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Decommissioning De Soto

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Radiation Survey for Release for Unrestricted Use of De Soto Facility, Second Floor, Building 104

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M. E. Remley [signature] 14 Oct 85

PREPARED BY/DATE	DEPT	MAIL ADDR
D. L. Speed [signature]	641	T100
F. E. Begley [signature]	641	T100

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ABSTRACT

Following cleanup of any previously detected radioactivity exceeding specified limits, a radiation survey was performed throughout the second floor of Building 104. The results of this survey show that these regions met the criteria established by the State of California, which are consistent with the ANSI standard and the U.S. Nuclear Regulatory Commission guideline for release of facilities for unrestricted use.

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I. INTRODUCTION

Building 104 at the De Soto complex was utilized for research and development from its construction in 1959 to 1983. This work is being continued on the first floor, but it was decided to release the second floor of this facility for other uses, and a decommissioning program was initiated. During operations in previous years under Atomics International and Energy Systems Group, this building was identified as Building 004. Subsequent to the merger of ESG with Rocketdyne, the designation was changed to Building 104.

Building 104 (originally 004) at the De Soto site in Canoga Park was originally designed for nuclear research and development work. A portion of Building 104 at the De Soto site was used on the ATR Fuel Fabrication Program for analysis of reactor fuel involving enriched uranium. This work was most recently conducted under the NRC Special Nuclear Materials License SNM-21.(1) This portion of the facility was decommissioned in June of 1984 and subsequently surveyed by a team from Oak Ridge Associated Universities for the NRC to permit unrestricted release. Details of this survey effort are reported in ESG 130SRR00001, "Radiation Survey for Release for Unrestricted Use Hot Chemistry Laboratory Area, ESG Headquarters, Building 004," June 1984. These areas were released by the NRC upon their receipt of the ORAU survey report.

Byproduct and source radioactive materials had been used in other laboratories on the second floor under State of California Broad Scope Type A Radioactive Materials License 0015-70. Due to a change in both the volume and nature of the R&D effort at the De Soto complex, it was decided to decontaminate these areas of Building 104 and to use the entire second floor of Building 104 for nonradioactive purposes. This facility will continue to remain under the control of Rockwell International until such time as agreement for release for unrestricted use with the State of California is made.

In summary, all detectable radioactive material was removed from the second floor of Building 104 with no measurable residual contamination remaining. Statistical analysis of data shows that essentially all residual radioactivity has been removed, and the area is acceptable for release for unrestricted use as defined in DECON - 1 (see Appendix B).

II. IDENTIFICATION OF PREMISES

The premises to be released consist of the second floor Building 104 (previously identified as 004) at the De Soto (previously ESG Headquarters) site. This site is shown in Figure 1. It is located at 8900 De Soto Avenue in Canoga Park, California.

Figure 2 shows the former laboratory areas located on the second floor of Building 104. Additional rooms and equipment on the first floor of this building were also decontaminated in this effort, but since work with radioactive materials will continue in laboratories on the first floor, only the second floor was surveyed for release, as documented in this report.

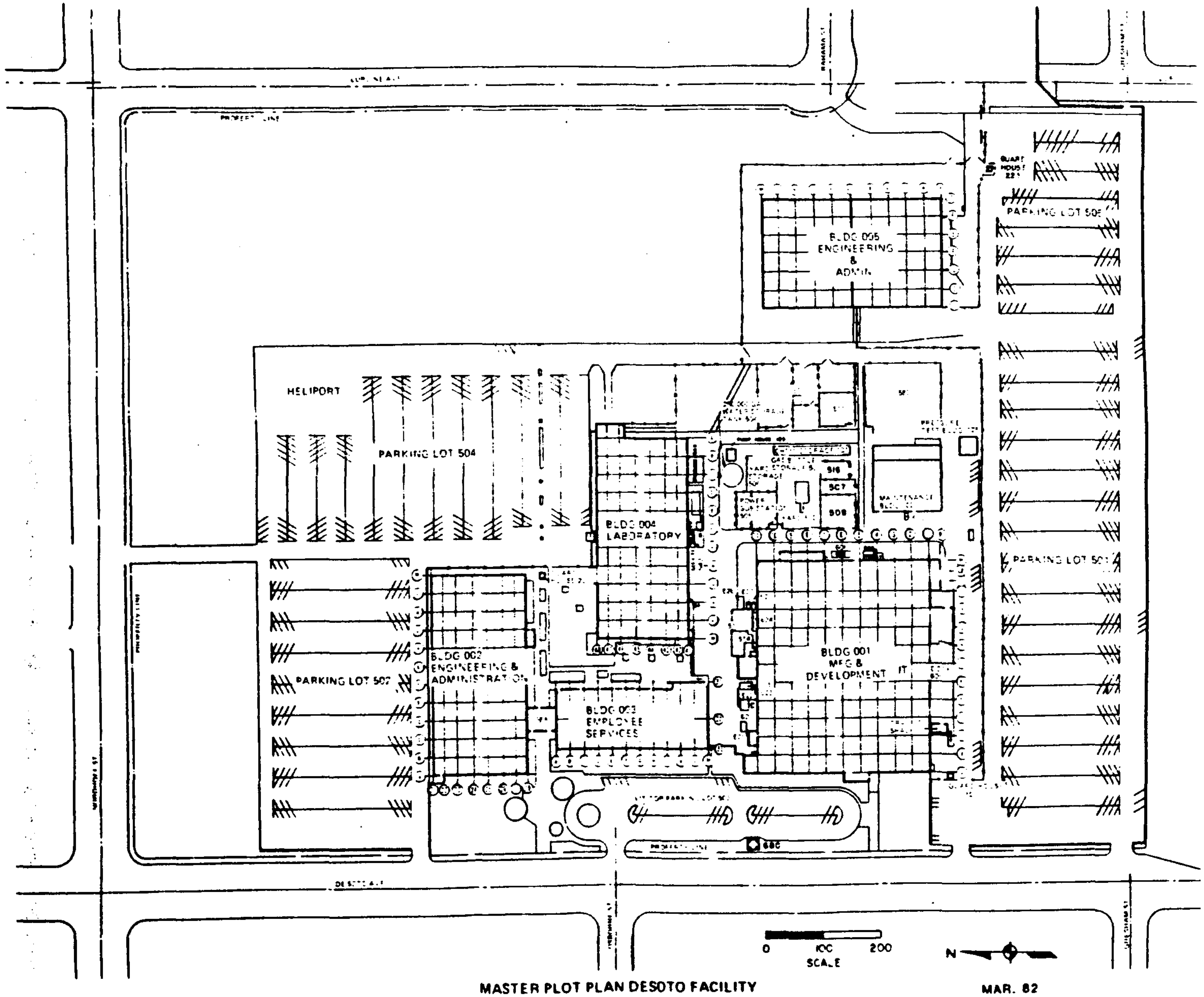

Figure 1. De Soto Avenue (former ESG Headquarters) Site in Canoga Park

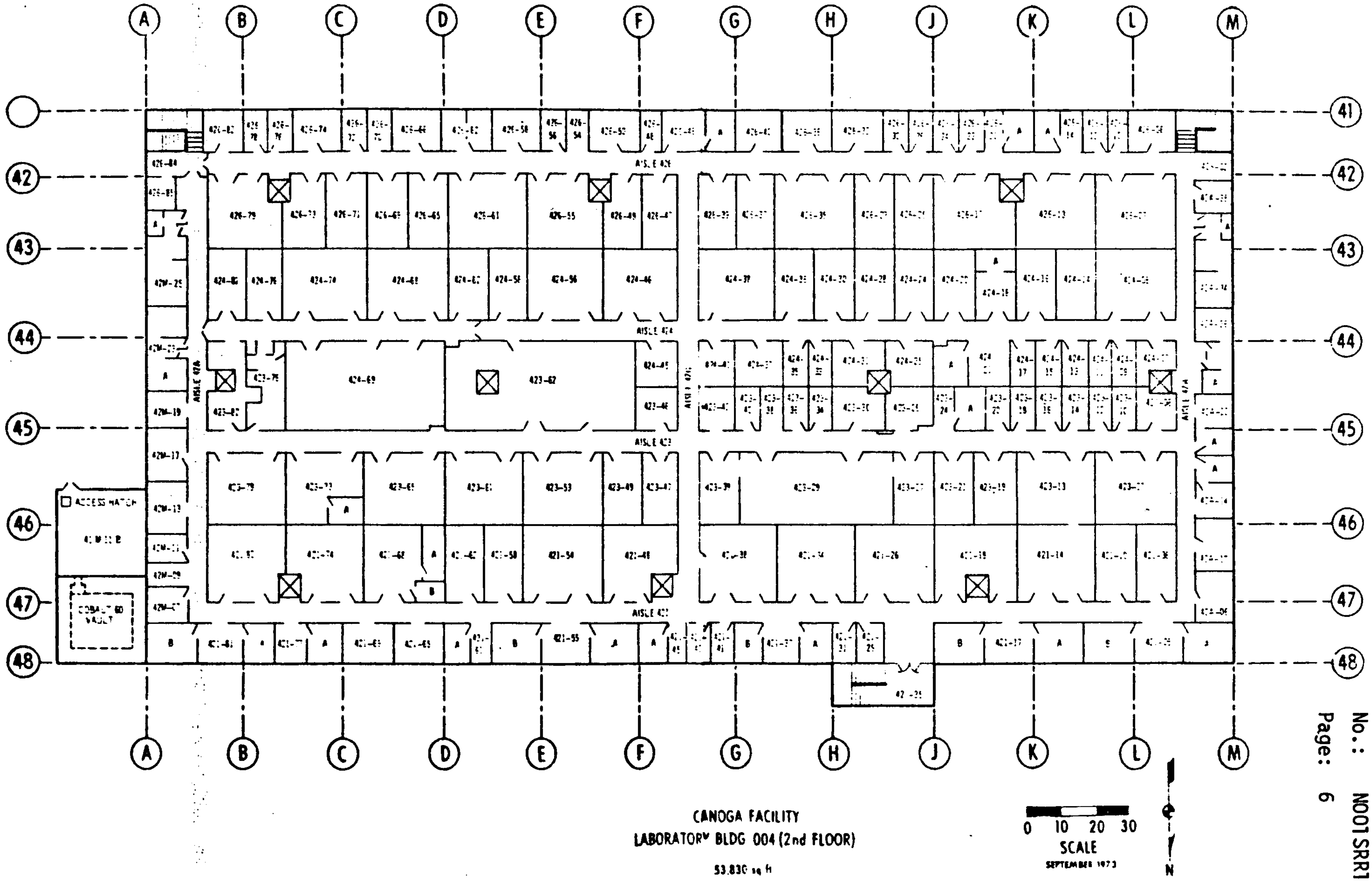

Figure 2. Building 104 Floor Plan

III. DECONTAMINATION EFFORTS

The second floor of Building 104 of the De Soto complex was used for a wide variety of research-oriented activities beginning in 1959. The activities carried out were quite diverse. Research of the authorized user files was conducted by Radiation and Nuclear Safety to determine the history of radio- active material use in these areas.

All of the radioactive material used under the State of California authorization in this area was encapsulated or used in small quantities for research purposes in fume hoods. Historically, no areas of extensive (i.e., the floor or walls of a room) contamination were allowed to exist. The only known exception to this was a series of tracer studies with Ca-45 and I-131 (short half-life isotopes) in the late 1960s which resulted in the general contamination of a laboratory area for a short time.

Both tritium and carbon-14 were used in various labs on the second floor in small quantities in laboratory fume hoods. The survey methods used were appropriate for carbon-14, and any small residual tritium activity would have diffused into the environment long before this survey effort.

Enriched uranium analysis activities were carried out in this facility but were limited to certain laboratory areas known as the ATR Hot Chemistry Laboratory. This area was licensed separately under the NRC SNM-21 license and subsequently decommissioned. The results of this survey are reported in the ESG Internal Document 130SRR000001, "Radiation Survey for Release for Unrestricted Use of Hot Chemistry Laboratory Area, ESG Headquarters, Building 004." In-situ gamma spectroscopy was done in these areas as a part of this effort. These spectra consistently showed a typical mix of cesium-137, cobalt-60, and uranium.

With this determination made, standards for the release for unconditional use could be established from the DECON - 1 document issued by the State of California in 1983. It should be noted that these criteria are in agreement with the guidance found in the most recent (January 1985) draft American National Standards Institute/Health Physics Society Decommissioning Standards (ANSI N13.12). DECON - 1 is reproduced in Appendix B to this report, and pertinent sections are extracted to Table 1.

TABLE 1

RESIDUAL CONTAMINATION LIMITS
FOR UNRESTRICTED RELEASE

Total average over 1 m^2	5,000 dpm/100 cm^2
Total maximum over 100 cm^2	15,000 dpm/100 cm^2
Removable contamination	1,000 dpm/100 cm^2

The handling of radioactive materials in these areas had ended by 1983, and, as the projects were completed and as work areas were relocated, the readily accessible areas were generally cleaned to acceptable levels. The bulk of the remaining residual contamination was located behind and beneath furniture, equipment, and floor tiles, and was inaccessible until the area was free for demolition.

The comprehensive decontamination effort was commenced according to ESG N065ACR630004, "Building 004 Analytical Radiochemistry Labs Decontamination and Decommissioning Requirements," dated December 1, 1982. This effort included the removal of all laboratory equipment and facilities (hoods, benches, cabinets, etc.), removal of radioactive exhaust facilities, most of the utility services and lighting, and all of the drain lines. The floor tile and suspended ceiling were also removed.

Small amounts of residual activity were detected on the concrete floor surface and were removed by scabbling. All materials leaving the area were monitored for contamination and disposed of by land burial at an authorized site when in excess of regulatory guidelines for unrestricted use. Internal walls and partitions, with the exception of the outer ring of offices, were also removed.

The radioactive exhaust system for this building serviced laboratories on both the first and second floors. Originally, seven HEPA-filtered exhaust plenums and stacks were located on the roof of this two-story structure. One of these exhaust systems had been removed as part of the previous decommissioning effort of the ATR Fuel Analysis Labs. Of the remaining six systems, only one remains as a HEPA-filtered system. At the conclusion of this decommissioning project, there were five of the old plenums, with the associated horizontal distribution ducts, still in place on the roof. These systems were surveyed prior to being sealed and found to have small amounts of radioactive contamination on the interior surfaces. The levels of activity which were measured were less than the release limits, but a comprehensive survey was not conducted due to the lack of access to many parts of the system. The systems were subsequently removed and disposed of as radioactive waste.

Vertical ducts connected the first floor labs with the exhaust fans and filter plenums on the roof of the building. All of the feeder ducts except one were removed. A single active HEPA-filtered radioactive exhaust system remains on the roof of this building. This system is in support of ongoing operations on the first floor of this building.

IV. SURVEY SCOPE AND PROCEDURES

A. SCOPE

A sampling inspection plan using variables has been used to demonstrate that the residual contamination in the area is below the limits shown in Table 1. These were extracted from DECON - 1 as noted in Section III.

The sampling inspection plan that was used is based upon a uniform 3-m (10-ft) square grid superimposed on the area. A 3-m square grid has been adopted to be consistent with both NRC and State of California guidance. The actual grid on the floor of each room was benchmarked in the northwest corner of the room. An identical grid was reflected onto the ceiling. A similar grid structure was also applied to the walls, benchmarked in the upper left corner of each wall. Each survey area has been identified with codes indicating the surface (F = floor; C = ceiling; N, E, S, W - north, east, south, and west walls, respectively) and a two-figure Cartesian coordinate showing the distance in meters from a local benchmark.

Within each square defined by the grid lines, a single 1-m^2 area was surveyed. Each area was outlined by felt marker or paint, with its coordinates marked within or beside the 1-m^2 area. The location of this 1-m^2 area was left to the surveyor's judgment: it was to be the area that, in his judgment, was most likely to have retained the most residual contamination of any similar area within the grid square. The surveyor was instructed to do this conscientiously to assure that any significant residual contamination would be detected before a report of acceptability was made to a regulatory agency. The use of a predetermined grid with discretion for the exact location provides a biased-uniform survey; selection of one 1-m^2 area out of the nine within each grid square provides an 11% sampling of the surface.

As can be seen in Figure 2, there was a ring of rooms on the outer perimeter of the building which had been dedicated to office space for the research and support personnel. Since radioactive materials were not used in these areas, a reduction in sampling was applied to this area. In this area, a 1-m^2 sample was measured from every other nine-m^2 grid in this area. This reduced inspection plan was also applied to the ceilings of the second floor of Building 104, resulting in a 5.5% sampling of these areas.

Sampling inspection consists of a sampling plan for selection of items to be tested--in this case, locations to be measured for radioactivity, and the method of analysis. The sampling plan used for this phase was to inspect one 1-m^2 area out of every 3-m grid square throughout the regions.

This 11% inspection (compared to 10% as recommended by the State of California) was used throughout this area except as explained above.

The 1-m^2 area chosen by the procedure described above is first measured for total alpha and beta activity and then for removable activity, as per procedures in Section IV.B.

The values resulting from these measurements (converted to the proper units) are analyzed in the following manner: The test statistic $\overline{x} + ks$ is compared to the acceptance limit U, where

$\overline{x}$ = average (arithmetic mean of measured values)
s = observed sample standard deviation
k = tolerance factor calculated from the number of samples to achieve desired sensitivity for this test
U = acceptance limit.

The State of California has stated (3) that the consumer's risk of acceptance (ß) at 10% defective (LTPD, Lot Tolerance Percent Defective) must be 0.1. For these choices of ß and LTPD,

$$K_\beta = K_2 = 1.282$$

The number of samples is n. The value of k for each sample size is calculated from (4):

$$k = \frac{K_2 + \sqrt{K_2^2 - ab}}{a}; \qquad a = 1 - \frac{K_\beta^2}{2(n - 1)}, \qquad b = K_2^2 - \frac{K_\beta^2}{n}.$$

For example, for n = 10, k = 2.41; n = 100, k = 1.47; n = 1000, k = 1.34.

The criteria for acceptance are presented as a plan of action. The plan of action is:

1) Acceptance: If the test statistic ($\bar{x}$ + ks) is less than or equal to the limit (U), accept the region as clean. (If any single measured value exceeds the limit, decontaminate that location to below the limit, but do not change the value in the analysis.)

2) Collect additional measurements: If the test statistic ($\bar{x}$ + ks) is greater than the limit (U), but $\bar{x}$ itself is less than U, independently resample and combine all measured values to determine if $\bar{x} + ks < U$ for the combined set; if so, accept the region as clean. If not, reject the region.

3) Rejection: If the test statistic ($\bar{x}$ + ks) is greater than the limit (U) and $\bar{x} > U$, reject the region.

Step 2 takes advantage of the improved discrimination of the acceptance test resulting from an increase in the number of samples to reduce the risk of rejecting a region that is acceptably clean. This false rejection should be avoided if possible to avoid the unnecessary expense of further decontamination. If the result of the additional inspection does not show acceptability, further decontamination is required. Step 3 assures that no truly contaminated area will be accepted. The contamination measurements made at the inspected location may be used to guide further decontamination, but these locations should be avoided in the subsequent inspection.

B. PROCEDURES

The following procedures were used in performing this survey.

1. Average Contamination Measurement

1) Identify 1-m^2 area to be measured.

2) With a portable scaler (Ludlum 2220 - ESG scaler or equivalent) set for 5-min count time, use an alpha probe (Ludlum Model 43-1 or equivalent) or a beta probe (Ludlum Model 44-9 or Technical Associates Model P-11 or equivalent) and uniformly scan the area. (Watch for and note any "hot spots" where the radioactivity may exceed the average limit. These are to be resurveyed later.)

3) Record the location and total count.

4) The total count is converted to dpm/100 cm^2 total surface activity by:

$$SA_T = \frac{(C - B)B}{5}\frac{(100)}{A}$$

where

SA_T = total surface activity in dpm/100 cm^2
C = total count in 5 min
5 = count time, min
B = background count in 5 min (generally 0-5 for alpha and about 200-220 for beta)
E = efficiency factor, dpm/cpm (generally 4 for alpha and 7 for beta)
100 = 100-cm^2 standard area
A = probe sensitive area (69 cm^2 for Ludlum Model 43-1 alpha scintillator; 20 cm^2 for Ludlum Model 44-9 and Technical Associates Model P-11 pancake G-M).

(Note that the analysis is done using counts rather than count rates.)

2. Maximum Contamination Measurement

1) Return to any area identified as having a "hot spot."

2) Repeat the uniform scan of only the hot spot area, covering approximately 100 cm^2 with the probe.

3) Record the location and total count as a "hot spot" measurement.

4) The total count is converted to dpm/100 cm sq as shown above.

3. Removable Contamination Measurement

1) Identify 1-m^2 area to be measured.

2) Using a Whatman 540 filter paper (2.4 cm diameter), wipe a "Z" or "S" pattern, with legs approximately 6 in. long, so as to sample removable contamination from an area of approximately 100 cm^2.

3) Place smear paper in file card "book" until ready for counting.

4) Count radioactivity using gas-flow proportional counter (NMC Model ACS-77 or equivalent) for 5 min.

5) Record the location and both the total alpha count and the total beta count.

6) The total counts are converted to dpm/100 cm^2 removable surface activity by:

$$SA_R = \frac{(C - B)E}{5}$$

where the appropriate alpha and beta backgrounds and efficiency factors are used. Backgrounds are typically 1-3 counts for alpha and 120-150 counts for beta. Efficiency factors are about 4 dpm/cpm, for alpha and beta.

V. SURVEY RESULTS

The survey of this area was conducted using the aforementioned standard survey plan. A summary of the survey results appears below in Table 2. The results of the mathematical statistical analysis (see Appendix A) are summarized in Table 3 of this report.

TABLE 2
SUMMARY OF SURVEY RESULTS
BUILDING 104 SECOND FLOOR

Measurement	Number of Locations	Average Value (dpm/100 cm^2)	Maximum Value (dpm/100 cm^2)	Limit
Average alpha	917	3.9	61.5	5,000
Maximum alpha	0	N/A	N/A	15,000
Removable alpha	917	0.03	5.9	1,000
Average beta	917	254.4	2338.9	5,000
Maximum beta	0	N/A	N/A	15.000
Removable beta	917	1.4	84.2	1,000
Gamma Dose Rate (Micro R/hr)	48	11.6	17.6	17

In all cases, both the maximum radiation measurement value from Table 2 and the inspection test statistic from Table 3 are well below the appropriate limits. The results summarized in this table confirm that the area is acceptable for release for unrestricted use at the present time.

TABLE 3

SUMMARY OF TEST STATISTICS
BUILDING 104 SECOND FLOOR
DE SOTO COMPLEX

Measurement	Number of Locations	Inspection Test Statistic	Test Statistic Limit
Average alpha	917	11.7	5,000
Maximum alpha	N/A	----	15,000
Removable alpha	917	1.8	1,000
Average beta	917	802.8	5,000
Maximum beta	N/A	----	15,000
Removable beta	917	17.6	1,000

The results of each of the types of survey measurements are shown in Figures 3 through 7. These are plotted as cumulative probability distributions as explained in Appendix A, and show graphically the inspection test. The straight line through the data points passes through $\overline{x}$ and $\overline{x}$ + ks. The vertical line shown about 1.3 standard deviations above the mean represents the value of the tolerance factory, k. The x marked on this line represents the value of the acceptance limit. The inspection test is satisfied if the line through the data points passes below the x. This is true for all the tests. In addition, the plots show that little, if any, residual radioactivity remains.

The second floor will be refurbished into office space and all R&D activities will cease. It is the intent of Rocketdyne to stop the use of radioactive materials in this area. It is anticipated that if no further activities involving radioactive materials occur in this area, this report will function as the documentation of the final survey of this area for the future release of Building 104 from the State of California Radioactive Materials License 0015-70.

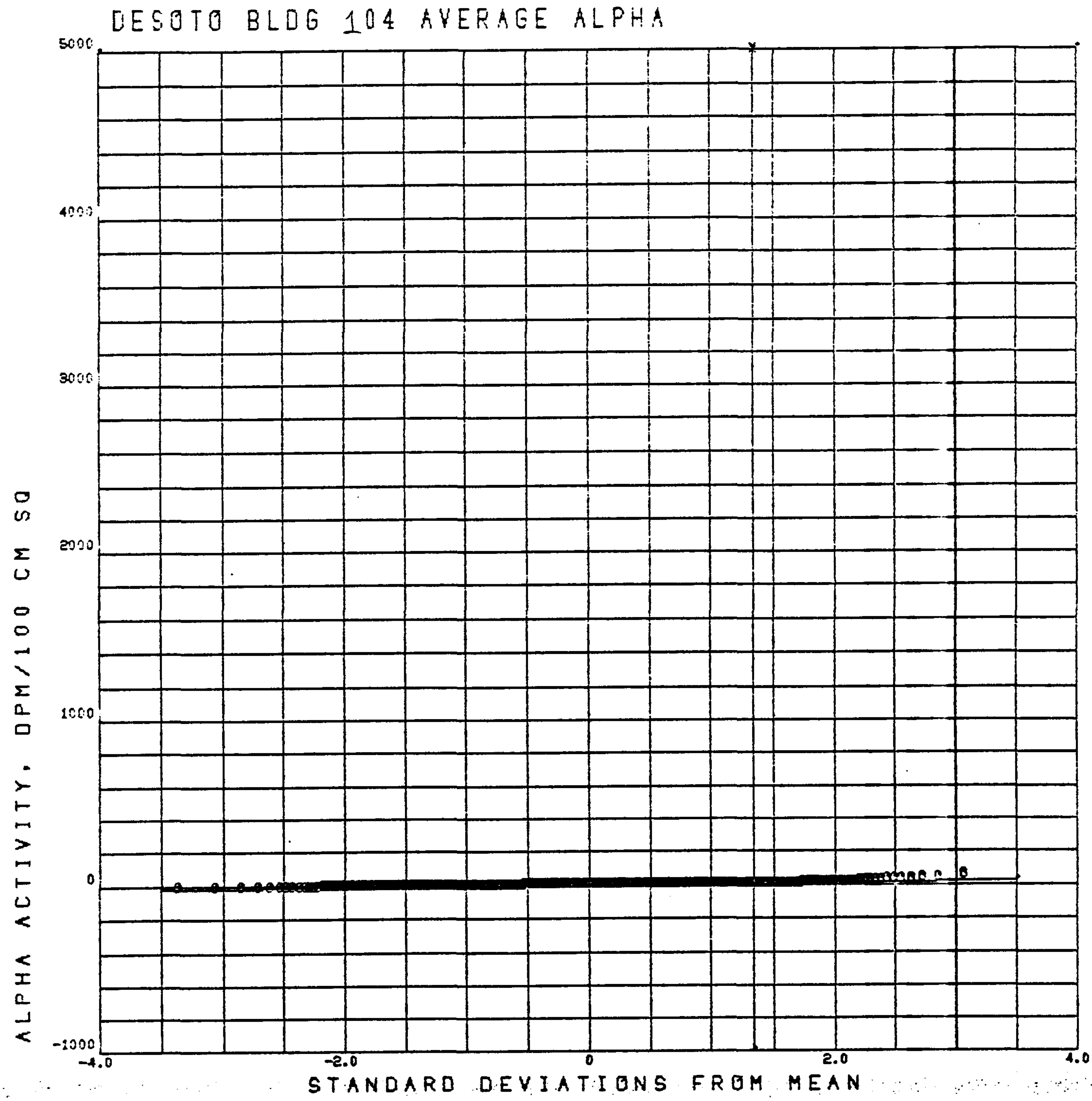

Figure 3. Average Alpha Activity

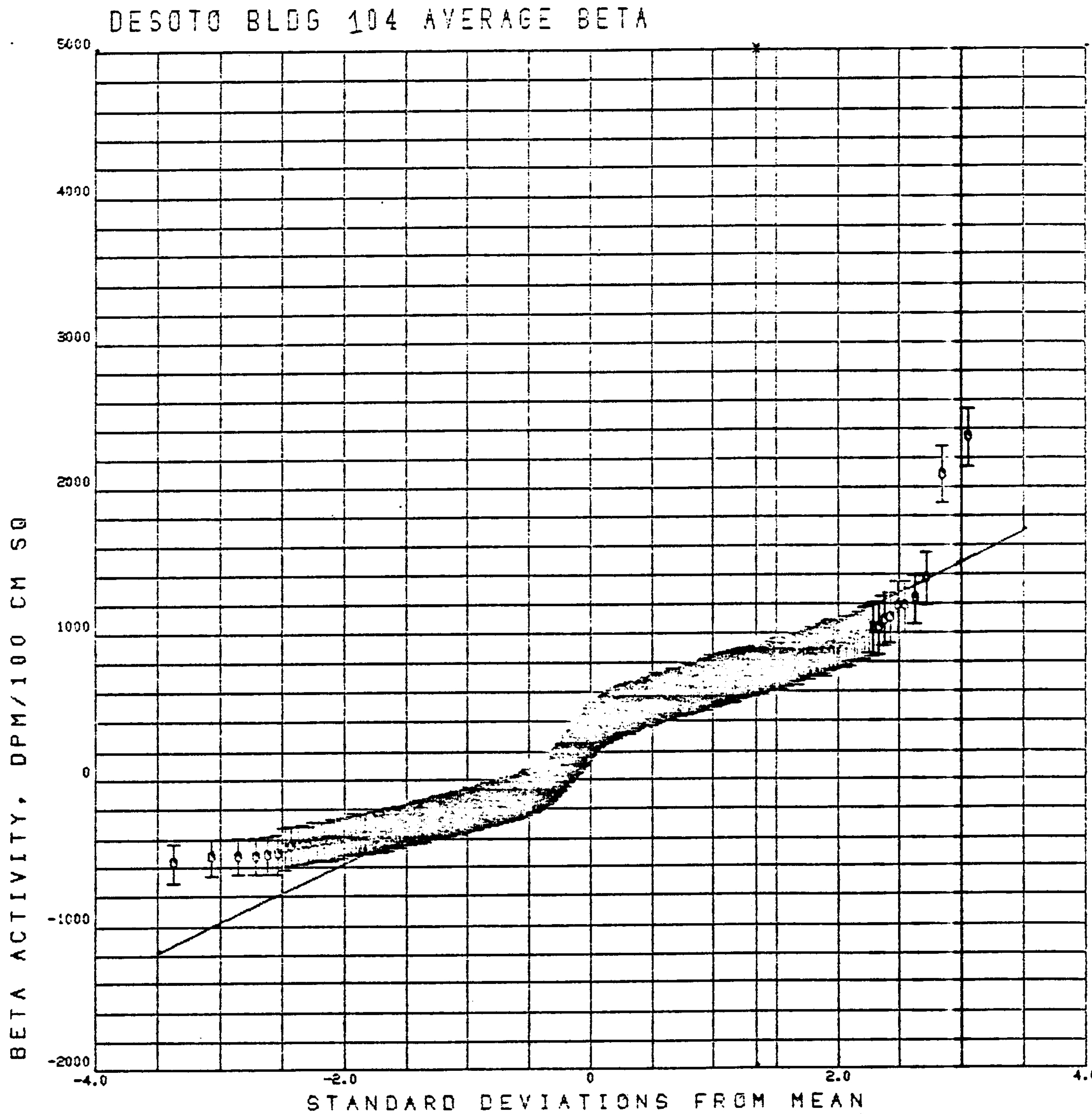

Figure 4. Average Beta Activity

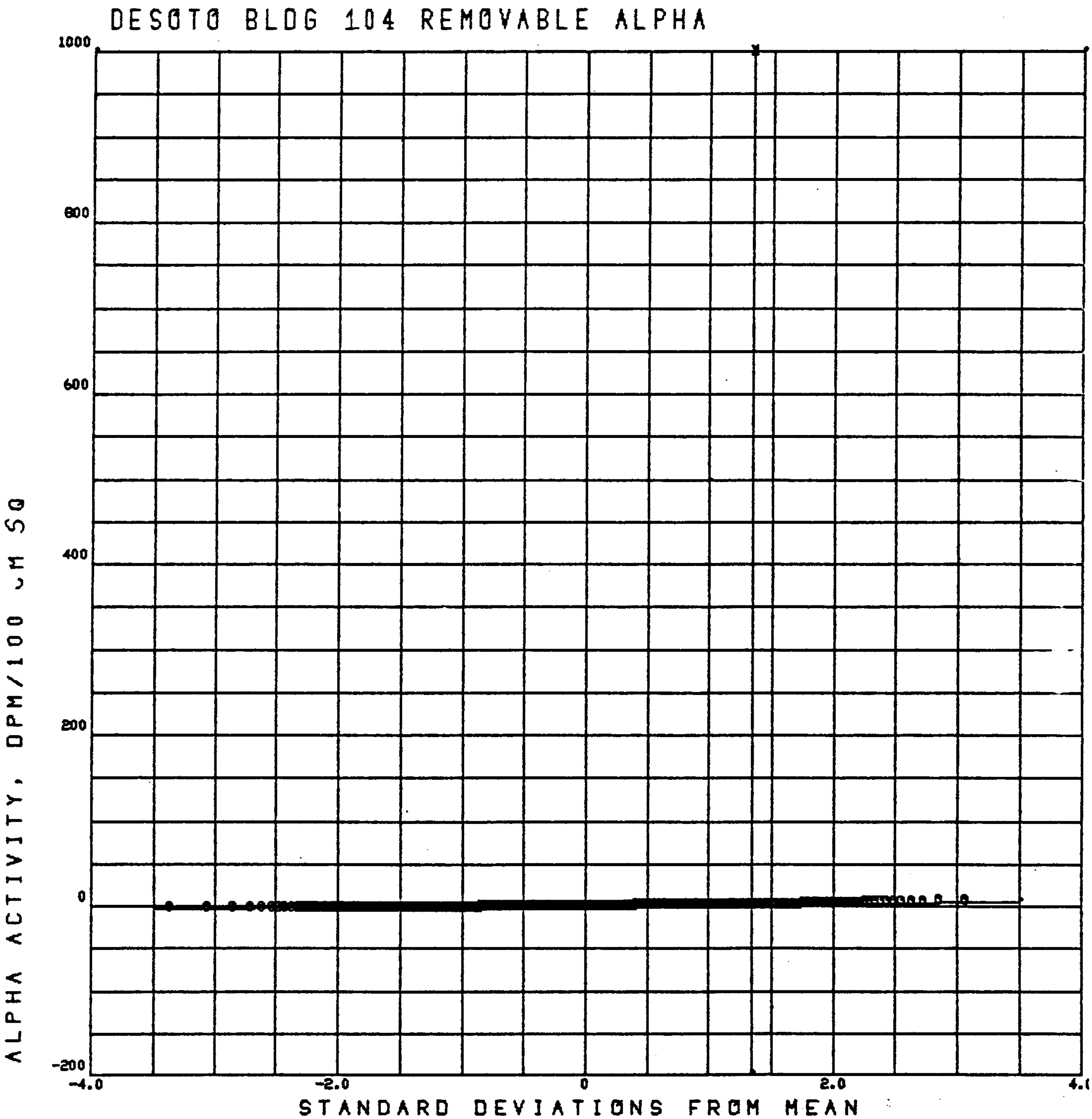

Figure 5. Removable Alpha Activity

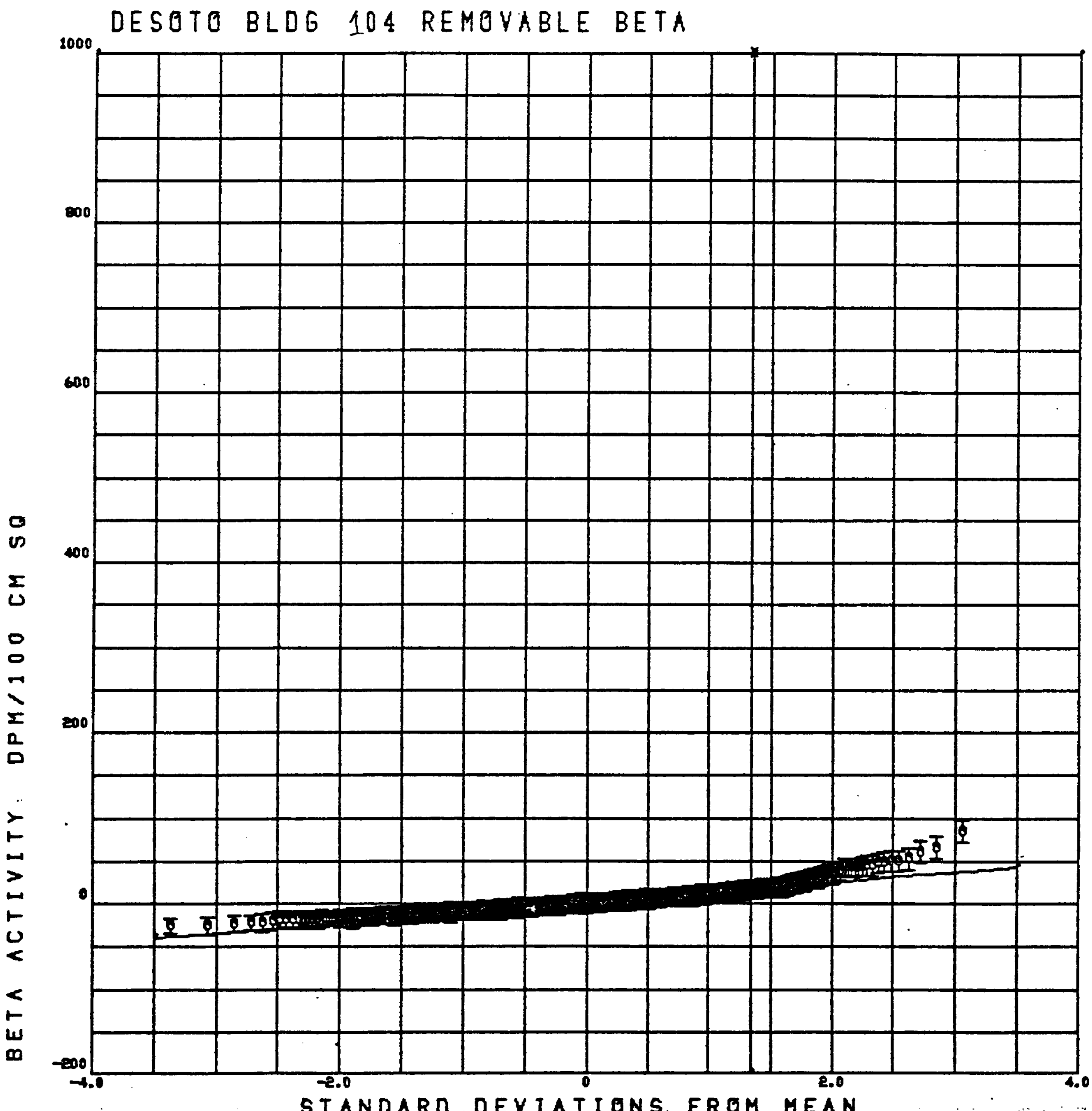

Figure 6. Removable Beta Activity

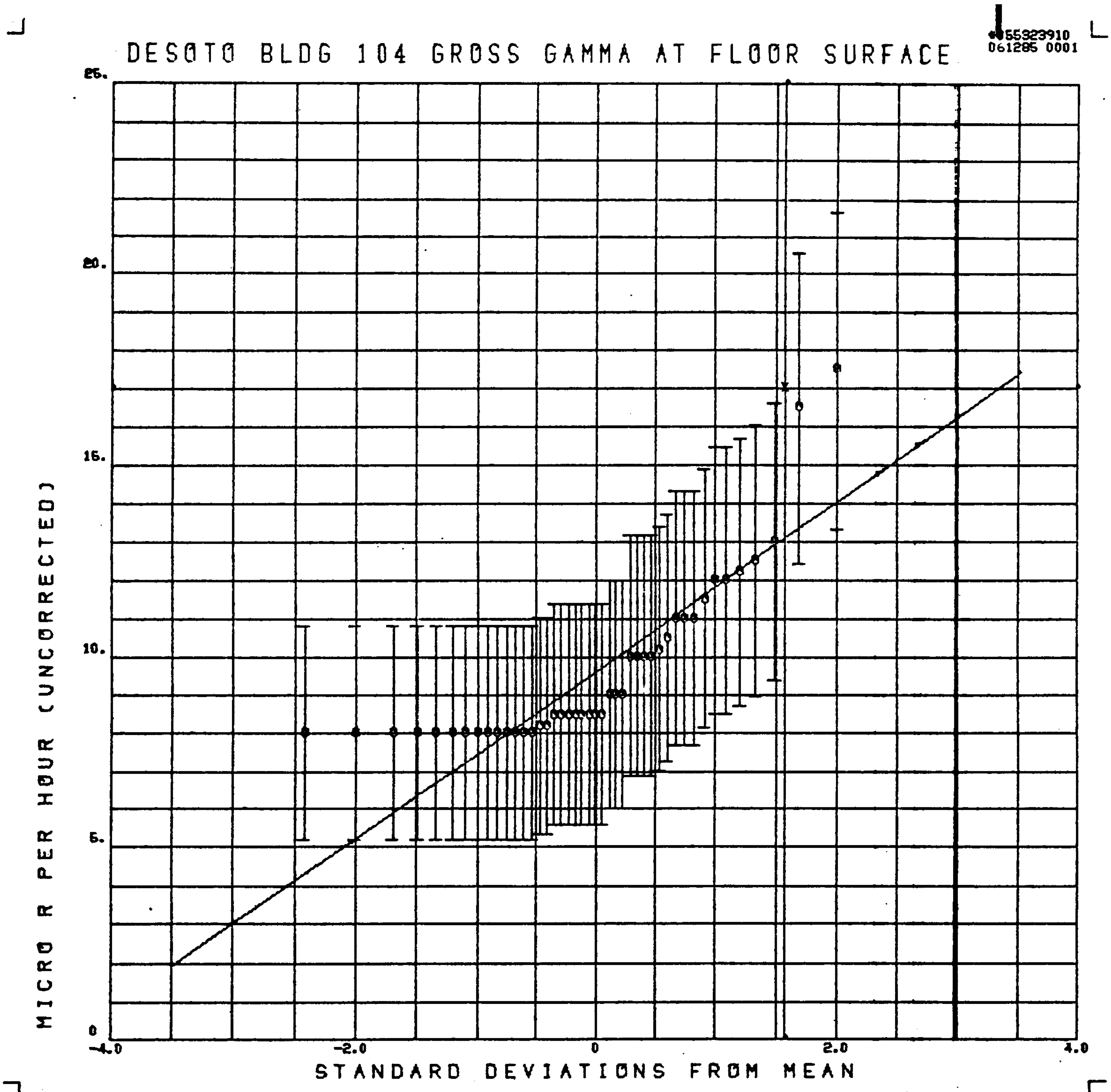

Figure 7. Gamma Exposure Rate

VI. CONCLUSION

An appropriate survey has been conducted throughout the area to be released. All remaining measured values of residual radioactivity are below the acceptance limits. The results of this survey show statistically that no residual contamination remains in this area and demonstrates a negligible risk of there being any undetected contamination exceeding the acceptance limits. With the concurrence of the State of California Department of Health Services Radiologic Health Section, this area will be removed from the Rocketdyne Radioactive Materials License 0015-70 and be released for unrestricted use.

VII. REFERENCES

1. Special Nuclear Materials License SNM-21 and Technical Specification for Operations at Atomics International, AI-75-46 and License Conditions

2. "Disposal or Onsite Storage of Thorium or Uranium Wastes from Past Operations," Federal Register 46, (205), 52061, October 23, 1981

3. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use," (DECON - 1) State of California, Radiologic Health Branch, Department of Health Services (June 1977)

4. "Radiation Survey for Release for Unrestricted Use of Hot Chemistry Laboratory Area, ESG Headquarters, Building 004," ESG Supporting Document 130SRR000001, June 12, 1984

5. "Building 004 Analytical Radiochemistry Labs Decontamination and Decommissioning Requirements," N065ACR630004, dated December 1, 1982

6. "Radiation Survey for Phase III Release for Unrestricted Use ESG Headquarters, Building 001," N065SRR205006, dated January 17, 1984

7. "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use," (DECON-1) State of California, Radiologic Health Branch, Department of Health Service (June 1977)

8. "Techniques of Statistical Analysis," C. Eisenhart, M. W. Hastay, W. A. Wallis, editors, McGraw-Hill, New York (1947)

APPENDIX A
INTERPRETATION OF GRAPHIC PRESENTATION

The purpose of statistical analysis is to convert a large amount of data into a manageable amount of understandable information. This process can involve a variety of mathematical techniques, the simplest being the determination of an average (or mean) value for a given set of data. This simple determination is improved upon by also calculating the standard deviation of the data about the mean, which gives an estimate of the variability of the data. In many cases, this variability represents variations both in the characteristics being measured (average alpha activity in one square meter, for example) and in measurement (due to random fluctuations in the detector efficiency and background radiation levels).

The significance of these quantities (mean and standard deviation) depends upon the distribution assumed for the data. Sometimes there is a theoretically known distribution for a particular measurement process, such as the binominal, or the Poisson distribution for counting radioactivity. These distributions are relatively well approximated by the Gaussian, or normal, distribution. In fact, the Gaussian distribution approximates the distribution of many different kinds of measurements and for simplicity is generally assumed to be the proper distribution. The Guassian distribution is frequently seen in the form of a "bell"-shaped curve, with most values occurring near the mean value and fewer and fewer values existing at increasing distance from the mean, both greater than and less than the mean.

However, it is difficult to derive this bell-shaped curve from experimental data unless the data are specifically selected to demonstrate the curve, and deviations from the distribution are difficult to see. A better version is the so-called "cumulative probability function," which forms an "S"-shaped curve when plotted in the usual manner. This can be further improved by adjusting the abscissa (the "X" values on an X-Y graph) so that the "S" curve becomes a straight line. This is a standard statistical technique and is the basis for special graph paper used for probability analysis of data. The parameters of the Gaussian distribution (the mean and the standard deviation) are determined by the usual calculational methods:

$$\text{Mean} = \bar{X} = \frac{\sum X_i}{N}$$

$$\text{Standard deviation} = s = \left[\frac{\left(\sum X_i - \bar{X}\right)^2}{N-1}\right]^{1/2}$$

where X_i represents the individual data values, and N is the number of points.

This method is the basis for the figures presented earlier in this report, where the measured values are plotted against the distance from the mean value, using the standard deviation of the assumed Gaussian distribution as the unit.

Where the data are not well-represented by a Gaussian distribution (and this is true of most cases) the departure is readily apparent; the data points do not lie along a straight line representing the Gaussian distribution. In most cases, this departure takes a single typical form. Much of the data lies along the theoretical straight line with a few points at either extreme lying somewhat above it.

This form can usually be interpreted as showing a large number of uncontaminated locations where the variability is due to random fluctuations in the measurements themselves, with the balance being locations that harbor more or less residual contamination.

If the contaminated area is large, there will be many points departing from the curve. In these cases, the points will not fit the theoretical straight line. If most of the region in question is contaminated, the distribution will be dominated by the contaminated data points, in a line of points generally sloping from the lower left to the upper right, fitting more or less closely, a theoretical straight line.

To promote the quantitative use of sampling inspection in radiological surveys, several governmental agencies (the U.S. NRC and the State of California) have established a policy for the interpretation of survey data. All survey results must be below the appropriate limits and, in addition, the set of data, when interpreted statistically, must indicate that there is less than a 10% risk of accepting a facility in which 10% of the area is contaminated in excess of the limits. The mathematical methods used for this interpretation are explained in the next section.

In this report, this analysis has been extended to provide a sampling inspection test. This analysis uses a standard quality control technique called inspection by variables, in which the distribution of the measured values is used to predict the probability that other unmeasured values would exceed a specified limit. The standard test method requires calculating the mean ($\overline{X}$) and the standard deviation(s). Then, depending on the values chosen for certain parameters that reflect the performance of the test in accepting bad lots, or rejecting good lots, the necessary number of samples is determined and a multiplier, k, is computed so that the inequality

$$\overline{X} + ks < U$$

where U is the acceptance limit, representing an acceptable lot. In the present application, "lot" is used to refer to a major segment of the survey effort.

The parameters used in this test are those recommended by the State of California, Radiologic Health Section, for the release of a facility for unrestricted use. These are so-called "consumers risk" (or beta) and the "lot-tolerance percent defective" (LTPD). The values recommended for these are beta = 0.1 and LTPD = 10%. This means that, if a lot just passes the acceptance test, there is one chance in ten (0.1) that 10% of the total number of locations would have residual contamination exceeding the limit.

The usual manner of applying this inspection test is to use tables giving the values of the sample size (N) and multiplier (k) for the selected values of beta and LTPD. In the present application, the number of measured values (N) in each lot was used to compute k, and this value was used to calculate $\overline{X} + ks$. The computation of k is somewhat complicated, but once programmed for the computer as part of a data analysis program, the complication is no obstacle to its use.

$$k = \frac{K_2 + \sqrt{K_2^2 - ab}}{a}$$

$$\text{with } a = 1 - \frac{K_{beta}^2}{2(N-1)}$$

$$\text{and } b = K_2^2 - \frac{K_{beta}^2}{N}$$

The value of K_2 is that for the variable of a Gaussian distribution corresponding to the LTPD value, and the value of K_{beta} is that for the Gaussian variable corresponding to beta.

An area that shows detectable contamination may still be acceptable for release according to the regulations if the levels of contamination are low enough. Acceptable limits have been established by the State of California, as shown in Appendix B. Clearly, all measured values must be less than the specified limits for an area to be acceptable. In the figures, these limits are shown as horizontal lines marked in the graph by an "x". Review of the figures shows that, in most cases, all data points lie below the limit. This test results in a vertical line on each graph, marked by an x where it crosses the horizontal limit line. A theoretical straight line is calculated for each distribution of data points; this shows as a line sloping more or less from the lower left to the upper right. The cleaner an area is, the closer to the horizontal this line will be. If this line passes below the x, the survey area is acceptable according to this set of well-established statistical criteria. (Any locations within the area that were measured to be contaminated in excess of the limit would still need to be decontaminated to a level less than the limit.)

APPENDIX B

DECON-1

DECON 1

Unconditional release of radioactively contaminated facilities and equipment requires decontamination to prevent risk to the public health and safety with subsequent unrestricted use.

Section 30298 of the California Radiation Control Regulations specifies that the user is responsible for this decontamination. The Department will impose no conditions with respect to future use of equipment and facilities following decontamination consistent with the following guidelines:

a) The user shall make every reasonable effort to eliminate residual contamination.

b) No covering shall be applied to contaminated surfaces of equipment or structures by paint, plating, or other means prior to release for unrestricted use. Equipment may be released and coated per paragraph (e) below if it is established by documented survey that concentrations are below the limits specified in Table I.

c) The radioactivity on the interior surfaces of pipes, drainlines, or ductwork can be determined by making measurements of all traps and other appropriate access points, provided contamination at these locations is likely to be representative of contamination on the interior of the pipes, drainlines, or ductwork. Surfaces of premises, equipment or scrap which are likely to be contaminated but are of such size, construction, or location as to make the surface inaccessible for purposes of measurement should be assumed to be contaminated in excess of the permissible radiation limits.

d) In the case of facilities to be released, Section 30298 requires 30 days prior notice of intent to vacate. This notice must be followed by a report summarizing the results of the surveys following decontamination establishing that levels of radioactivity are within the limits specified in Table I.

The summary should be supported by sufficiently detailed survey records maintained for inspection. The Department must have an opportunity to confirm by spot survey the summary report submitted prior to granting approval for release.

TABLE I

ACCEPTABLE SURFACE CONTAMINATION LEVELS

Nuclide	Fixed Average[b)c)] dpm/100 cm^2	Fixed Maximum[b)d)] dpm/100 cm^2	Removable[b)e)] dpm/100 cm^2
a) U-nat, U-235, U-238, & associated decay prod.	5,000	15,000	1,000
b) Transuranics, Ra-226, Ra-228, Th-230, Th-228 Pa-231, Ac-227, I-125, I-129	100	300	20
c) Th-nat, Th-232, Sr-90 Ra-223, Ra-224, U-232 I-126, I-131, I-133	1,000	3,000	200
d) Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and other noted above	5,000	15,000	1,000
e) H-3, C-14 except as DNA precursors f)	20,000	60,000	4,000

[a)] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b)] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c)] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each such object.

[d)] The maximum contamination level applies to an area of not more than 10 cm sq.

[e)] The amount of removable radioactive material per 100 cm sq of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f)] DNA precursors mean molecules or compounds that are directly incorporated into the DNA molecule during DNA biosynthesis, e.g., purine and pyrimidine bases and their analogs, nucleotides and nucleosides. The acceptable surface contamination levels for H-3 and C-14 in DNA precursors are as tabulated in Paragraph d) for beta-gamma emitters.

e) In the case of equipment to be released, no request or report is required if guide limits are met. The licensee must, however, maintain detailed survey records sufficient to justify the release.

f) If California guidelines are not satisfied in a particular instance, the Department must be consulted with respect to future use of the item in question, except where there will be a transfer to a specific license. The Department's determination as to whether the item may be released will involve such factors as the practicality of further decontamination and the likely hazard considering possible future use of the item. Requests for review and variance should provide: (1) Detailed and specific information describing the item, radioactive contaminants, and the nature, extent, and degree of residual contamination. (2) A detailed health and safety analysis establishing that residual contamination is not of concern with respect to the health and safety of the public given the nature of the residue and the prospective use of the facilities or equipment.

Facility Release Survey

A facility release survey is required to confirm that the user's decontamination efforts and comprehensive survey are adequate with respect to future unrestricted use of the facility. Test procedures are designed to assure that Table I limits are satisfied at a spot frequency of 0.1/100 ft sq and a consumer's risk of 10%.

1. Establish a 100-ft-sq unit grid divided into equal area quadrants. Repeat every 10,000-80,000 ft sq as is necessary for coverage.

2. a) Area $\leq$ 1700 ft sq

Survey the entire area for hot spots. Obtain readings from each 100-ft-sq unit per 3(b) below to establish the average activity.

b) 1700 ft < area ≤ 5000 ft sq

Select one 100-ft-sq unit from areas where any residual contamination is likely to be maximum. This first unit may be a single contiguous area or a number of noncontinguous areas approximating 100 ft sq. Select 16 additional units at random, 4 from each quadrant. Obtain readings from each 100-ft-sq unit drawn per 3(b) below to estabish the average activity.

c) 5000 ft sq < area ≤ 80,000 ft sq

Select three 100-ft-sq units from areas where any residual contamination is likely to be maximum. These first units may be single contiguous areas of 100 ft sq each or a number of noncontiguous areas approximating 300 ft sq. Select 20 additional 100-ft-sq units at random, 5 from each quadrant. Obtain readings from each 100-ft-sq unit drawing per 3(b) below to establish the average activity.

3. a) Hot Spots - (Maximums as specified in Table I)

Survey each unit selected for hot spots and record.

b) Average - (Average fixed and removable as specified in Table I)

1) Fixed--Obtain readings from 5 randomly selected points within each 100-ft-sq unit drawn and record. Increase readings from each unit to obtain at least 20 readings total.

2) Removable--Wipe at least 100 cm sq within each 100-ft-sq unit drawn and record. Increase readings from each unit to obtain at least 20 wipes total.

TABLE A-1

Lot Size	Sample Size	Reject	Continue Testing	Accept	Consumer's Risk
		Hot Spots (Table I Maximum)			
1700 ft$^2 \geq$ A	<all	1	0	-	
	all	1	-	0	$\leq$10%
1700 $<$ A $\leq$5000 ft^2	$\leq$100 ft^2	1	0	-	
	$<$400 ft^2 per quad. for 1600 ft^2 total	1	0	-	
	400 ft^2 per quad. for 1600 ft^2 total	1	-	0	$\leq$10%
5000 $<$ A $<$80,000 ft^2	$\leq$300 ft^2	1	0	-	
	$<$500 ft^2 per quad. for 2000 ft^2 total	1	0	-	
	500 ft^2 per quad. for 2000 ft^2 total	1	-	0	$\leq$10%
		Average ($\overline{X}$) on n readings if $X + 1.3\sigma/\sqrt{n}$			
Any-fixed	5 per 100 ft^2 & 20 total min.	>Table I		<Table I	$\leq$10%
Any-removable	$\geq$1 per 100 ft^2 & 20 total min.	>Table I		<Table I	$\leq$10%