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Shoreham Decommissioning Project
Long Island Power Authority
Comments on Draft NUREG/CR-5849
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Ref: (1) NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination", Oak Ridge Associated Universities, Prepared for U. S. Nuclear Regulatory Commission, Draft June, 1992.

Ladies and Gentlemen:

Enclosed are comments prepared by the Long Island Power Authority on draft NUREG/CR-5849, "Manual for Conducting Radiological Surveys in Support of License Termination" (Reference 1). It is my understanding that the NRC Staff is planning to issue this document in final form and desires to receive comments on the draft report. The enclosed comments are based upon the use of the document in planning and conducting the Shoreham termination survey, after an agreement was reached with the NRC Staff in August, 1992 that draft NUREG/CR-5849 would be used.

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If you have any questions on the comments, please contact me or Mr. Michael Tucker, the Shoreham Decommissioning Project Termination Survey Section Head.

Very truly yours,

A. J. Bortz
Resident Manager

mt/dyf/kc

Enclosure: "Review Comments - Draft NUREG/CR-5849", prepared by Long Island Power Authority.

cc: Mr Robert Bernero, Director
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REVIEW COMMENTS - DRAFT NUREG/CR-5849
Prepared by Long Island Power Authority

I. GENERAL COMMENTS

Overall, the document is a significant improvement on the predecessor document NUREG/CR-2082. It is generally well written and focuses upon the tasks necessary to achieve a successful license termination of facilities regulated by the Nuclear Regulatory Commission. It contains much practical information. On most topics, it strikes a reasonable balance between technical accuracy on the one hand and a pragmatic approach which incorporates the results of much practical experience on the other hand. Topics for which the document could provide improved guidance are highlighted below:

1. Satisfaction of the various criteria for measurement sensitivity, and action levels expressed as small fractions of guideline values (typically $\leq$ 25%) imposes significant demands for measurement accuracy, including establishment of background with a high degree of precision. In some instances, these are not practically achievable. See specific comments in Chapter 2, 4, 8 and Appendix A comments.

2. The guidance in the NUREG implies that a typical facility undergoing a final status survey consists of buildings and grounds from which essentially all equipment has been removed. The document provides little practical guidance for design and performance of surveys of piping and equipment which remains in a facility after decommissioning. See specific comment in Chapter 4 comments.

3. The method for establishment of specific guideline values for individual radionuclides (given in Appendix A) imposes severe measurement difficulties when hard-to-detect radionuclides are present above the threshold of 10%. This results in lowered guideline values, and proportionally lowered action levels for those radionuclides which are detectable and which are used as indicators for measurements. See specific comments in Appendix A comments.

4. Statistical approaches to survey sampling-design are prescribed which are intended to provide a specified level of confidence that each defined population (survey unit) meets applicable release criteria limits. However, the methods applied tend to under estimate the uncertainties in the overall results. As a result, the intended level of confidence is not achieved. See specific comments in Chapter 4 and 8 comments.

5. The document discusses the decommissioning process as a series of events with the final status and confirmation surveys following completion of decommissioning. Several facilities have been divided into portions which have been surveyed and reported to the Commission in stages. Some facilities have also performed decommissioning and final status surveys in parallel while radioactive materials still remain on site. Some time may elapse between the owner's final status survey and license termination. A discussion of the additional controls needed to maintain the "as-surveyed" condition under such "dynamic" conditions is desirable.

6. Additional emphasis on the significance of accurate "background" values for the various types of survey measurements should be provided. The recommended method of performing measurements at a nearby site with similar characteristics may not be adequate. See specific comments in Chapter 1 and 2 comments.

II. SPECIFIC COMMENTS

Specific comments are given in the following text under each NUREG/CR-5849 Chapter heading.

1.0 Introduction

1.1. Page 1.1 last item; document title appears to contain a typographical error: It should be.... *Waste* from Past Operations,...

1.2. Page 1.2 paragraph 2; an additional reason that follow-up surveys of previously decommissioned sites have revealed residual radioactive contamination above release criteria is that release criteria or cleanup guidelines have been modified subsequent to the initial cleanup and release surveys. Some of the US sites were initially decommissioned or remediated decades ago and found to be acceptable under the criteria in effect at the time.

1.3 Page 1.2, last line. It may be more appropriate to state, "...methodologies described in the Manual are based on the use of state-of-the-art, ..."

1.4 Page 1.3, paragraph 1. Please expand on the concept of advanced planning during the operational period or when bringing facilities on line. Specific mention of use of the Manual for conduct of Characterization surveys and to establish pre-operational background levels for a facility would be useful guidance. Where the Manual might be used for the conduct of these early surveys, the documentation and survey controls then allow better use of the survey data as a part of the final survey, thus providing more efficient use of resources.

2.0 The Decommissioning Process

2.1. § 2.2 page 2.3 , text beginning line 6. This infers that facility release guidelines are site-specific values derived from analysis of radiation exposure pathway scenarios. This has not been the case for reactor facility licenses ,historically and continuing through facilities currently in the decommissioning and license termination process. The release criteria have typically included Regulatory Guide 1.86 Table 1 limits for surface contamination, a value of 5 μR/hr (above background, measured at one meter from a surface) for gamma exposure rate and various concentration limit values for soil.

2.2 Page 2.4, <u>Surface Activity</u>, second paragraph. The parameter of 20% of the average surface activity being attributable to removable activity is a convention derived from such documents as Regulatory Guide 1.86. This parameter may not be appropriate for surface activity guidelines derived from site-specific pathway analyses.

2.3. § 2.2 page 2.4 <u>Soil Activity</u> line 2. " For *your* land areas"; *your* appears to be a typographical error.

2.4 Page 2.5, last sentence. It should be emphasized that in the event background levels are established well in advance of the final survey, e.g. years or even decades, the specifics as to which types of instrumentation was used as well as calibration and sensitivity data should be retained to allow comparison of instrument responses with those used in the eventual final survey.

2.5 § 2.3.1, Background Survey, pages 2.5 -2.7. The significance of "accuracy" in estimates of background for the various types of measurements in decommissioning radiological surveys should be elaborated. This is particularly important for "direct" measurements, e.g., direct surface and gamma exposure rate measurements. The NUREG implies that the "average" background at a site is the parameter of most interest and the major problem in background determination is to ensure that enough measurements are taken to estimate the average within a specified precision. The problem of establishing accurate backgrounds is not sufficiently addressed. At Shoreham, the prescription of "finding" a building or site which is similar in construction or composition and taking enough measurements to satisfy equation 8-22 (page 8.15) was followed initially.

When applying the results to termination survey measurements, it was observed that the backgrounds so determined tended to be biased, i.e., not representative of actual backgrounds inferred from on-site survey results. The backgrounds derived from off site measurements tended to be too high. Application of biased backgrounds tends to skew survey results; when backgrounds are too high, areas of low contamination are potentially "masked". In addition, at the request of the NRC Staff, LIPA had agreed to investigate survey results when more than 50% of calculated contamination levels in a survey unit sample were < zero. Conversely, when backgrounds are too low, artificially high contamination levels are reported and the rate of false positive (erroneous indication of levels in excess of action levels) is increased.

Faced with these complications which resulted from inaccurate backgrounds, background estimates were refined using measurements taken on site under conditions controlled to the extent possible to eliminate contributions from licensed radioactive materials. Further, it was observed that backgrounds for direct measurements of surface beta-gamma activity vary considerably within the facility and the site. For example, average "background" count rates on the heavily used GM pancake detector vary over the facility by a factor of 5 and those of the 126 cm^2 GM detectors, by a factor of over four. This required further refinement of background information, resulting in the development of building specific and material-specific backgrounds to accommodate the observed variation in measurements on the site which were not attributable to residual contamination.

2.6. § 2.3.1 page 2.7, paragraph 1, line 3. The *upper 95% level bound* on the background average .. is not standard statistical terminology. The parameter being described is *the upper limit of the confidence interval about the background mean, at the 95% confidence level.*

2.7. § 2.3.1 page 2.7, paragraph 1. In this discussion, it should be noted that in some facilities, for some types of measurements, e.g., surface beta-gamma in reactor facilities, there is no background contribution to the measuring instrument from the radionuclides comprising the residual activity as they are not naturally present. In such cases, equating the instrument background response to a percentage of release criteria guideline values is not strictly correct. This paragraph implies that the instrument measurement efficiency for background sources is the same as for the radionuclides for which the release criteria guideline values are specified.

2.8. § 2.3.1 page 2.7, paragraph 1, sentence beginning line 5. *Testing a sample of background measurements to assure that the average represents the "true" mean* *within ± 20% at the 95% confidence level* is not an accurate description of the evaluation referred to, i.e., equation (8-22). The sentence implies that this is a method for establishment of the background to a specified degree of accuracy, i.e., within ± 20%. What the equation does provide is a determination of the number of measurements needed to estimate the average background with an acceptable level of precision. The acceptable precision is expressed in the equation by limiting the sample standard deviation to 20% of the sample mean.

2.9. § 2.3.1 page 2.7, paragraph 1, last line. The reference should be to Section 8.6 instead of 8.7.

2.10. § 2.3.3, page 2.8, Characterization Survey, paragraph 1, beginning line 12. The implications of the scope and intensity of the characterization survey when residual levels are near the guideline values should be elaborated further. A higher degree of "accuracy" in the characterization survey in such instances is taken to mean both a higher degree of accuracy for individual measurements and a higher intensity of measurements to accurately define the extent of areas (and equipment) which have residual levels at or near guideline levels. It should be emphasized in such situations that the Characterization survey should be of comparable intensity and quality as a final status survey, including the associated increased levels of documentation and quality controls. The impacts of inadequate and incomplete site characterization on the cost and schedule of a decommissioning project can be significant.

2.11. § 2.3.5, page 2.9, Final Status Survey, paragraph 2, beginning line 3. Guidance should be given as to what constitutes *proper conditions* for incorporation of scoping and characterization survey data into the final status survey. Historically, scoping and characterization survey data has been less well documented than surveys which follow the guidance in NUREG/CR-5849.

3.0 Assessing the Radiological Status of the Site

3.1. It is noted that an entire section in the manual is devoted to the initial scoping survey. At a minimum, the topic of detailed site characterization surveys deserves a similar emphasis.

4.0 Planning and Designing the Final Status Survey

4.1. § 4.1.1 page 4.2, Quality Assurance, paragraph 1, beginning line 4. A definition of *data quality objectives* (DQOs) for final status surveys would be helpful as would some explanation with specific directly applicable examples. The reference cited in the Bibliography (§ 11.0): Data Quality Objectives For Remedial Response Activities - .... US EPA PB90-272634, provides some insights, but is oriented toward programmatic approaches to remedial action and cleanup planning for sites covered by CERCLA (Superfund) regulations. Additional references, if any exist which are applicable, would also be helpful.

4.2 § 4.1.1 page 4.4, Data Management., lines 2 through 4. The recommendation that... "In general, information and data should be recorded in bound logs or on standardized field and laboratory record forms." should be expanded in recognition of the role of "data logging" survey instruments and laboratory counters. These devices reduce the need to manually record measurement data on forms or in logs.

4.3. § 4.1.1 page 4.4, Data Management. The NUREG/CR-5849 manual does not address the role of computers in data management for final status surveys. Final status surveys for facilities which follow the prescriptions of NUREG/CR-5849 will generate large amounts of data (at least 10,000 measurements for a small facility and several hundred thousand for large ones). Satisfaction of all the NUREG "requirements" necessitates many checks of the measurement data and calculation of multiple parameters for each measured value, in addition to the statistical calculations for each survey unit data set. These factors make the use of computers essential for data handling and report generation. As far as is presently known, there are no commercial data management software programs which can be used "off the shelf" to manage the survey data for a nuclear facility, without modification . A variety of software packages have been used in site final status surveys, ranging from spreadsheets to custom database applications. The minimum attributes of Quality Assurance and data protection safeguards procedures should be described.

4.4 § 4.1.3, page 4.6, Physical Characteristics of Site. This entire subsection of the Manual is a discussion of how activity may be concentrated in localized areas. Yet, the guidelines provided in the remainder of Section 4.0 support an objective which is to provide a statistically based plan for selecting measurement locations which is accomplished through random or systematic sampling and supported by the assumption that the pattern of residual activity will approximate a normal distribution. (Refer to Section 4.2.3 of the Manual.) This appears quite inconsistent and leads to potential confusion over the correct approach for selection of measurement locations. The considerations of this portion of the Manual are entirely appropriate to surveys which precede the final status survey; scoping surveys, characterization surveys or even remediation surveys. As such, it is suggested the information be relocated to the earlier discussions of these surveys.

4.5. § 4.1.3, page 4.7, Building Interiors, paragraph 2. This paragraph introduces the topic of survey of the interiors of plant systems. However, the document provides essentially no guidance on the design and performance of surveys to demonstrate satisfaction of applicable release criteria for piping and other equipment used to process contaminated or potentially contaminated fluids. The sections identified in this paragraph as addressing inaccessible surfaces (§ 6.4.3 and § 6.4.5) provide no additional information for survey of systems and system components. The Shoreham Termination Survey has devoted considerable effort (over 50% of the survey costs) to survey the many plant systems which will remain in the facility. This has been done at some risk, i.e., without benefit of prior guidance as to the acceptability of the survey approach. Some of the issues are:

a. What are reasonable criteria for survey measurement densities in piping and equipment classified as affected and unaffected?

b. Which methods of sampling, i.e., selection of measurement locations in piping and equipment, are appropriate: random, systematic, or judgement (biased) and under what circumstances.?

4.6. § 4.2.1, pages 4.9 and 4.9, Classification of Areas by Contamination Potential. Limiting survey design classification (and the associated survey measurement intensity) to only two levels presents difficulties in implementing a cost-effective survey.

a. As defined in the NUREG, an unaffected area is not expected to contain residual radioactivity; however, the NUREG specifies minimum survey intensity, which in a large facility, results in a significant number of measurements. There is no latitude to adjust the survey density for areas of very low probability to a survey frequency lower than prescribed for unaffected areas. The only option at present, is to exclude very low probability areas from the survey entirely, rather than be subject to the survey requirements for unaffected areas. This may result in a risk of "overlooking" possibly contaminated areas. A more cost-effective design approach for large and complex facilities in which radioactive material use was limited to a portion of the site would be to utilize three levels of survey intensity; adding a level of survey intensity lower than currently applied to areas designated as unaffected.

b. An associated issue is the establishment of the scope of the final status survey, i.e., the physical boundaries. The implication in the final paragraph of § 4.2.1 is that the entire site must be segregated into the two classifications: affected and unaffected. Guidance is needed on how to establish the limits of the survey, utilizing the results of history reviews, scoping and characterization surveys.

4.7 § 4.2.1, page 4.9, definition of <u>affected areas</u>. The use of the term "potential" can be broadly interpreted. Some may argue that <u>all</u> areas of a facility have the potential for residual contamination. The definition of <u>unaffected areas</u> uses the phrase "not expected", suggesting that affected areas are those where radioactive contamination is expected or known to be present. Furthermore, the storage or use of certain forms of radioactive material, such as a sealed source, would not seem sufficient to necessitate the highest intensity final survey.

4.8 § 4.2.2 paragraph 5, page 4.12. Clarification is needed on the maximum size of a building surface classified as affected. If the 100 m^2 limit is intended to include all surfaces of an interior room, as opposed to floors only, it can produce survey units of very small floor area (only 16.67 m^2 or about 13 ft. on a side for a cubical room). If so interpreted, the number of measurements in each survey unit is controlled by the specified minimum of 30 measurements. This results in an inefficient use of survey resources in a large facility, such as Shoreham where many rooms would have to be subdivided into multiple survey units. Whereas, if larger areas are defined as survey units, the minimum number of measurements is controlled by the specified minimum number per area (e.g., one per 20 m^2 for overhead areas in affected areas).

4.9 § 4.2.2, page 4.12, paragraph 5, last sentence. The prohibition that a survey unit may not include both affected or unaffected areas may cause inefficient application of resources. This guidance seems to be included solely to ease the burden of determining the proper survey density to be applied in any given survey area (survey unit). It is entirely reasonable to consider certain areas of a survey unit, such as floors and lower walls, to be affected areas while the upper walls and ceiling of the same room might be correctly surveyed as an unaffected area. This is, in effect, permitted by the provisions of § 4.2.3 which allows lower survey intensity in overhead areas of affected survey units under the provision that the upper areas of the survey unit are not suspected to be contaminated, i.e., no measurements are greater than 25% of guideline values. However, the prescriptive survey density for these overhead areas of an affected survey unit, may be excessive for areas which can correctly be designated as unaffected.

4.10 § 4.2.3, page 4.13, paragraph 1, last sentence. The method provided in the Manual for assessment of survey results is not well suited to areas of unusual localized contamination where, as acknowledged in the preceding discussion of the Manual, a normal distribution of residual activity may not be a reasonable assumption.

4.11 § 4.2.3, page 4.13, Structure Surveys, Affected Areas, paragraph 2, line 4. The first two phrases of the sentence beginning.. "Residual activity which exceeds 3 times the guideline value... are not properly separated.

4.12 § 4.2.3, Structure Surveys, Affected areas, page 4.13, paragraph 3 line 4. When the guideline value is 5000 dpm/100 cm^2 for beta-gamma surface contamination, scanning sensitivities of ≤ 25% of guideline levels, are difficult to achieve reliably using generally available instruments and reasonable scanning speeds. A more realistic criterion would be ≤ 50% when the guideline value is 5000 dpm/100 cm^2. If more restrictive limits were in effect such as Regulatory Guide 1.86 Table 1 limits for Transuranics, et. al. (100 dpm/100 cm^2) or Th-nat, et. al. (1000 dpm/100 cm^2) scanning survey sensitivities of ≤ 25% would likely be impossible to achieve.

4.13 § 4.2.3, page 4.13, Structure Surveys, Affected areas, paragraph 3. Guidance as to how such sensitivities are determined, as provided in the Manual in Section 5 2, does not provide for the eventuality that multiple guidelines may be applicable to any given structural area, owing to the possible presence of multiple isotopes.

4.14 § 4.2.3, page 4.13, paragraph 4, line 5. The spacing of every 2 m or less is sometimes confused with the phrase "every other grid block". Figure 4.3 of the Manual would provide for sampling which is essentially 1 per every 4 m^2, whereas every other grid block would provide a sampling density of 1 per every 2 m^2. This should be clarified.

4.15 § 4.2.3, Structure Surveys, Affected areas, page 4.15, paragraph 2. The criterion for classification of overhead areas as "suspect" if scans or measurements indicate residual activity of 25% of the guideline value is not practical for direct surface measurements, in particular. Experience has shown that the measurements obtained for a typical set of direct surface beta-gamma measurements exhibit a range of 2000 dpm/100 cm^2 with a calculated standard deviation of from < 100 dpm/100 cm^2 to over 700 dpm/100 cm^2. A survey unit with no detectable contamination and a well known background distribution would yield a mean measurement value of about 0 dpm/100 cm^2. However, given the variability of the measurements, about 5% of the individual measurements are > 25% of the 5000 dpm/100 cm^2 guideline value in effect at Shoreham.

4.16 § 4.2.3, Structure Surveys, Affected Areas, page 4.15, paragraph 2. Clarification is needed whether the minimum of 30 measurement locations is to be applied separately to vertical and horizontal surfaces.

4.17 § 4.2.3, Structure Surveys, Affected Areas, page 4.15, paragraph 2. This paragraph should be expanded or otherwise modified to separate the types of measurements to their respective guideline values. Failure to do so may result in inefficient utilization of resources. For example, it is not necessarily appropriate to increase the density of survey for total surface or removable contamination solely because the gamma exposure rate in the area is suspected to be greater than 25% of the gamma exposure rate guideline value.

4.18 § 4.2.3, Structure Surveys, Unaffected Areas, page 4.15, beginning at line 5. this Manual should state that identification of activity levels in excess of 25% (or some increased percentage as discussed in Comment 4.15) of the guideline, either by scans or measurements, may require reclassification of the area to the "affected" category. A single measurement, or a few measurements, adequately investigated and explained, does not support the need to reclassify the entire survey unit. This has great potential to require excessive expenditure of resources.

4.19 § 4.2.3, Open Land Surveys, Affected Areas, page 4.16 paragraph 1, line 5. There is a typographical error; "area 1" extent; this should read ... "areal" extent

5.0 Radiological Instrumentation

5.1 § 5.1.2, Table 5-3, page 5.5. The comment in the Remarks column "cross calibrate with pressurized ion chamber..." does not apply to the use of a NaI(Tl) scintillator for surface activity measurements; it applies only when used for gamma exposure rate measurements.

6.0 Survey Techniques

6.1 § 6.4.3, Direct Measurements, page 6.4. Guidance should be provided on the maximum detector surface area considered appropriate. Licensees may select large-area detector probes with effective surfaces much greater than 100 cm^2 in order to provide better sensitivities which meet the guidelines of the Manual. As occurred during the final survey at the Shoreham facility, this practice may give rise to concerns over the ability to adequately report survey results in units of dpm per 100 cm^2.

6.2 § 6.4.4, Removable Surface Contamination Measurements, page 6.5, paragraph 2. Guidance on interpretation of counting data from swabs , smears or other methods to investigate removable surface contamination which do not cover an area of 100 cm^2 would be helpful.

7.0 Sample Analysis

No comments.

8.0 Interpretation of Survey Results

8.1 § 8.1.1, Surface Activity, page 8.2, equations (8-1) and (8-2). Certain difficulties attend the interpretation of direct surface activity measurement results when detectors with sensitive areas not equal to 100 cm^2 are used. Additional guidance may be needed. In equation (8-1), the observed count rate is converted to dpm/100 cm^2 by subtracting background and dividing by detector efficiency. A factor of 100/A is applied to convert from dpm/(detector area) to dpm/100 cm^2. As the detector response is inherently averaged over the sensitive area of the detector, uncertainty in interpretation is minimized when a detector with a sensitive area of 100 cm^2 is used. The calculated result is the activity averaged over 100 cm^2. However, when detectors with sensitive area not equal to 100 cm^2 are used, uncertainties arise and assumptions regarding the distribution of the surface activity must be examined.

When a detector smaller than 100 cm^2 is used, application of the 100/A factor assumes that any activity present is uniformly distributed over a contiguous area of 100 cm^2 surrounding the detector location. When activity is non uniformly distributed two general outcomes are possible:

a. If the detector coincides with a localized area of elevated activity < 100 cm^2 in area, the calculated dpm/100 cm^2 over estimates the average activity in the 100 cm^2 surrounding area.

b. If the detector coincides with a localized small area of lower than average activity, the calculated dpm/100 cm^2, underestimates the average activity of the 100 cm^2 surrounding area.

When a detector larger than 100 cm^2 is used, application of the 100/A factor assumes that the activity is uniformly distributed over the area of the detector. When the activity within the area covered by the detector is non uniformly distributed, several outcomes are possible:

a. If the activity is confined to a small area < 100 cm^2 beneath the detector, it is possible to underestimate the "average" activity in an area of 100 cm^2 covered by the detector, not coincident with the localized area containing the activity.

b. If the activity is distributed in multiple sites each of small area < 100 cm^2 beneath the detector, the calculated dpm/100 cm^2 tends toward the "true" average activity in any 100 cm^2 area under the detector.

Due to concerns on the part of the NRC Staff that outcome a. above for large detectors can occur, LIPA agreed to discontinue the use of large area detectors (252 cm^2). However, the use of detectors with sensitive area smaller than 100 cm^2 also introduces potential errors of a non-conservative nature as described above.

8.2 § 8.1.1, page 8.2, Surface Activity, page 8.2, equation (8-3). As discussed in comment 6.2, guidance should be provided for processing samples which cannot be obtained over 100 cm^2 areas.

8.3 § 8.2, Measurement Uncertainty, page 8.4, paragraph 2. The paragraph implies that equation (8-9) yields the background measurement uncertainty. It actually provides an estimate of the uncertainty in the net counts (count rate).

8.4 § 8.5.5, Comparisons, pages 8.9 through 8.13. This section presents methods for comparing survey results to various guideline values to enable decisions whether or not the site satisfies the applicable release criteria. The NUREG discussion focuses on evaluation of each defined survey unit as a distinct population. The implicit assumption is that if each survey unit individually satisfies the various comparison tests, then the entire site satisfies the release criteria. The overall NUREG survey design approach is a stratified sampling design. For site wide inference purposes, several overall populations are identified which are defined by the prescribed sampling approach. These include: floors and lower walls of affected structures (systematic sampling), upper walls and ceilings of affected structures which are "suspect" (systematic sampling), upper walls and ceilings of affected structures determined to be non suspect (judgement sampling), surface areas of unaffected structures (random sampling), etc. Methods should be discussed for drawing conclusions which are appropriate for the overall sampling design approach.

8.5 § 8.5.5, Comparisons, page 8.9, last paragraph and equation (8-13),page 8.10. The equation calculates the upper limit of the confidence interval about the mean at the specified confidence level (determined by the value of $t_{1-\alpha,df}$). This method for estimating confidence intervals is based upon several assumptions. These are:

the sample is a simple random sample,

the sampling distribution is a normal distribution and

the population being sampled is infinite.

The most important of these assumptions is the assumption of a simple random sample, i.e, a sampling method in which every possible sample of a specified size has the same probability of being selected. This assumption is violated in that the measurements taken in a typical survey unit which follows the guidance in the NUREG usually consist of a mixture of survey measurement points selected randomly and others selected in non-random fashion. The other two assumptions listed above are not always well satisfied either. As a result, the error in the population mean will be underestimated and hence the degree of confidence (confidence level) that a population mean is below the guideline value will be lower than intended. See for example, G. Hahn & W. Meeker, Statistical Intervals, pp. 10 - 13, John Wiley and Sons, NY, 1991.

8.6 § 8.5.5, Comparisons, page 8.10, Sample Calculation 1. Inclusion of certain data points in this example as "less than" values is inconsistent with the example of data reporting provided in the Manual. (Refer to Section 8.4, Format for Data Presentation, page 8.5.). If the guidance is to report net surface activity regardless of the level relative to established MDAs, the example calculation should not demonstrate alternative treatment of survey data.

8.7 § 8.5.5, page 8.12, paragraph 4. It states that the technique of combining systematic and randomly selected measurements, giving equal weight to each and to the weighted means of areas of elevated activity provides a conservative approach (for estimating the confidence interval about the mean). This conclusion does not seem justified in view of comment 8.4 above.

9.0 Survey Documentation and Reports

No comments.

Appendix A Determining Site-Specific Guidelines

A.1. The requirement to develop nuclide specific guideline values for individual beta-gamma emitters when hard-to-measure radionuclides are present (or potentially present) can pose difficulties. For example, radionuclides such as Fe-55, Ni-59, Ni-63, H-3, C-14 can be present in nuclear reactor facility residual contamination. These are not detectable using normal measurement procedures with typical field survey instruments (GM or proportional detectors). According to Appendix A, if individual radionuclides are present above 10% of the total activity concentration (or contribute over 10% of the calculated total dose from all contaminants), individual guideline values are to be calculated for each. Typical reactor facility residual contamination sources are a mixture of Co-60, Cs-137, Mn-54, etc, and some or all of the hard-to-measure radionuclides listed above. For this group of radionuclides, the current overall guideline value is 5000 dpm/100 cm^2, per Regulatory guide 1.86. Application of the Appendix A method under these conditions causes two major difficulties:

a. The resulting scaled guideline value for the detectable radionuclides, Co-60 etc, can be significantly reduced from 5000 dpm/100 cm^2, to levels where minimum sensitivity and reclassification action levels cannot practically be achieved using direct measurements. For example if Fe-55 and Co-60 are determined to be the only radionuclides present in "significant" amounts, and are estimated to be present in equal concentrations, the guideline value for each is 2500 dpm/100 cm^2 according to the prescription of Appendix A. The 25% surface scanning sensitivity capability recommended in § 4.2.3 is now reduced from 1250 to 625 dpm/100 cm^2; the reclassification action level for unaffected areas (§ 4.2.3), and the criterion for non-suspect overhead areas in affected areas (§4.2.3) are also reduced from 1250 to 625 dpm/100 cm^2. These levels are below the MDAs obtained for most commonly used beta-gamma survey instruments using the method of equation (5-1) in the NUREG.

b. Residual levels of the hard-to-detect radionuclide cannot be reliably estimated by applying "scale factors" to measurements of detectable radionuclides under the above circumstances. If indirect measurements are then necessary, meeting the survey measurement frequencies called for in the NUREG would be prohibitively expensive.