two types of detectors do respond differently to different energy spectra. But to suggest that "more than a few feet in any direction" would invalidate a calibration is incorrect. A large fraction of the gamma radiation comes from space and is not dependent on where we are making a measurement. An additional fraction comes from radioactivity dispersed through the atmosphere and similarly is quite independent of location. Only if the radioactivity of the soil were grossly inhomogeneous, as in the case of localized contamination, or different from a reference soil as in the case of Tapia and Wildwood where lack of K-40 reduces the exposure rate significantly, would the spectrum change in any appreciable amount. Even then, for radioactivity distributed in soil, much of the detected radiation has been scattered to form a broad energy distribution. Tests show that because the NaI(Tl) detector is less sensitive to scattered radiation than to direct radiation, the gamma survey instrument over-responds to surface contamination. (Scattered radiation is at a lower energy than the direct radiation and this results in a lesser signal in the instrument.) A NaI(Tl) detector calibrated to the scattered radiation of the environment (as was done for the Area IV survey) will over-respond to the direct

radiation of contamination, while a detector calibrated to the direct radiation of a laboratory calibration source will under-respond to contamination.

In any event, calibration by comparison with the HPIC in the field, and use of that response factor, is superior to calibrating the instrument in a laboratory with an unscattered reference source at a significantly higher exposure rate, and using that response factor in the field.

Our recent test (performed in cooperation with DHS/RHB) of the variability of response of the NaI(Tl) detector compared to the Reuter Stokes HPIC showed that the conversion factor varied from 212 to 232 cpm per μR/hr at four different uncontaminated locations at SSFL. This ±5% range is typical of the daily variability of the conversion factor measured daily during the survey, as listed in Table C-2 of the Area IV report. In this test, the NaI(Tl) detector over-responded by about 35% to the direct radiation from the radioactive waste stored at RMHF.

Paragraph 3.

It was suggested that 3x3 NaI(Tl) detectors should have been used, instead of the 1x1 that we used. There are several reasons why this is not suitable for a field survey of this sort.

1. The detectors are bigger and heavier than the 1x1 detectors.
2. The larger detector needs more electrical power, so batteries are bigger and heavier.
3. While the 3x3 detector clearly provides better energy resolution, this survey is an application where energy resolution is not needed.
4. The larger detector also provides a higher count rate, so that a single measurement could be made in 5 seconds rather than 1 minute, saving approximately 160 hours over the several year survey time. Counting for 1 minute, would reduce the observed variability of the exposure rate from ± 1.78 μR/hr to ± 1.76 μR/hr, a negligible improvement.
5. The 3x3 detector is not an industry-wide standard for these surveys
6. The 3x3 detector is different from those used in the other off-site surveys (including those done by EPA), thus reducing the basis for comparability.

Paragraph 4.

The comment suggested that the probe was moved too rapidly in the walk-about survey for the instrument to respond or for the surveyor to respond to an increase in the reading. However, in the walk-about survey, the surveyor listened to the audio output of the instrument, which indicates an increase in count-rate instantly, in contrast to the slower response of a meter needle

The report was somewhat misleading in describing a 4-second 180° swing of the detector. Review of the gamma survey procedure A4CM-SP-0001 and discussion with the lead field

surveyor verified the following. Strips of land, 5 ft wide were measured and scanned side to side with a detector mounted on the end of a balanced 5 foot pole. With the surveyor stationary the detector was slowly swept from side to side of the 5 ft wide strip with a 4 second swing. Thus the swing arc was approximately 60° and the speed of the detector head over the surface was approximately 1.25 ft/sec. This is approximately one third of the speed suggested by a 180° arc swing. The surveyor then stepped forward 1 foot (or a shoe length) and repeated the 4-second side to side swing. Thus the detector was within 6 inches of any point on the ground. The length of time taken to traverse a 200 ft long strip was therefore approximately 4-5 seconds times 200 or approximately 15 minutes (assuming no elevated audio signal was detected). Each strip was therefore traversed at an average speed of approximately a quarter foot per second. Forty of these strips were traversed for each 200 x 200 ft grid block Of course, if an elevated signal was detected, the surveyor would stop his routine scanning and slowly zero-in on the source of the elevated signal.

That the surveyor could respond adequately is shown by the fact that when a 5-μCi Cs-137 source (one-half the exempt quantity of Cs-137) was hidden in each of the 183 grid blocks, it was found by the surveyor in every case. The effectiveness of the walk-about survey was also shown by the detection of an area of elevated radioactivity consisting of naturally occurring uranium in shale. The average uranium activity in the soil selectively removed from this area was just 10 times the average for Area IV, and less than one-third the release limit for soil contaminated with uranium.

Paragraph 5.

Careful review of the gamma exposure rate plots in Appendix B shows that there are no anomalies. All the data sets are close to Gaussian. The "higher reading...with no follow up" appears to refer to a higher reading in grid E12 which ended at an inaccessible area (see Figure B-31 in the report, volume 1). The soil at this location was sampled and found to contain a moderate amount of Cs-137, not significantly different from the Area IV distribution, but significantly higher Th-232 (natural thorium). The thorium was identified as the dominant contributor to the higher exposure rate. Since thorium is a naturally occurring radioactive material, even at this elevated level, no further investigation was deemed necessary.

Paragraph 6.

The comment suggested that we might miss an area where the true exposure rate is more than 5 μR/hr above background from contamination, because of variations in the response of the detector, or maybe areas where the exposure rate is not more than 5 μR/hr above background from contamination, because the contamination is deeply buried, with no significant remaining surface trace.

It should be stressed that neither the grid exposure measurements nor the walk-about surface survey were the only criteria used for soil sampling. In reality, only 12 locations

were sampled as a result of elevated exposure measurements. Elevated radiation was only one of six criteria for sampling soil; others included proximity to the Sodium Disposal Facility (28 samples), proximity to radiological buildings (38 samples), drainage areas (37 samples), leachfields (10 samples), and random sampling of each of the six topographical areas (22 samples). Sampling according to these criteria was a mixture of random sampling and non-random sampling whichever was the most appropriate. It should be noted that the off-site McLaren-Hart study (whose objective was the same as this study) did not do any radiation mapping or surface surveys, it only performed random and non-random soil sampling at selected locations.

As discussd earlier, the NaI(Tl) detectors over-respond to direct radiation when calibrated by use of scattered radiation. Calibration by comparison with the High Pressure Ion Chamber in the field provides this scattered-radiation calibration. Much of the radiation that is detected has been scattered in its passage through the soil and air, and is of lower energy than direct radiation, such as is provided by a laboratory calibration source. Because of this over-response to direct radiation when calibrated in this manner, contamination that produces a true increase in exposure rate of 5 μR/hr above background, will actually produce a greater detector response. If the contamination is so deeply buried, without a trace of surface activity, that the surface exposure rate is less than 5 μR/hr above background, it would indeed be missed by the surface surveys. That is why we specifically sample the leach fields, which are the locations where contamination could exist without leaving a surface trace. If there is a source buried so deeply, or a source so weak, that the surface exposure rate is less than 5 μR/hr above background, it will not be found, but it will not cause an exposure of greater than 15 mrem/year either.

Paragraph 7.

Was a Formal Data Validation Performed?

The Sampling and Analysis Plan describes the data validation process for soil sample analysis in section 7.1.1.2 and includes the following:

1. Field data-sheets were reviewed for completeness and clarity.

2. Laboratory analysis reports were reviewed for completeness and conformance to the lab request and to verify that sample serial numbers in each batch corresponded to serial numbers reported in of analysis reports.

3. Chain-of-custody forms were reviewed for continuity.

4. Analysis results were reviewed to ensure reported radionuclide concentrations were consistent with method detection limits.

5. Anomalous or questionable results were reported to the laboratory and re-analyses requested. This was done for 4 samples.

6. All QC sample results were analyzed to determine factors such as precision and accuracy for each isotope. These results are reported in Section 5.0

   - Blind Field Duplicates. 5% of scheduled samples. 88% pass rate.
   - Laboratory Duplicates. 7% of scheduled samples. 93% pass rate.
   - Laboratory Control Samples. 9% of scheduled samples. 99% pass rate.
   - Laboratory Blanks. 9% of scheduled samples. 96% pass rate.
   - Rinsate Samples. 5% of scheduled samples. 97% pass rate.
   - DHS Field Duplicates. 8% of scheduled samples. 69% pass rate.

Each data package received from the lab. for every batch of soil samples (either 10 or 20 samples per batch) consisted of:

1. Case Narrative (provided in the report Appendix)
2. Data Summary (provided in the report Appendix)
3. Chain-of-Custodies (CoC)

In addition the laboratory prepared for each batch of samples:

1. aliquot information
2. preparation log for QC samples
3. calibration data for liquid scintillation counter
4. copies of raw data sheets including calibration data for gamma spectrometer

These additional items were provided to Rocketdyne for the first 25% of samples. We did not request this data for the final 75% of samples. This additional information is voluminous. If we had put all of this supporting laboratory data for all the samples into the report, there would have been 15 volumes of lab data instead of 3 volumes.

There is Missing Chain-of-Custody Information.

We can confirm that we received all CoCs. Rocketdyne did not intend to put CoCs into the final report. However some CoCs were unintentionally included in the report for some batches. This obviously led to the perception that CoCs did not exist for all samples. That is incorrect. We regret the confusion this caused.

Information in Volumes II, II and IV is hard to follow.

In hindsight, we concur that a better job of segregating the laboratory data could have been done. The raw data was exhaustively tabulated, graphed, statistically analyzed, and

interpreted in the main body of the report, for the very reason that the raw lab data was impossible to assimilate for the casual reader. Perhaps because of this, less effort was devoted to indexing/annotating/titling the raw lab. data in Volumes II to IV. The laboratory reports were actually ordered chronologically, since any other way would have been even more confusing. In situations where re-analysis was requested and/or voluntarily performed by the laboratory, both original and re-analysis results are given in the chronological order in which the results were received. To repeat, this is the very reason we spent considerable effort in tabulating all results including re-analysis results in a more readable format in Table D-1

Cobalt 60.

Co-60 is present in the RIHL, from cutting stainless steel fuel element cladding, and is in the activated steel and concrete at T059, and was detected in the subsurface region of T010 after D&D, and was present at the SRE. The location of the highest Co-60 finding (1 of 3 samples showing this radionuclide) is in the drainage path from the SRE.

Hot particle.

One sample was reanalyzed several times for Pu-239. One aliquot taken from the soil sample read 0.19 pCi/g, while a second aliquot read less than detection limits and a field duplicate also read less than detection limits. 0.19 pCi/g Pu-239 in a 5 gram portion of one 500 gram soil sample can hardly be characterized as a "hot particle" when uniform contamination of all soil at SSFL at 36 pCi/g would meet the release criteria of 15 mrem/year.

Paragraph 8.

See responses to Dr. Lyou's comments on background.

Paragraph 9.

The decommissioning and decontamination and radiological surveys of nuclear facilities by Rocketdyne, the independent verification surveys by third parties and regulatory agencies, and the radiological release process has been documented in a mountain of reports. These activities are driven and controlled by regulation. The (as then) current status of facilities was documented extensively in the Area IV Radiological Characterization Plan when it was issued. The Area IV Radiological Characterization Survey was not driven by regulation but by a desire on the part of Rocketdyne to allay the public's belief that "the rest" of Area IV was subject to widespread contamination. It therefore complemented the regulatory required facility decontamination/survey/release process. This was made plain in the Final Report. It was not intended, nor was it appropriate to describe in detail every facility decontamination/survey/release process in this report. The status of each facility was briefly summarized in Table 2 of the report.

If such a comprehensive bridging report were to be written, then it would more logically be done at the very end of all cleanup activities.

Figure 1. Annual Exposure Rates vs. Distance from SSFL

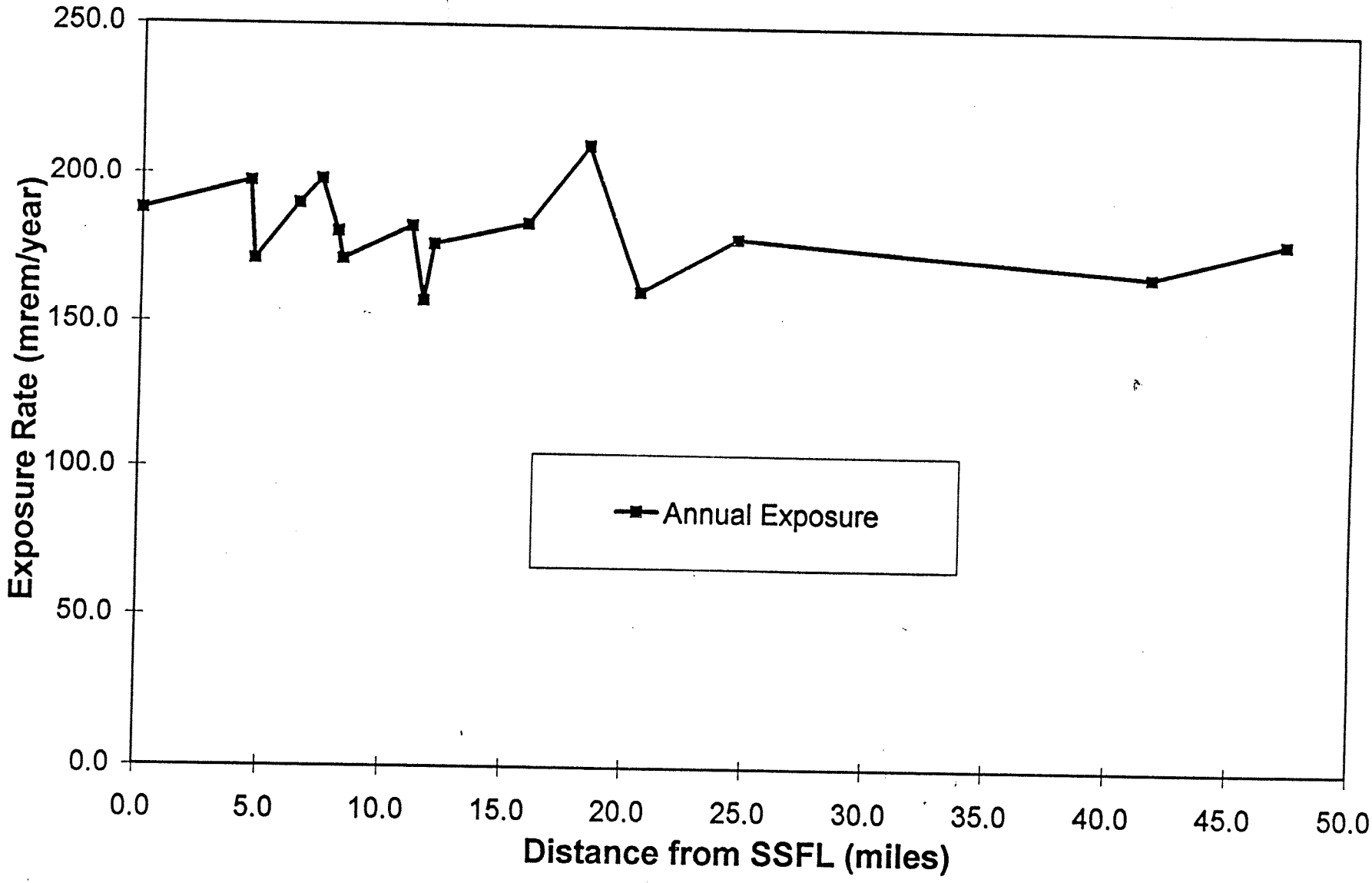

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Figure 2. Comparison of radioactivity in soils and exposure rate

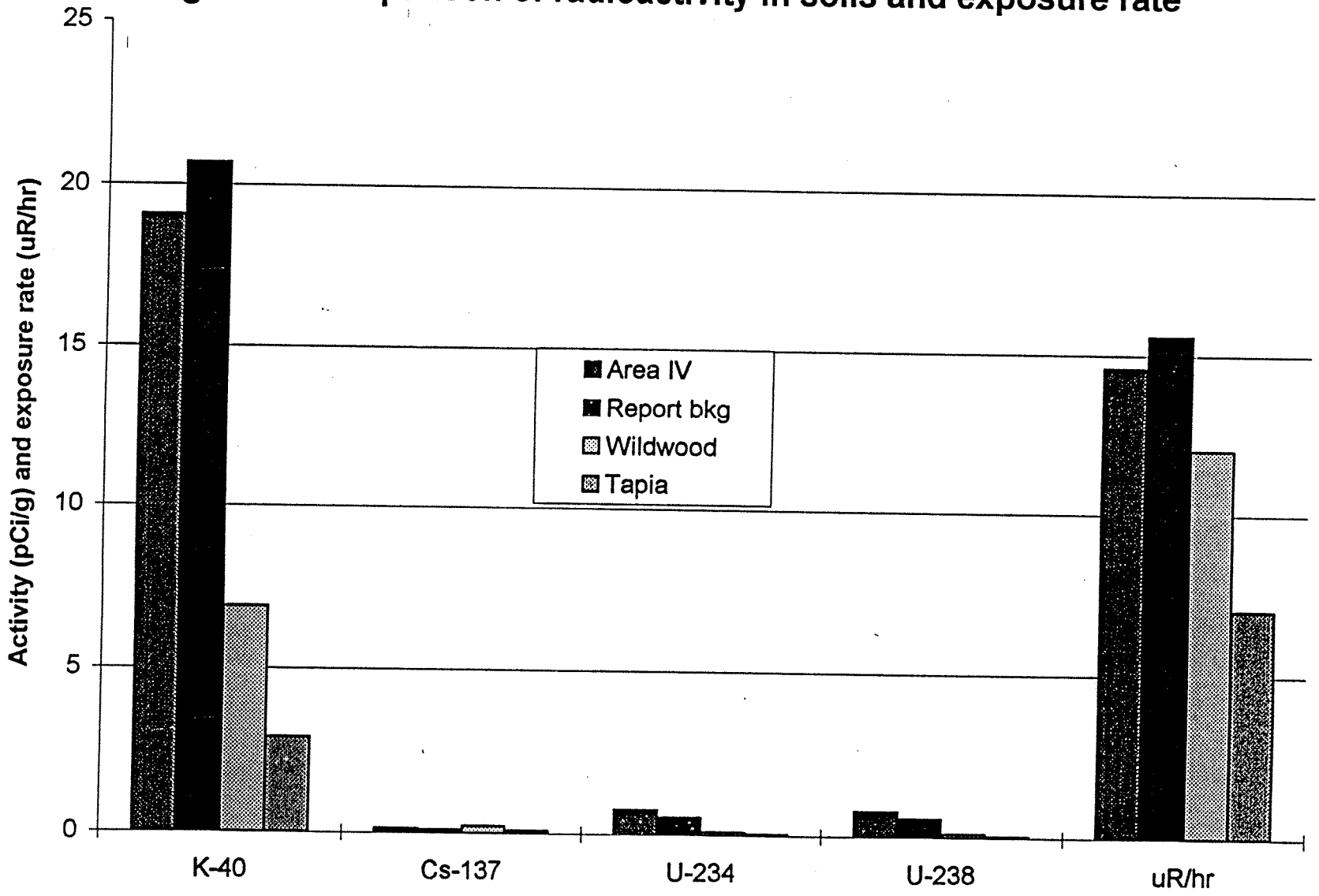

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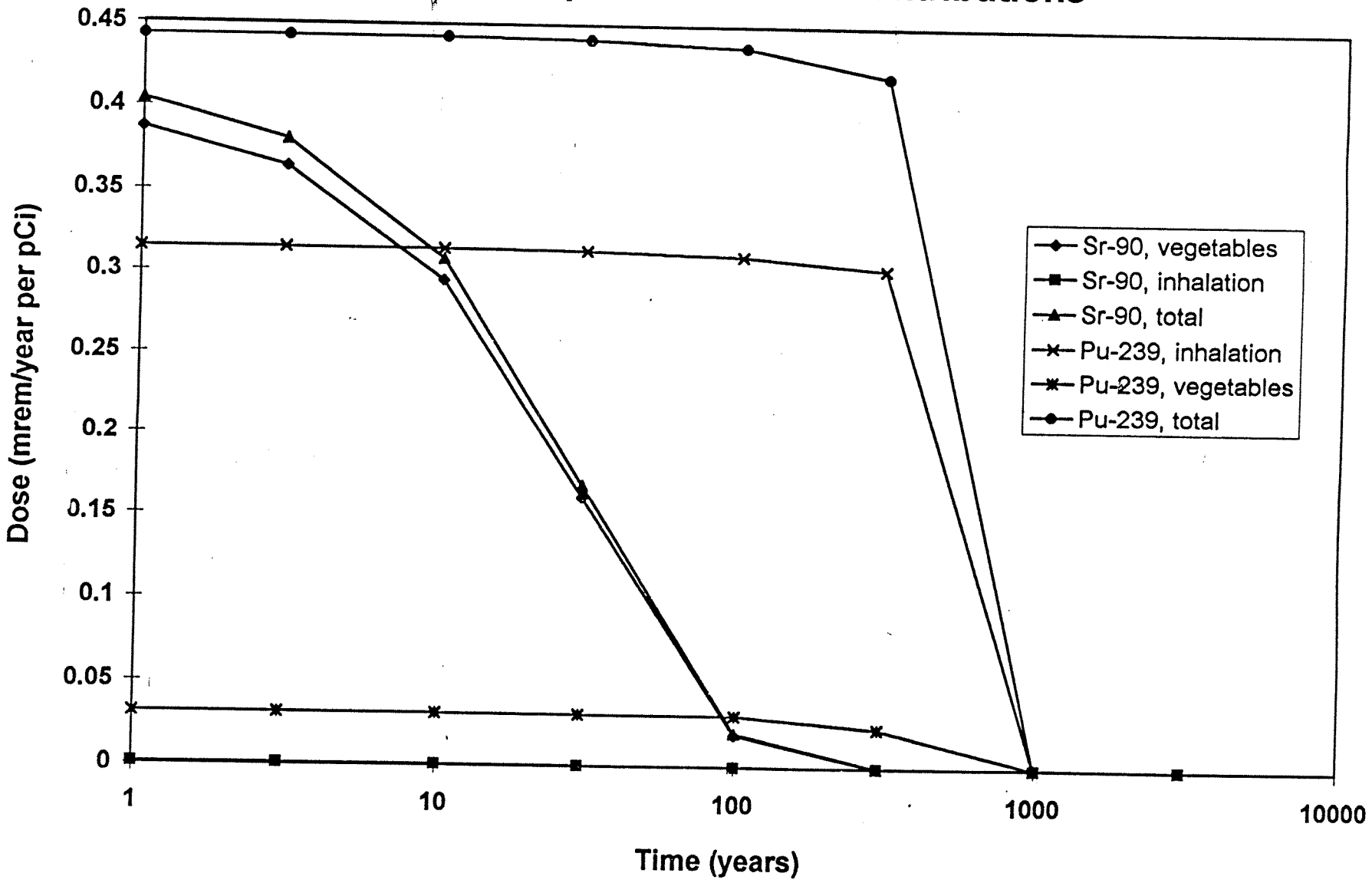
Figure 3. Comparison of dose contributions



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