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UNITED STATES
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OFFICE OF INSPECTION AND ENFORCEMENT
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May 14, 1981

IE Circular No. 81-07: CONTROL OF RADIOACTIVELY CONTAMINATED MATERIAL

Description of Circumstances:

Information Notice No. 80-22 described events at nuclear power reactor facilities regarding the release of radioactive contamination to unrestricted areas by trash disposal and sale of scrap material. These releases to unrestricted areas were caused in each case by a breakdown of the contamination control program including inadequate survey techniques, untrained personnel performing surveys, and inappropriate material release limits.

The problems that were described in IE Information Notice No. 80-22 can be corrected by implementing an effective contamination control program through appropriate administrative controls and survey techniques. However, the recurring problems associated with minute levels of contamination have indicated that specific guidance is needed by NRC nuclear power reactor licensees for evaluating potential radioactive contamination and determining appropriate methods of control. This circular provides guidance on the control of radioactive contamination. Because of the limitations of the technical analysis supporting this guidance, this circular is applicable only to nuclear power reactor facilities.

Discussion:

During routine operations, items (e.g., tools and equipment) and materials (e.g., scrap material, paper products, and trash) have the potential of becoming slightly contaminated. Analytical capabilities are available to distinguish very low levels of radioactive contamination from the natural background levels of radioactivity. However, these capabilities are often very elaborate, costly, and time consuming making their use impractical (and unnecessary) for routine operations. Therefore, guidance is needed to establish operational detection levels below which the probability of any remaining, undetected contamination is negligible and can be disregarded when considering the practicality of detecting and controlling such potential contamination and the associated negligible radiation doses to the public. In other words, guidance is needed which will provide reasonable assurance that contaminated materials are properly controlled and disposed of while at the same time providing a practical method for the uncontrolled release of materials from the restricted area. These levels and detection capabilities must be set considering these factors: 1) the practicality of conducting a contamination survey, 2) the potential of leaving minute levels of contamination undetected; and, 3) the potential radiation doses to individuals of the public resulting from potential release of any undetected, uncontrolled contamination.

Studies performed by Sommers[1] have concluded that for discrete particle low-level contamination, about 5000 dpm of beta activity is the minimum level of activity that can be routinely detected under a surface contamination control program using direct survey methods. The indirect method of contamination monitoring (smear survey) provides a method of evaluating removable (loose, surface) contamination at levels below which can be detected by the direct survey method. For smears of a $100cm^2$ area (a de facto industry standard), the corresponding detection capability with a thin window detector and a fixed sample geometry is on the order of 1000 dpm (i.e., 1000 dpm/100 cm^2). Therefore, taking into consideration the practicality of conducting surface contamination surveys; contamination control limits should not be set below 5000 dpm/100 cm^2 total and 1000 dpm/ 100 cm^2 removable. The ability to detect minute, discrete particle contamination depends on the activity level, background, instrument time constant, and survey scan speed. A copy of Sommers studies is attached which provides useful guidance on establishing a contamination survey program.

Based on the studies of residual radioactivity limits for decommissioning (NUREG-0613[2] and NUREG-0707[3]), it can be concluded that surfaces uniformly contaminated at levels of 5000 dpm/ $100cm^2$ (beta-gamma activity from nuclear power reactors) would result in potential doses that total less than 5 mrem/yr. Therefore, it can be concluded that for the potentially undetected contamination of discrete items and materials at levels below 5000 dpm/$100cm^2$, the potential dose to any individual will be significantly less than 5mrem/yr even if the accumulation of numerous items contaminated at this level is considered.

Guidance:

Items and material should not be removed from the restricted area until they have been surveyed or evaluated for potential radioactive contamination by a qualified* individual. Personal effects (e.g., notebooks and flash lights) which are hand carried need not be subjected to the qualified individual survey or evaluation, but these items should be subjected to the same survey requirements as the individual possessing the items. Contaminated or radioactive items and materials must be controlled, contained, handled, used, and transferred in accordance with applicable regulations.

The contamination monitoring using portable survey instruments or laboratory measurements should be performed with instrumentation and techniques (survey scanning speed, counting times, background radiation levels) necessary to detect 5000 dpm/100 cm^2 total and 1000 dpm/100 cm^2 removable beta/gamma contamination. Instruments should be calibrated with radiation sources having consistent energy spectrum and instrument response with the radionuclides being measured. If alpha contamination is suspected appropriate surveys and/or laboratory measurements capable of detecting 100 dpm/100 cm^2 fixed and 20 dpm/100 cm^2 removable alpha activity should be performed.

*A qualified individual is defined as a person meeting the radiation protection technician qualifications of Regulatory Guide 1.8, Rev. 1, which endorses ANSI N18.1, 1971.

In evaluating the radioactivity on inaccessible surfaces (e.g., pipes, drain lines, and duct work), measurements at other appropriate access points may be used for evaluating contamination provided the contamination levels at the accessible locations can be demonstrated to be representative of the potential contamination at the inaccessible surfaces. Otherwise, the material should not be released for unrestricted use.

Draft ANSI Standard 13.12[4] provides useful guidance for evaluating radioactive contamination and should be considered when establishing a contamination control and radiation survey program.

No written response to this circular is required. If you have any questions regarding this matter, please contact this office.

REFERENCES

[1]Sommers, J. F., "Sensitivity of Portable Beta-Gamma Survey Instruments," Nuclear Safety, Volume 16, No. 4, July-August 1975.

[2]U.S. Nuclear Regulatory Commission, "Residual Radioactivity Limits for Decommissioning, Draft Report," Office of Standards Development, USNRC NUREG-0613, October 1979.

[3]U.S. Nuclear Regulatory Commission, "A Methodology for Calculating Residual Radioactivity Levels Following Decommissioning," USNRC NUREG-0707, October 1980.

[4]Draft ANSI Standard 13.12, "Control of Radioactive Surface Contamination on Materials, Equipment, and Facilities to be Released for Uncontrolled Use," American National Standards Institute, Inc., New York, NY, August 1978..

Attachments:
1. Reference 1 (Sommers Study)
2. Recently issued IE Circulars

Control and Instrumentation

Edited by E. W. Hagen

Sensitivity of Portable Beta–Gamma Survey Instruments

By J. F. Sommers*

Abstract: *Development of a new generation of portable radiation survey instruments and application of the "as low as practicable" (ALAP) philosophy have presented a problem of compliance with guides for radioactive contamination control. Isolated, low-level, discrete-particle beta–gamma contamination is being detected with the new instruments. To determine the limits of practicability requires, in turn, the determination of the limits of detection of these surface contaminants. The data and calculations included in this article indicate the source detection frequencies that can be expected using the new generation of survey instruments. The author concludes that, in low-population groups of discrete particles, about 5000 dis/min of beta activity per particle is the minimum level of activity per particle which is applicable for confident compliance with surface contamination-control guides. Lower control levels are possible with additional development of instruments or through high-cost changes in radiation survey and contamination-control methods. Additional analyses are required for assessment of the hazard caused by widely dispersed discrete-particle contaminants.*

The common, historical way to classify surface radioactive contamination has developed into standard definitions, limits, and control guides which, in some instances, are difficult, if not impossible, to apply.

In general, the definition of "removable" radioactive contamination must be inferred from guides[1] and regulations[2] on the significance of the quantity of radioactive materials removed. "Fixed" contamination, although not as uniquely defined, is, by inference, the radioactive contaminants that remain on a surface after the surface has been checked and found to have less than some defined removable contamination level. There are many minor variations of these definitions, but these will suffice to outline a major problem that applied health physicists have to verify compliance with radioactive surface contamination limits and guides.

In recent years the lowering of limits and the emphasis on as low as practicable[3] (ALAP) hazard control has encouraged commercial development of more sensitive survey instruments, the big improvement being detectors with thin windows. Peripheral features, such as audible alarms with adjustable set points, external speakers (instead of earphones), and selectable meter time constants, are common. However, the strong commercial competition to supply this type of instrumentation, the extreme competition for funds that could be used to improve radiation protection equipment, and the health physicists' reluctance or inability to provide adequate specifica-

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tions have left something to be desired in quality and overall performance of many of the instruments.

Although present beta–gamma contamination-control practices are more rigorous than in the past, there is still less than complete control of low-activity low-density particulate sources within the operating areas. In a typical situation the highest density of these particles, outside of contamination-control zones, may be on the order of one detectable particle per 10^2 to 10^3 ft^2. The particles are removable beta–gamma activity, but because of the large areas involved, the multiple types of surfaces on which they are deposited, and the low area density of the particles, they are not subject to detection with any sensible frequency using the smear or wipe technique. Thus survey instruments must be used to detect and measure the activity of the removable particles.

The particles tend to be trapped and concentrated on certain types of surfaces, such as mopheads and acrylic fiber rugs. From these deposits it has been determined that the specific activities of most of the particles range from about 2×10^3 to 2×10^4 dis/min. In order to determine why the particles escape detection and control within the operating areas, experimenters devised a rigorous test to determine the expected frequency of detection of the particles using standard survey methods. The results of these experiments have shown that the main hope for improvement lies in the development of more sensitive survey instruments and portal monitors and the development and application of contamination-control methods similar to those used in facilities where the much more hazardous alpha-emitting materials are handled.

THEORY

The ability of a count-rate meter to provide reliable information for detection of small-diameter sources during surveys for radioactive contaminants depends upon a number of factors. These factors, for any given type and energy of radiation sources, are the specific activity of the sources, the influence of background radiation, the instrument time constant, the source–detector geometry, and the relative source–detector velocities. When an alarm set point is used to indicate the presence of radioactive sources, investigation shows that the sensitivity of the instrument is increased by setting the alarm set point as low as possible without causing alarms due to the fluctuations of background; the response of the count-rate meter is modified from the equilibrium count rate when source residence time under the detector is on the same order of magnitude of or less than the time constant of the meter; the count rate of the instrument increases as the source–window distance decreases; and the response of the count-rate meter increases as the source residence time under the detector window increases.

On the basis of the approximate Gaussian distribution of a count rate around the true average count rate, an alarm set point A has a probability p of being reached and causing an alarm due to an average background count rate B during a counting interval T that can be expressed as

$$A \doteq (1 - e^{-T/\tau})(B + k|T^{-1/2} B^{1/2}|) \qquad (1)$$

where τ is the time constant of the count-rate meter and k is a constant that uniquely defines the probability of alarm.[4] The term $1 - e^{-T/\tau}$ (the fraction of equilibrium count rate obtained during T) is limited by design considerations of count-rate meters to the accuracy of the meter output. Most instruments have 1% (of full-scale reading) or larger accuracy limits. For this reason the value of $0.99 = 1 - e^{-T/\tau}$ has been assigned for this study. Knowing the value of τ allows solution for T, and the solution is used in the second term of Eq. 1. This solution can be thought of as the practical, constant, integrating interval observed by the count-rate meter.

The approximate response of an instrument to small-diameter sources can be calculated by defining standard survey conditions and relating them to the response characteristics of the instrument. For these calculations the velocity vector v of a flat circular window of the detector is assumed to be parallel to the surface being surveyed, and the velocity is held constant. The sources passing under the window of the detector bisect the circular projection of the window on the surface. The beta-counting efficiency of the instrument is assumed to be positive and constant when a source resides in the circular projection of the window on the surface; otherwise, the efficiency for counting the source is zero. This latter assumption may cause significant perturbations of experimental data from calculated data when source–window distances are larger than 2.5 cm. Gamma-counting efficiencies, the same order of magnitude as the beta-counting efficiencies, may also cause significant perturbation of experimental results, depending on the detector shielding configuration and effectiveness. The ideal source residence time t is assumed to be equal to the window diameter d divided by the velocity vector v. Under field conditions, t will usually be less than the ideal value because the source velocity vector will hardly ever exactly bisect the circular window projection on the surface being surveyed.

Using the ideal survey conditions and an average background count rate B, a source with a net equilibrium count rate S will cause a count rate as large as, or larger than, A, with a probability P_i that is uniquely defined by the constant K_i when the source residence time under the window is t and the time-dependent meter response term is $1 - e^{-t/\tau}$. The count rate A can then be expressed as

$$A \leqq (1 - e^{-t/\tau})\,(B + S + K_i|t^{-1/2}(B + S)^{1/2}|) \quad (2)$$

By substitution of the alarm set-point count rate A from Eq. 1 into Eq. 2 and rearrangement, the source strength is found to be

$$S \geqq \left(\frac{1 - e^{-T/\tau}}{1 - e^{-t/\tau}}\right)(B + k|T^{-1/2}\,B^{1/2}|) - (B + K_i|t^{-1/2}(B + S)^{1/2}|) \quad (3)$$

Analysis of Eq. 3 shows that P_i is the probability, or time-dependent frequency, that S will cause an alarm when K_i is positive, and $(1 - P_i)$ is the probability that the alarm will be actuated when K_i is negative. Solutions for S can be obtained using selected values of K_i, B, τ, t, and T.

METHODS

In order to determine expected alarm-actuation frequencies during standard contamination surveys, experimenters established the following conditions. These conditions would also allow an experimental check of the calculated alarm-actuation probabilities that occur when the source strength, background, instrument time constants, and source residence time are changed.

Commercially available (two manufacturers) portable survey instruments were used as models for the calculations and experiments. Selectable time constants of 0.0159 and 0.159 min were calculated from the manufacturers' quoted time-response characteristics: "90% of the equilibrium count rates in 2.2 or 22 seconds." Survey velocities between 2.4 and 15 cm/sec were selected for analysis, velocities that cause the source residence times under the 5-cm-diameter detector windows to range from 0.33 to 2.1 sec. Cesium-137 sources having small diameter and low backscatter were used experimentally for verification of calculated data; these sources are counted with an efficiency of 0.1 count per beta at ½ in. from the center of 1.7 mg/cm^2, 5-cm-diameter windows of "pancake"-type semishielded Geiger-Mueller tubes. Extrapolation of the data to other beta emitters is a practical exercise; i.e., from Evans,[5] beta transmission factors through 3.0 mg/cm^2 (air plus window) were calculated and shown to be greater than 72% for betas with energy spectra having maximum-energy betas (E_{max}) greater than 0.2 MeV. Thus ^{137}Cs betas, with a mean $E_{max} \cong 0.58$ MeV, provide a beta-counting efficiency from the thin-window detectors which is typical of beta emitters with E_{max} greater than 0.2 MeV. Also, background and source size data are presented in counts per minute, so that changes in beta energies of sources and/or source–window distances can be normalized, using observed counting efficiencies, to the calculated data presented in this article.

With some manipulation of Eq. 3, a computer program was used to obtain an iterative set of solutions for S that are accurate to within 1% of the true values. The alarm set points were determined using Eq. 1. Selections of background count rates, relative detector–source velocities, and the instrument time constant were arbitrary but within the ranges chosen for investigation. Values of K_i were chosen to provide known probabilities of alarm actuation.

An extensive set of experimental data was obtained by moving calibrated sources past the detector windows at measured velocities and source–window distances to check the validity of the calculations. The same experimental setup to determine source detection frequencies was used with the audio (speaker) output of the survey meters. The use of audio output during contamination surveys is a well-known practice and will not be described further.

When the experimental and calculated source detection frequencies were compared, it became apparent that the time constants of the commercial survey instruments were not equal to specified values. Variations were noted between instruments of one model and between the different alarm set points on the other model. By measuring the buildup of the indicated count rates to 90% of equilibrium, we were able to determine the actual time constant on the instruments for any particular alarm set point.

The experimental data were obtained on an instrument that exhibited the advertised time constants. However, the poor (time-dependent response) performance of these instruments as a group has caused us to abandon the alarm set-point method for source detection under field conditions.

RESULTS

Alarm set points vs. background count rate were calculated from Eq. 1. These are illustarted in Fig. 1 for time constants of 0.0159 and 0.159 min. The k value selected, 4.89, uniquely defines the probability of an alarm being caused by a constant average background as 5×10^{-7} min^{-1}.

Figure 2 shows that the short-time-constant set point is more sensitive for source detection, even though the long-time-constant set point is the lowest. The relative difference between the two becomes less as the source residence time increases.

Figure 3 illustrates the improved sensitivity to be expected as the source residence time increases (detector velocity decreases). The set point is obtained from Eq. 1 or Fig. 1. Note that with a source residence time of 1 sec (5 cm/sec), it takes 5000 betas/min (500 counts/min) at a background of 60 counts/min to cause an alarm 90% of the time. As a practical illustration, if an individual surveys himself at 10 cm/sec, it will take about 3 min for him to survey half the surface area of his body, and the particles he discovers with a 90% confidence level will have a beta-emission rate of about 9000 per minute (900 counts/min).

Figure 4 illustrates the benefit of selecting low-background areas to perform contamination surveys. As indicated by Eq. 1, the alarm set point has to be changed each time the background changes, and, if the time constant is not dependable (known), the set point may not be correct. Changing background count rates are a common occurrence in our operations, and our inability to make time-constant determinations in the field has caused us to abandon the alarm set-point method for contamination surveys.

Figure 5 shows that the calculational method of determining source detection frequencies using the alarm set point is valid in comparison with experimental data. Both the time constant and the alarm set point were verified on the instrument used. In practice, there would be some ambiguity in the setting of the alarm owing to the crude alarm set-point dial furnished on this model instrument.

Figure 6 compares calculated alarm-actuation frequencies with experimental data on audio-output source detection frequencies at an average background of 120 counts/min and a relative surface–window velocity of 15 cm/sec. Using the speaker output method, smaller sources are detected with the same frequency that is obtained using the alarm set-point method. The improvement is about a factor of 3.

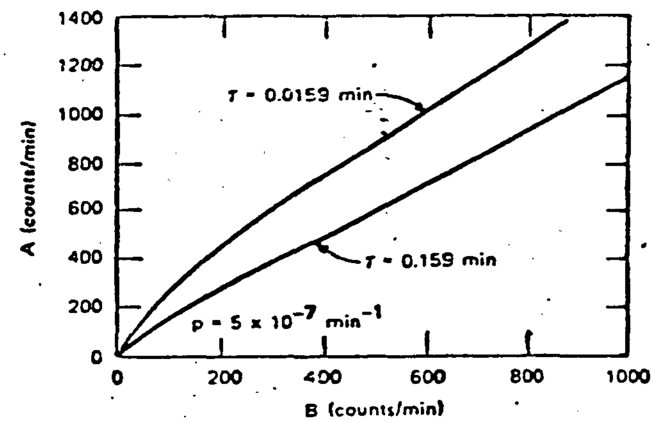

Fig. 1 Effect of background on the optimum alarm set point.

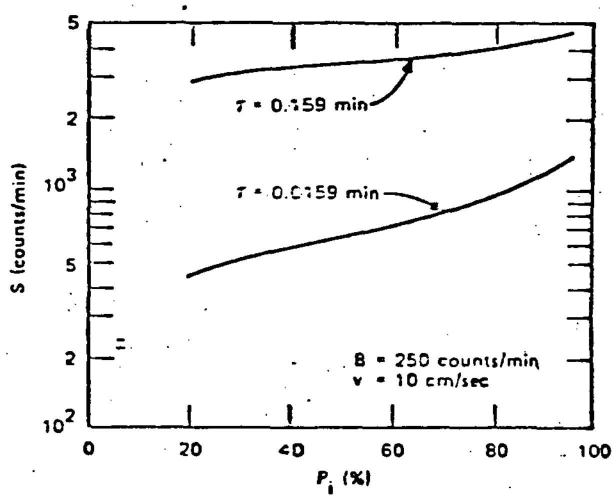

Fig. 2 Effect of instrument time constant on source detection frequency.

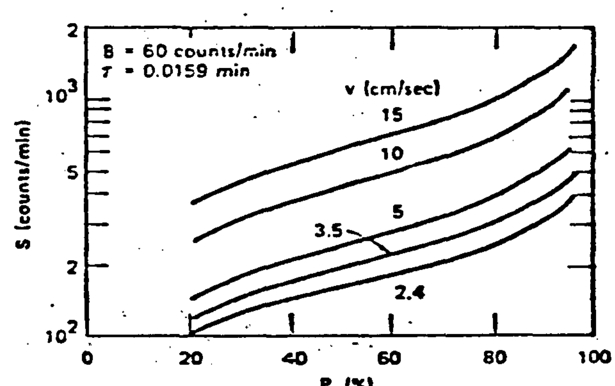

Fig. 3 Effect of probe velocity on source detection frequency.

Figure 7 shows a similar comparison using a detector velocity of 3.5 cm/sec. Here, the difference in detection frequencies narrows, and the alarm set-point method becomes better than the audio detection method for the larger sources at this low survey velocity.

Figure 8 compares experimental audio-output data for three different survey velocities at 120 counts/min background. The difference in source detection frequencies is surprisingly small when compared with the alarm-actuation method. This is explained by the adaptability of the human audio response; i.e., the effective time constant (human) adapts, within bounds, to the source size that can be detected with a given survey velocity and background count rate. Note that at 500 counts/min (5000 betas/min), the source detection frequencies appear to converge at about 80%. The results shown are averages of over 100 observations per datum point from two or more experienced surveyors. The largest variations in the data occurred between individuals; i.e., the largest variables were caused by the physical and psychological conditioning

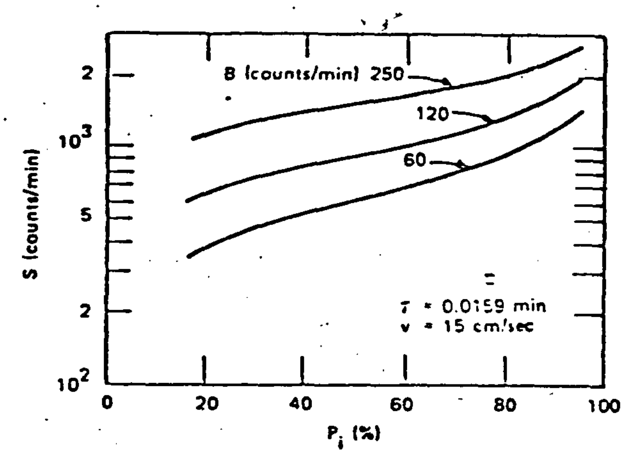

Fig. 4 Effect of background on source alarm-actuation frequency.

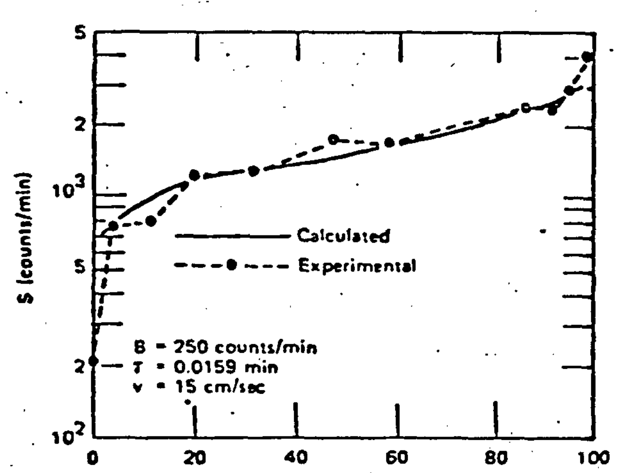

Fig. 5 Comparison of experimental and calculated data on source detection frequencies.

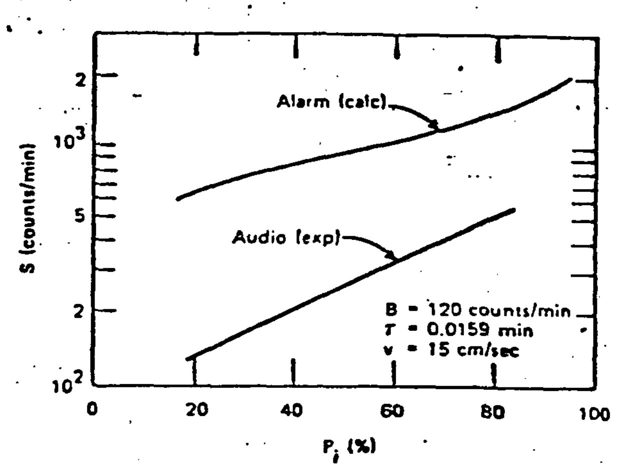

Fig. 6 Comparison of source detection frequencies using alarm set-point and audio detection methods.

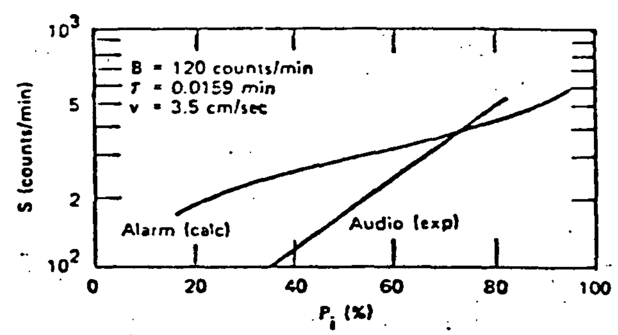

Fig. 7 Comparison of source detection frequencies using alarm and audio detection methods.

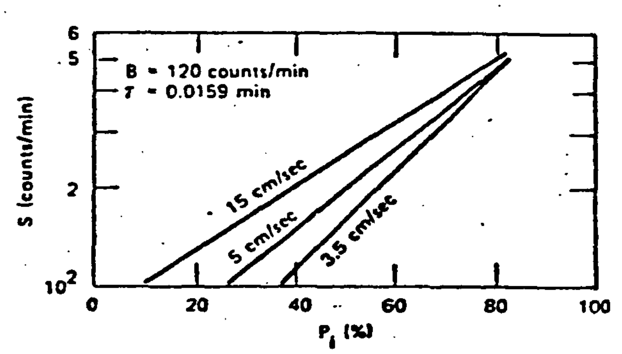

Fig. 8 Comparison of audio source detection frequencies and velocities.

of the surveyors. The lower detection frequencies have been ignored because of the statistical deviations that occurred. The time consumed to obtain reliable data at the higher detection frequencies was considerable, and, as our interest is in setting high-confidence-level control criteria, it was considered not practicable to obtain good, small source, detection-frequency statistics.

DISCUSSION AND CONCLUSIONS

A method has been shown whereby detection frequencies of small-diameter radioactive sources can be calculated for portable survey instruments that have known time constants and alarm set points. Source detection frequencies are strongly dependent upon (1) source strength, (2) survey velocities, (3) background activity, (4) detector sensitivity, and (5) the time constant of the survey meter. With activity of a large-area uniform surface, the survey velocity and the time constant of the survey meter are immaterial (within reasonable bounds). The calculations show that, even under the most rigorous conditions (survey velocities <2.5 cm/sec), small-diameter sources emitting 3000 betas/min can only be detected in low-background areas with a confidence of about 90% using the alarm set-point method. At more sensible survey velocities of 10 to 15 cm/sec, it takes sources emitting 10,000 to 15,000 betas/min to provide the same detection frequency using the alarm set-point detection method.

At the higher probe velocities investigated, source detection frequencies are larger using the audio output rather than the alarm set-point method. With small-diameter sources emitting 5000 betas/min, source detection frequency at 120 counts/min background is about 80% using the speaker output, regardless of the survey velocities between 3.5 to 15 cm/sec. With 3000 betas/min sources, the speaker detection frequency, using the slowest survey velocity (3.5 cm/sec), is only about 65%. At this velocity the alarm set-point method is as good as or better than the audio method with sources larger than 3500 betas/min. Although most of the experimental data were obtained at only one background level (120 counts/min), it is apparent that it is not practical to set contamination-control limits on discrete particles of beta–gamma activity much below 5000 betas/min if we are to have confidence in our ability to detect discrete-particle sources before they escape the contamination-control areas.

These results then pose several problems. Are the particles of beta–gamma activity that escape detection, and thus control, a health hazard of consequence? Krebs[6] and Healy[7] have presented arguments on the relative hazards of discrete-particle and small-area sources in relation to more diffuse sources. However, the data used involved higher specific activity than that of the particles we have been observing. Healy has published[8] a comprehensive resuspension hazards analysis for diffuse contaminants which is difficult to apply to the low-density particle population we observe. Good hazards analyses are needed on the resuspension of discrete particles in the size range under discussion. Development of portable instruments for surveying large areas with a practical expenditure of time and effort appears possible, but it will take time and money to design, develop, and make them commercially available. In the meantime, the advisory, standards, and regulation agencies need to look at the control guides and limits to assure that the conservatism applied using the ALAP philosophy is, in fact, *practicable* for compliance with the equipment and methods available to the industry. For this particular problem (low-density discrete particles of removable beta–gamma activity), I suggest that removable contamination be defined in two categories, "uniform" and "dispersed," and then resuspension factors applied that have some reality in the calculation of exposure hazards. This is the only way at this time that the industry has any hope for practicable compliance with contamination-control limits.

REFERENCES

1. Administrative Guide for Packaging and Transporting Radioactive Materials, ANSI-N14.10.1-1973, p. 7, American National Standards Institute, New York.
2. Department of Transportation, Hazardous Materials Regulations of the Department of Transportation, *Code of Federal Regulations*, Title 49, 173.397, effective Sept. 13, 1973.
3. Concluding Statement of the AEC Regulatory Staff in the "As Low As Practicable" Hearing, *Nucl. Safety*, 15(4): 443-452 (July–August 1974).
4. A. A. Jarrett, Statistical Methods Used in the Measurement of Radioactivity (Some Useful Graphs), USAEC Report AECU-262, 1946.
5. R. D. Evans, *The Atomic Nucleus*, pp. 627-628, McGraw-Hill Book Company, Inc., New York, 1955.
6. J. S. Krebs, The Response of Mammalian Skin to Irradiation with Particles of Reactor Debris, Report USNRDL-TR-67-118, U. S. Naval Radiological Denfense Laboratory, September 1967.
7. J. W. Healy, A Proposed Interim Standard for Plutonium in Soils, USAEC Report LA-5483-MS, Appendix C, Los Alamos Scientific Laboratory, January 1974.
8. J. W. Healy, Surface Contamination: Decision Levels, USAEC Report LA-4558-MS, Los Alamos Scientific Laboratory, September 1971.

Attachment 2
IEC 81-07
May 14, 1981

RECENTLY ISSUED
IE CIRCULARS

Circular No.	Subject	Date of Issue	Issued to
81-06	Potential Deficiency Affecting Certain Foxboro 20 to 50 Milliampere Transmitters	4/14/81	All power reactor facilities with an OL or CP
81-05	Self-Aligning Rod End Bushings for Pipe Supports	3/31/81	All power reactor facilities with an OL or CP
81-04	The Role of Shift Technical Advisors and Importance of Reporting Operational Events	4/30/81	All power reactor facilities with an OL or CP
81-03	Inoperable Seismic Monitoring Instrumentation	3/2/81	All power reactor facilities with an OL or CP
81-02	Performance of NRC-Licensed Individuals While on Duty	2/9/81	All power reactor facilities (research & test) with an OL or CP
81-01	Design Problems Involving Indicating Pushbutton Switches Manufactured by Honeywell Incorporated	1/23/81	All power reactor facilities with an OL or CP
80-25	Case Histories of Radiography Events	12/5/80	All radiography licensees
80-24	AECL Teletherapy Unit Malfunction	12/2/80	All teletherapy licensees
80-23	Potential Defects in Beloit Power Systems Emergency Generators	10/31/80	All power reactor facilities with OL or a CP
80-22	Confirmation of Employee Qualifications	10/2/80	All holders of a power reactor OL or CP architect-engineering companies and nuclear steam system suppliers

OL = Operating Licenses
CP = Construction Permit