Department of Energy

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JAN 22 1999

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V-SRF-5J
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

DOE-0356-99

Mr. Tom Schneider, Project Manager
Ohio Environmental Protection Agency
401 East 5th Street
Dayton, Ohio 45402-2911

Dear Mr. Saric and Mr. Schneider:

SUBMITTAL OF REVISED REAL-TIME IN SITU GAMMA SPECTROMETRY REPORTS AND DOCUMENTATION TO SUPPORT THE USE OF HIGH PURITY GERMANIUM DETECTORS TO PERFORM FINAL SOIL CERTIFICATION FOR PRIMARY RADIONUCLIDES

We are pleased to submit, for your review and approval, the following revised reports and associated documentation supporting the Department of Energy, Fernald Environmental Management Project's (DOE-FEMP) proposal to utilize High Purity Germanium (HPGe) detectors to assist in the performance of final certification for the primary radionuclides of uranium, thorium, and radium-226. The submittal of this real-time radiological characterization documentation represents the culmination of over two years of work in developing and documenting the in situ real time program.

The enclosed documents are listed below.

1) Comparability of In Situ Gamma Spectrometry and Laboratory Data, Revision 1, dated January 1999.
2) Comparability of In Situ Gamma Spectrometry and Laboratory Data and Decisions for Certification Units, Revision 0, dated January1999.
3) Revised Radiation Tracking Vehicle (RTRAK) Applicability Study, Revision 2, dated January 1999.
4) Draft Data Validation Check List for validating High Purity Germanium (HPGe) detector measurements to Analytical Support Level (ASL) D.

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5) Updated Section 2.5, (Revision B), for incorporation into User's Manual, entitled, "Certification."
6) Updated Section 3.7, (Revision B), for incorporation into User's Manual, entitled, "Certification Measurements."
7) Crosswalk between U.S. EPA comments on the three 1997 Comparability Study addenda and the enclosed Comparability Study documents, items numbered (1) and (2).
8) Crosswalk between U.S. EPA comments on the RTRAK Applicability Study and the enclosed revised RTRAK Applicability Study (item no.3).

Over the past two years, through the Real-Time Working Group Meetings, representatives from FEMP, (U.S. EPA, OEPA, Ohio Department of Health (ODH) and Department of Energy, Environmental Measurements Laboratory (DOE-EML) have been working together to develop and implement an in situ real-time characterization program, which meets the highest standards for data quality and acceptability. As you are aware, a considerable amount of success with the real-time program has already been achieved and implemented at FEMP. FEMP, with the collaborative support and approval of the U.S. EPA and OEPA, has successfully implemented the Radiation Tracking Vehicle (RTRAK) and HPGe detectors to support pre-design investigations, excavation control for Waste Acceptance Criteria (WAC) attainment, and pre-certification for hot spot identification, delineation and removal confirmation as well as for providing a status of Final Remediation Level (FRL) attainment prior to final certification. With the enclosed reports and documentation, the FEMP is pleased to be providing the final ingredients, as requested through your comments and work group discussions, necessary to support the use of HPGe detectors in the performance of final FRL certification.

If you have any questions, please contact Robert Janke at (513) 648-3124.

Sincerely,

Johnny Reising

Johnny W. Reising
Fernald Remedial Action
Project Manager

FEMP:R.J. Janke

Enclosures

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cc w/enclosures:
C. Gogolak, DOE-EML
K. Miller, DOE-EML
G. Jablonowski, USEPA-V, SRF-5J
C. Petullo, USEPA-Office of Radiation & Indoor Air, Las Vegas
R. Beaumier, TPSS/DERR, OEPA-Columbus
T. Schneider, OEPA-Dayton (3 copies of enclosures)
M. Davis, ANL
R. Johnson, ANL
K. Picel, ANL
F. Bell, ATSDR
M. Schupe, HSI GeoTrans
R. Vandegrift, ODH
F. Barker, Tetra Tech
S. Pastor, Tetra Tech
AR Coordinator, FDF/78

cc w/o enclosures:
N. Hallein, EM-42/CLOV
A. Tanner, OH/FEMP
D. Carr, FDF/52-2
J. Chiou, FDF/52-0
R. Danahy, FDF/35
T. Hagen, FDF/65-2
J. Harmon, FDF/90
R. Heck, FDF/2
S. Hinnefeld, FDF/90
S. Lorenz, FDF/52-5
D. Seiller, FDF/29
C. Sutton, FDF/35
J. White, FDF/52-8
D. Yesso, FDF/35
SCEP Library, FDF/52-0
EDC, FDF/52-7

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Project Name:	Project No.:
PSP No.:	Variances:
Detector No.:	Software: Version:

1.0	GENERAL PACKAGE REVIEW	
	NOTE: [ ] is the desired response (requiring no action) for the following checklist. All responses are: (Yes) (No) (NA), respectively. **NOTE:** In any of the following steps, if required information is missing, then immediately submit an electronic request (cc:mail) to data generator for the information. **NOTE:** Attachments A (Radiological Measurement Data Qualification Summary) and B/C (Radionuclide Qualifier Sheet) are to be completed by validator as part of the supporting documents for this checklist	
1.1	Is the data package complete? **ACTION:** If not, then stop validation until all material is received.	[ ] ___ ___
1.2	Has FS-F-5509, HPGe Data Verification Checklist been completed? **ACTION:** If not, then stop validation until completed.	[ ] ___ ___
1.3	Have all required responses checked NO or NA on FS-F-5509, HPGe Data Verification Checklist been explained in comment section of FS-F-5509? **ACTION:** If not, then stop validation until comments are received. **ACTION:** If documented, then qualify data as noted.	[ ] ___ ___
1.4	Do the following items on the electronic worksheet match the same items on the summary file: • moisture measurement, • detector height, and • detector serial number **ACTION:** If values differ, stop validation until errors are corrected.	[ ] ___ ___

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1.5	Do the location ID's and coordinates specified in the PSP match the sample header? **ACTION:** If values differ, stop validation until errors are corrected.	[ ] ___ ___
1.6	Are spectra files located in proper directory of the LAN and are all associated results in the SED? **ACTION:** If no, stop validation until missing files or results are present.	[ ] ___ ___
2.0	**INITIAL AND CONTINUING CALIBRATION**	
2.1	Are the detector calibration parameters current? **ACTION:** If no, stop validation until current calibration is received.	[ ] ___ ___
2.2	Were pre-operation checks performed to verify proper energy calibration, efficiency, and resolution? **ACTION:** If no, then qualify associated data as unusable (R).	[ ] ___ ___
2.3	Was the pre-operation energy calibration within limits of the following table?	[ ] ___ ___

SOURCE ENERGY		
Am-241	59.5 keV	158 ± 3
Cs-137	661.6 keV	1763 ± 3
Co-60	1332.5 keV	3553 ± 3

ACTION: If an energy calibration or energy calibration check was done prior to use of the instrument, and any one of the peak centroids are outside the established acceptance criteria, then qualify results as unusable (R).

2.4	Were the results of the pre-operation efficiency checks for Co-60 within established limits? **NOTE:** The net peak area shall be within plus or minus 3 standard deviations of the mean. **ACTION:** If net peak area is confirmed to be outside of acceptable range for both original and subsequent determinations, qualify all associated data as unusable (R). **ACTION:** If net peak counts were outside acceptable range, but two subsequent determinations were within acceptable range, do not qualify any associated data.	[ ] ___ ___

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2.5	Were the pre-operation resolution checks within established limits? **NOTE:** The check source resolution for Co-60 shall be within plus or minus 10% of the mean. **ACTION:** If check source peak resolution is greater than 110% of the mean for both original and subsequent determinations, qualify all associated data as unusable (R). **ACTION:** If check source peak resolution is less than 90% of the mean, then qualify data as stated on applicable FS-F-5509. **ACTION:** If original check source resolution is outside acceptable range, but two subsequent determinations were within acceptable range, then do not qualify any associated data.	[ ] ___ ___
2.6	Were the post-operation checks performed to verify proper efficiency and resolution **ACTION:** If no, qualify associated data as unusable (R).	
2.7	Were the result of the post-operation efficiency check for Co-60 within established limits? **NOTE:** The net peak area shall be within plus or minus 3 standard deviations of the mean. **ACTION:** If net peak area is confirmed to be outside of acceptable range for both original and subsequent determinations, qualify all associated data as unusable (R). **ACTION:** If net peak counts were outside acceptable range, but two subsequent determinations were within acceptable range, do not qualify any associated data.	[ ] ___ ___

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2.8	Was the post-operation resolution check within established limits? **NOTE:** The check source resolution for Co-60 shall be within plus or minus 10% of the mean. **ACTION:** If check source peak resolution is greater than 110% of the mean for both original and subsequent determinations, qualify all associated data as unusable (R). **ACTION:** If check source peak resolution is less than 90% of the mean, then qualify data as stated on applicable FS-F-5509. **ACTION:** If original check source resolution is outside acceptable range, but two subsequent determinations were within acceptable range, then do not qualify any associated data.	[ ] ___ ___
2.9	Were the same daily check sources performed with the same source as was used to establish control charts? **NOTE:** Three energies are used to perform the energy calibration or energy calibration checks. They are 59.5 keV (Am-241), 661.6 keV (Cs-137), and 1332.5 keV (Co-60).. **ACTION:** If the same source was not used, then qualify all associated data as unusable (R).	[ ] ___ ___

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3.0	**SPECTRAL REVIEW**	
3.1	Is the detector dead time 20% or less? **ACTION:** If the detector dead time is greater than 20% and FS-F-5509 indicates that the data is acceptable for its intended purpose, then qualify the data as estimated (J). **ACTION:** If the detector dead time is greater than 20% and FS-F-5509 indicates that the data is unacceptable for its intended purpose, qualify the measurement results as unusable (R).	[ ] ___ ___
3.2	Is the K-40 1460.8 keV peak present and less than or equal to 3 keV at FWHM? **NOTE:** Under certain conditions K-40 may not be present, and in those cases its absence does not indicate spectral problems. **ACTION:** If K-40 is absent and there is no explanation on FS-F-5509 stop validation until corrected. **ACTION:** If the FWHM resolution of the K-40 1460.8 keV peak is greater than 3 keV, qualify all measurement results as estimated (J).	[ ] ___ ___
4.0	**MEASUREMENT RESULTS AND DETECTION LIMITS**	
4.1	Were measurement concentrations and a posteriori minimum detectable concentrations (MDCs) reported for all nuclides requested? **ACTION:** If concentrations and a posteriori MDC are not reported for all requested nuclide, then stop validation until information is received.	[ ] ___ ___
4.2	Are any of the reported results less than the applicable a posteriori MDC AND does the reported a posteriori MDC exceed the Final Remediation Levels (FRL's) approved for the site? **ACTION:** If any of the non-detects have a reported MDC which exceeds the FRL, then qualify data as MDC elevated detection limit (UJ) with the comment code "Result <MDC>FRL".	[ ] ___ ___
4.3	For each radionuclide reported as a detect, is the 1.96 sigma counting error less than 50% of the measured value? **ACTION:** If the 1.96 sigma counting error exceeds 50% of the result, qualify the associated result as estimated (J)	[ ] ___ ___

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4.4	Were any of the Ra-226 results not corrected for radon disequilibrium in soil? **ACTION:** Qualify any Ra-226 data which have not been corrected for radon disequilibrium as estimated (J) with the comment "low bias, no radon correction".	[ ] ___ ___
4.5	Were radon monitor corrections applied to compensate for radon accumulation near the ground surface? **ACTION:** Qualify any Ra-226 data which do not have radon monitor corrections as estimated (J) with the comment "high bias, no radon monitor correction".	[ ] ___ ___
5.0	**QUALITY CONTROL**	
	NOTE: At least one duplicate measurement must be performed as specified in the PSP with a minimum of one per PSP or one duplicate measurement per 20 measurements , whichever is more frequent.	[ ] ___ ___
5.1	Were duplicate measures performed at the proper frequency? **ACTION:** If insufficient duplicate measurement(s) were made, qualify associated data as estimated (J).	[ ] ___ ___
5.2	Were duplicate measurements taken consecutively or non-consecutively in accordance with the PSP? **ACTION:** If the duplicate measurement(s) were taken consecutively, validate according to 5.3. **ACTION:** If the duplicate measurement(s) were taken non-consecutively, validate according to 5.4	[ ] ___ ___

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5.3	Were duplicate precision criteria met for consecutive duplicates? **NOTE:** If both the original and duplicate measurement concentrations are greater than five times their respective MDCs, calculate the duplicate precision (the Relative Percent Difference - RPD) as indicated below: $$RPD = 200\% * \frac{\lvert Conc_{ori} - Conc_{dup} \rvert}{(Conc_{ori} + Conc_{dup})}$$ where RPD is the Relative Percent Difference between the original measurement and the duplicate measurement. $Conc_{ori}$ is the reported concentration for the original measurement $Conc_{dup}$ is the reported concentration for the duplicate measurement **ACTION:** If the RPD is greater than 20%, qualify all associated data as estimated (J).	[ ] ___ ___
5.4	Were duplicate precision criteria met for non-consecutive duplicates? **NOTE:** If both the original and duplicate measurement concentrations are greater than five times their respective MDCs, calculate the duplicate precision (the Relative Percent Difference - RPD) as indicated below: $$RPD = 200\% * \frac{\lvert Conc_{ori} - Conc_{dup} \rvert}{(Conc_{ori} + Conc_{dup})}$$ where RPD is the Relative Percent Difference between the original measurement and the duplicate measurement. $Conc_{ori}$ is the reported concentration for the original measurement $Conc_{dup}$ is the reported concentration for the duplicate measurement **ACTION:** If the RPD is greater than 35%, qualify all associated data as estimated (J).	[ ] ___ ___

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5.5	If the original and/or the duplicate of consecutive measurement concentrations are less than or equal to five times their respective MDC, calculate the duplicate precision measurement (the Absolute difference - AD) as indicated below: $AD = \lvert Conc_{ori} - Conc_{dup} \rvert$ **ACTION:** If the AD is greater than or equal to the average of the original measurement MDC and duplicate MDC, then qualify associated data estimated (J).	[ ] ___ ___
5.6	If the original and/or the duplicate of non-consecutive measurement concentrations are less than or equal to five times their respective MDC, calculate the duplicate precision measurement (the Absolute difference - AD) as indicated below: $AD = \lvert Conc_{ori} - Conc_{dup} \rvert$ **ACTION:** If the AD is greater than or equal to 1.6 times the average of the original measurement MDC and duplicate MDC, then qualify associated data estimated (J).	[ ] ___ ___
5.7	Was at least one Field Control Station (FCS) Measurement analyzed each day? **NOTE:** Field Control Station is a location where the gamma emitting radionuclide composition of the soil is well characterized by independent sampling and analysis. The Field Control Station measurements serve as the field equivalent of a Laboratory Control measurement for purposes of quality control. **ACTION:** If no, then qualify data as unusable (R).	[ ] ___ ___
5.8	Were the FCS results withing the established acceptance criteria? **NOTE:** Perform the FCS measurement evaluation on energies that have actual FCS control limits established. **ACTION:** If the FCS is outside acceptable range, but subsequent determination is within acceptable range, do not qualify any associated data.	[ ] ___ ___

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6.0	COMMENTS SECTION

Check List No.:	The release description and exceptions, if any are noted below with reason(s) for rejection (R) or qualification as estimated (J).Any laboratory deficiencies also should be noted in this section.

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Detector Number:			
Efficiency Calibration Date:		**Calibration Expires:**	
Software Title:		**Version Number:**	

1.0	**GENERAL PACKAGE REVIEW**	
	NOTE: [ ] is the desired response (requiring no action) for the following checklist. All responses are: (Yes) (No) (NA), respectively. **NOTE:** In any of the following steps, if required information is missing, then immediately submit an electronic request (cc:mail) to data generator for the information. **NOTE:** Completion of this checklist is an annual requirement.	
1.1	Were NIST, NIST-traceable, or equivalent, certified standards used for calibration? **ACTION:** If the standards used for calibration are not certified, or traceable, or cannot be positively identified, then reject the calibration.	[ ] ___ ___
1.2	Were the calibration standards used within their expiration dates? **ACTION:** If the calibration standards were used past their expiration date or have exceeded five half-lives of the radionuclide of interest if no expiration date is specified, then reject the calibration.	[ ] ___ ___
1.3	Was a minimum of 10,000 net counts obtained for each calibration peak used for each energy for each angle? **ACTION:** If the net counts for the calibration peaks were less than 10,000, then reject the calibration.	[ ] ___ ___

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1.4	Was an energy calibration or energy calibration check performed prior to the performance of the efficiency calibration and were the peaks within acceptance criteria of the following table? **ACTION:** If an energy calibration was not performed prior to the performance of the efficiency calibration or the above energy calibration criteria were not met, then reject the calibration.	[ ] ____ ____
1.5	Does the conversion factor curve appear normal in that it decreases rapidly at low energies and remains relatively flat at high energies? **NOTE:** A minimum of 12 gamma energies must be used with the lowest energy being less 40 keV and the highest energy being 1400 keV. **ACTION:** If the detector calibration does not approximate a smooth curve then reject the calibration.	[ ] ____ ____
1.6	Was the detector system deadtime on the calibration spectrum less than or equal to 20% for the efficiency and energy calibration(s)? **ACTION:** If the printouts show a deadtime greater than 20% but less than or equal to 30%, then this calibration cannot be used for ASL D data. **ACTION:** If the printouts show a deadtime greater than 30%, then reject the calibration.	[ ] ____ ____
1.7	Has the software used to compute the conversion curve been verified and validated (V&V) and is the software and version identified on the calibration efficiency curve? **ACTION:** If the software has not been V&V or is not identified on the calibration efficiency curve, then stop validation and notify data generator.	[ ] ____ ____

PEAK	ENERGY (KEV)	CHANNEL
Am-241	59.5	158 ± 3
Cs-137	661.6	1763 ± 3
Co-60	1332.5	3553 ± 3

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1.8	Was the resolution of the peaks used for the calibration less than or equal to 3.5 keV at FWHM? **ACTION:** If the resolution of the system is greater than 3.5 keV for any of the peaks used for calibration, then reject the calibration.	[ ] ____ ____
1.9	Does the new calibration yield data within 10% of data generated using the old calibration for Total U, Th-232, and K-40? **NOTE:** This checklist item is not applicable for the first calibration of the detector. **NOTE:** Attach documentation to demonstrate compatibility of data. **ACTION:** If data calculated with the new calibration are not within 10% of data calculated using old calibration, then stop validation until problem is resolved.	[ ] ____ ____

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2.0	COMMENTS SECTION
Check List No.:	If the calibrations are rejected, note reasons below. Any additional calibration deficiencies also should be noted in this section.

2.5 CERTIFICATION

Certification consists of demonstrating for a certification unit (CU) that the residual concentrations of contaminants are below their FRLs and that no hot spots are present. Residual concentrations of a given radionuclide are determined to be below FRLs when the upper 95% confidence interval of the mean of the residual concentrations is below that radionuclide's FRL. Figures 2.5-1 and 2.5-2 (Figures 3-9 and 3-10 of the SEP) illustrate the general certification process. Confidence intervals for a certification unit are determined using 12 to 16 samples collected randomly in the certification unit. In principle, samples may be collected using either conventional methods (physical sampling and laboratory analysis) or using the HPGe instrument (*in-situ* measurement). The procedure for determining sampling locations is described in Section 3.4.2.1 of the SEP. Twelve to 16 physical samples or HPGe measurements is an adequate sample size given the expected low degree of variability in soil concentrations of contaminants following remediation. If a certification unit fails certification because the variability in sample results is too high (i.e., upper 95% confidence interval exceeds the FRL), even though the average concentrations of all contaminants are below FRLs, additional samples can be added. If the average is elevated or all or portions of the certification unit have elevated concentrations, the certification unit should be remediated further or certification unit boundaries should be revised to allow remediation to be better focused on areas with elevated levels of contamination. Details on approaches to addressing certification failures are provided in the SEP.

Hot spots generally will be addressed during precertification. However, if certification samples (either physical samples or HPGe measurements) indicate the presence of hot spots (concentrations of primary COCs at least twice the FRLs), the hot spots will be delineated (User's Manual, Section 3.3.3) and removed, and the area of the hot spots sampled again (by either physical samples or HPGe measurement).

The HPGe instrument is well suited for use in certification. It provides reproducible measurements of the primary COCs with a low degree of uncertainty. HPGe has low MDCs, and this can provide reliable data even for very low concentrations of radionuclides. HPGe measurements show good comparability with results obtained using conventional methods for uranium and thorium and for radium when empirical correction factors are used to compensate for radon disequilibrium in soil and

for radon accumulation near soil surfaces. But most importantly, the *in-situ* technique provides a better average over a CU for a given number of measurements than will the same number of physical samples. This is because HPGe measures a large area within the field of view, while physical samples basically represent very small areas and soil volumes. This advantage has been demonstrated in two reports: 1) Comparability of *In-Situ* Gamma Spectrometry and Laboratory Data (DOE 1998a) and 2) Comparability of *In-Situ* Gamma Spectrometry and Laboratory Data and Decisions for Certification Units (DOE 1998b).

Both physical sample analyses and HPGe measurements shall be carried out under ASL D data quality levels as specified in the SCQ. The QA and QC program as well as ASL D specifications are detailed in the *In-Situ* Gamma Spectrometry Addendum to the SCQ (DOE 1998c).

2.5.1 Guidance

- All certification measurements performed with HPGe will be made at ASL D data quality levels. *In-situ* gamma spectrometry personnel must ensure that each detector used for ASL D measurements complies with all of the QC criteria for ASL D listed in procedure ADM-16, "*In-Situ* Gamma Spectrometry Quality Control Measurements," and also given in the *In-Situ* Gamma Spectrometry Addendum to the SCQ (DOE 1998).

- At least 10% of all ASL D data will have to be validated. Project personnel and *in-situ* gamma spectrometry personnel should check the ASL D validation checklist for data validation requirements.

- RTRAK measurements will not be used as the basis for certification of remediated areas, but will be extensively used in pre-certification measurements for hot spot detection and assessment of CU heterogeneity.

2.5.2 See Also:

2.1 Overview of RTRAK and HPGe Usage
2.4 Precertification Investigations
3.1 Individual HPGe Measurements
3.3 Hot Spot Evaluation
3.7 Certification Measurements

CU - Certification Unit
COC - Constituent of Concern

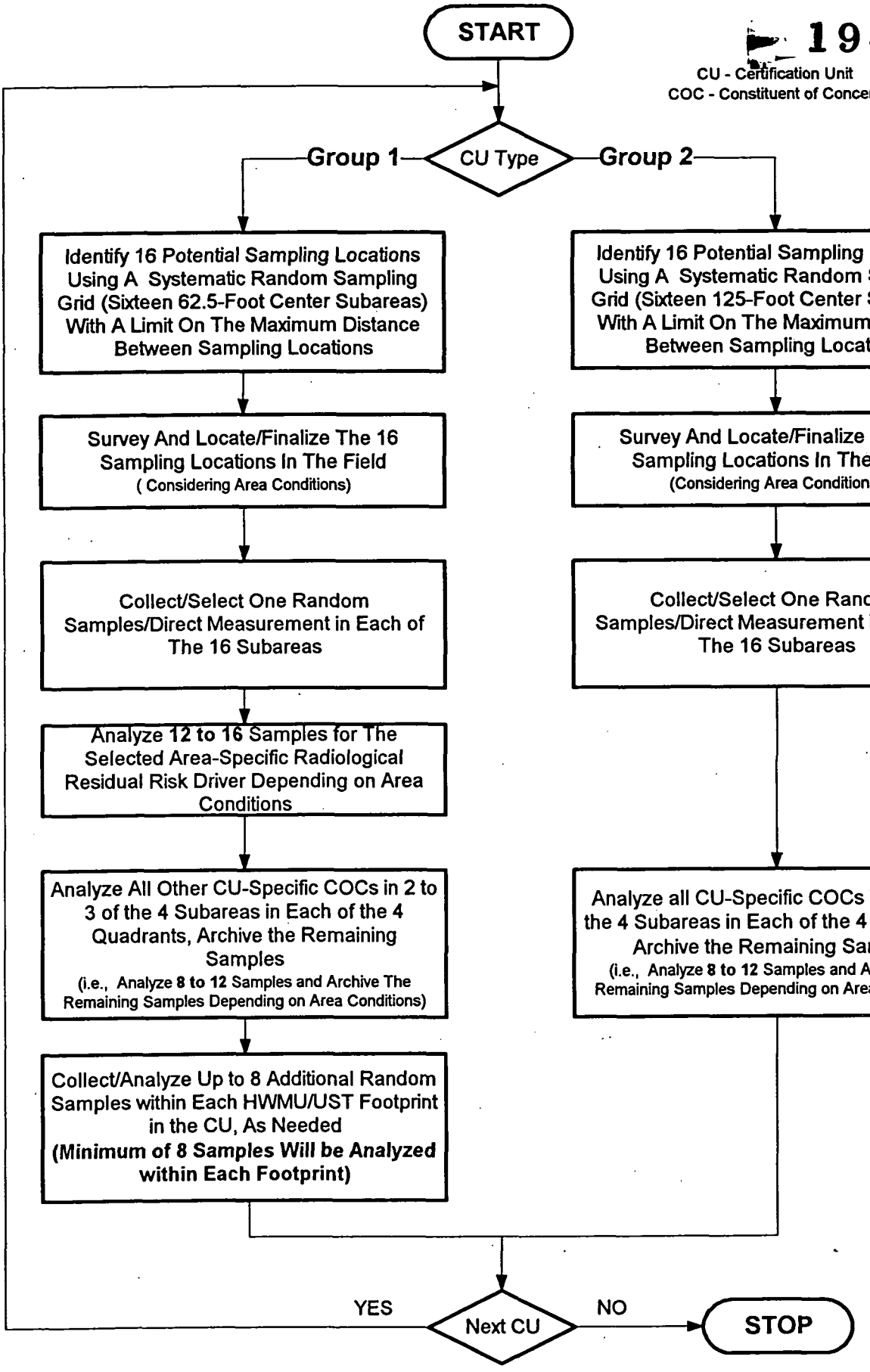

FIGURE 2.5-1 GENERAL CERTIFICATION SAMPLING STRATEGY

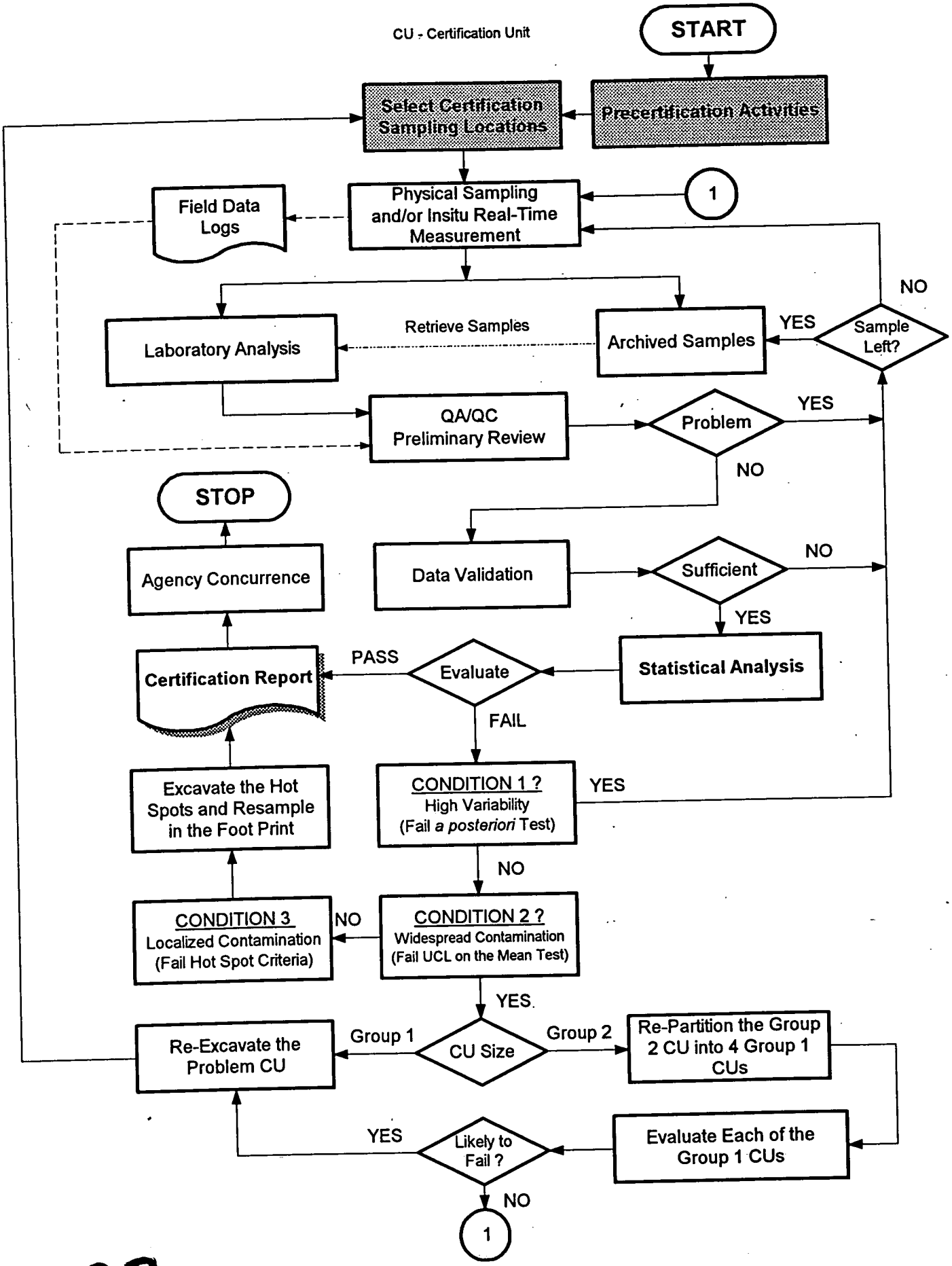

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FIGURE 2.5-2 GENERAL CERTIFICATION PROCEDURE

3.7 CERTIFICATION MEASUREMENTS

3.7.1 Comparability of HPGe and Laboratory CU Certification Data

The report entitled "Comparability of *In-Situ* Gamma Spectrometry and Laboratory Data and Decisions for Certification Units" (DOE 1998b) demonstrates that:

1. The same decisions with respect to CU certification will be made for total uranium, thorium-232, and radium-226 (with occasional exceptions; see Section 3.7.4 below) regardless of whether HPGe or laboratory data are used.

2. HPGe certification data are very comparable to laboratory certification data for total uranium, thorium-232, and radium-226.

3. HPGe data generally have smaller percent relative standard deviations than laboratory data, they are based on a larger "sample" size, and hence are more representative for certification purposes.

Accordingly, the FEMP will use HPGe as the principal analytical instrument for certification measurements of primary radionuclide contaminants of concern (total uranium, thorium-232 and radium-226). Certification for certain secondary radionuclide contaminants of concern, such as technetium-99, cannot be accomplished with the HPGe.

3.7.2 Pre-Certification Measurements

The key to successfully using HPGe for certification is the precertification investigation (Section 2.4). Pre-certification involves 100 percent scan of all CUs by RTRAK/RSS to demonstrate that contamination is below the FRL for each radiological COC and that no potential hot spots exist. With regard to hot spots, if for any reason the two point moving average of RTRAK/RSS measurements exceeds thee times the FRL for radium-226, thorium-232 or total uranium, a hot spot may be present (Section 3.3.1). The location in each CU of the highest RTRAK total activity reading is also measured by HPGe to confirm that the highest total activity measurement does not correspond to a hot spot. If remediation has been successful, pre-certification measurements will demonstrate an absence of elevated contamination areas and a relatively homogeneous residual contamination distribution.

3.7.3 Certification Approach

The overall approach to certification using HPGe will be similar to the approach used for physical samples with respect to sample locations and statistical interpretation of data. The procedure for determining sample locations is described in Section 3.4.2.1 of the SEP. Sixteen HPGe measurements will be performed in randomly selected locations irrespective of CU classification. To prevent clumping of measurement locations in one small area of the CU, the two criteria for selecting measurement locations described in Section 3.4.2.1 of the SEP will be followed. Physical samples will serve as QC checks on HPGe measurements. One physical sample will be taken per CU at the highest HPGe reading that was obtained during certification measurements.

Sixteen HPGe measurements is an adequate sample size given the expected low degree of variability in soil concentrations of primary radionuclides following remediation. A statistical analysis of the HPGe measurements will be conducted with the validated HPGe data as described in Sections 3.4.3, 3.4.4, and Appendix G of the SEP. Table 3.7-1 presents certification data (means and standard deviations) for individual radiological COCs averaged from all CUs in A1PI, A1PII, A1PI sediment traps, and A8PI. Both laboratory and HPGe means are all well below FRLs, and the small standard deviations attest to relative homogeneity. Similar results are expected for future areas to be certified.

Similar to laboratory analysis of physical samples, HPGe measurements will be performed at ASL D for certification. Further, all measurements will be carried out under the auspices of a QA/QC program that is in full compliance with the SCQ. The *In-Situ* Gamma Spectrometry Addendum to the SCQ (DOE 1998c) contains a complete description of the QA and QC programs that will govern HPGe measurements as described in procedures ADM-16 and 20300-PL-0002 listed in Appendix A. The QC requirements to perform ASL D HPGe measurements are specified in ADM-16. Finally, HPGe measurement data will be validated independently of the *in-situ* gamma spectrometry group performing the measurements.

3.7.4 Radium-226 Certification Measurements

Radium-226 measurements must be conducted in strict accordance with Sections 5.3.1.1 and 5.3.3.3 in order to compensate for radon-222 disequilibrium in soil and radon-222 accumulation near the ground surface. Radon monitors (Section 5.3.2) must be employed to address the second effect. Despite the use of radon monitors, they occasionally are unable to properly compensate for radon buildups near the ground surface. This may happen when the normal cycle of ground surface warming and cooling is interrupted or when atmospheric inversions occur and last throughout the day. When these situations arise, radium-226 data will be biased high. Typically, such occasions can be recognized in two ways: 1) the radon monitor consistently yields radium-226 concentrations above 0.90 pCi/g (wet weight) throughout the day, and 2) measured radium-226 concentrations are consistently considerably higher than those measured on preceding or succeeding days. As shown in the 1998 Certification Comparability Report, anomalously high radium-226 concentrations may cause a CU to fail certification. When radon monitors cannot properly compensate for radon accumulations near the ground surface and the CU subsequently fails certification, the CU will be remeasured using physical samples as the basis for certification.

3.7.5 Guidance

- Sixteen HPGe measurements will be taken per CU at a 31 cm detector height and a 15-minute count time. A 31 cm detector height was chosen because the field of view is approximately 20 m^2. Given the size of the field of view and given hot spot criteria in Section 3.3, a 31 cm detector height is well suited to provide relevant information pertaining to the presence of hot spots, should any be present within the field of view of the detector during certification measurements.

- All data will be reviewed within 24 hours of being collected. Any measurement that is greater than the 95% UCL or lower than the 95% LCL for the CU and is more than 50% greater than the CU mean or is less than 50% of the CU mean will be remeasured for accuracy. If the second measurement agrees with the first (less than 20% RPD), the average of the two measurements will be used for the measurement location. If the second measurement does not agree with the first (greater than 20% RPD), a third measurement will be taken and the average of the two measurements in closest agreement will be used for the measurement location.

- If the radon monitor consistently yields radium-226 concentrations greater than 0.90 pCi/g (wet weight) and calculated radium-226 concentrations at CU locations are considerably higher than those calculated on succeeding or preceding days and the CU

fails certification for radium-226, physical samples shall be used as the basis for certification.

- One physical sample will be taken per CU at the location of the highest HPGe reading that was obtained during certification measurements. The sample location will be based upon the highest ratio of measured concentration to the FRL irrespective of analyte.

- The higher value of either the HPGe or laboratory measurement will be used in the statistical analysis for certification decisions.

- If laboratory analytical data from the physical sample are greater than 2 x FRL for a primary radionuclide COC, then a hot spot will have been detected. The hot spot will be delineated per Section 3.3.3.

- If an HPGe measurement (31 cm) performed during certification exceeds 2xFRL for a primary radionuclide COC, then a hot spot will have been detected. The hot spot will be delineated per Section 3.3.3.

- One duplicate HPGe measurement per CU will be taken. This duplicate measurement will not be taken back to back with the original measurement.

- The QC requirements to support an ASL D program are specified in ADM-16 and must be met to ensure an ASL D compliant program for certification measurements.

3.7.6 See Also:

2.4	Precertification
2.5	Certification
3.3	Hot Spot Evaluation
5.3	Radium-226 Corrections
5.6	Strengths and Limitations

TABLE 3.7-1
AVERAGES AND STANDARD DEVIATIONS FOR CERTIFICATION DATA
FROM A1PI, A1PII, A8PI, AND A1PI SEDIMENT TRAPS

DATA	Total Uranium (ppm)		Thorium-232 (pCi/g)		Radium-226 (pCi/g)	
TYPE	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Laboratory Data*	13.0	11.6	1.05**	0.16**	1.21	0.23
HPGe Data*	16.4	6.8	0.95	0.15	1.23	0.26

*Means and standard deviations are weighted based upon the number of measurements in each of the four certification areas.

**Laboratory thorium-232 excludes data from A1PI because those data are biased anomalously high per the certification comparability study discussed in Section 3.7.1.

Crosswalk Between U.S. EPA Comments and Location in 1998 Comparability Study

U.S. EPA Comment	Comment Addressed in 1998 Comparability Study?	Location in 1998 Comparability Study Document	Explanation
Comments on Total Uranium Addendum			
GC-1	Partially	Table 4-1	A statical comparison of the variability among laboratory analytical methods is not included. A preliminary assessment was performed, but it immediately became clear that limited insight could be gained without an accompanying detailed analysis of error propagation involving HPGe total system uncertainty, total laboratory uncertainty, total uncertainty associated with measurements in heterogeneous areas, and total uncertainty associated with the comparison of two different analytical techniques. Such an analysis was believed to beyond the scope of this report. Table 4-1 presents strengths and weaknesses of various laboratory analytical techniques to show how variability between method could arise
GC-2A	No	--	The User's Manual addresses in detail heterogeneity considerations (Section 5.5) and the detection of small WAC exceedances (section 4.6)
GC-2B	Yes	Appendix D1	The 0.06 ppm value was an artifact of the peak integration algorithm. PBC-01 has HPGe values of 10.9 and 7.5 ppm using GammaVision. See Appendix D1
GC-2C	Yes	Tables 5-2A, 5-2B, Section 5.6	PBC-07 HPGe data were not nearly as low compared to laboratory data using GammaVision. Section 5.6 discussed why 31 cm data appears more comparable than 100 cm data.
OSC-1	Yes	Section 4.4	Rationale for assessing comparability using wet weight data is provided
OSC-2	Yes	Section 2.6	Long-term total system uncertainty is addressed
OSC-3	Yes	Section 5.4.1	Reason for excluding PBC-03-1 is discussed
OSC-4	Yes	Table 4-2	Basis for comparability based upon linear correlation accepted by USEPA at 11/13/98 Technical Workgroup meeting
OSC-5	Yes	Appendix H.3.2	Additional text on interferences added

Crosswalk Between U.S. EPA Comments and Location in 1998 Comparability Study

U.S. EPA Comment	Comment Addressed in 1998 Comparability Study?	Location in 1998 Comparability Study Document	Explanation
Comments on Environmental Effects Addendum			
GC-1	Yes	Appendices A, B, C and Section 2.0	Environmental effects encompass a full years worth of data.
GC-2	No	--	Both wet and dry weight data included for completeness.
GC-3	Yes	--	See original specific comments 1-3 and 5-7
GC-4A	Yes	Section 2.2	Correction of soil moisture values discussed in more detail.
GC-4B	Yes	Section 8.4	Comparison of corrected radium data and laboratory data used as independent verification of radon compensation algorithm.
GC-5	Yes	User's Manual, Section 5.3.2.1	Use of radon monitor compensates for radon accumulation near ground surface.
OSC-1	Yes	Table 2-1	95% UCL and 95% LCL for the slope of the regression line are shown.
OSC-2	Yes	Table 2-1, Section 2.4	95% UCL and 95% LCL for the slope of the regression line are shown
OSC-3	Yes	Table 2-1	95% UCL and 95% LCL for the slope of the regression line are shown
OSC-4	Yes	Section 2.6	Reason for low concentrations on April 23 discussed.
OSC-5	Yes	Table 2-3B	"t" tests performed on morning and afternoon radium-226 data
OSC-6	Yes	Section 2.8, Table 2-5	"t" tests carried out on different detector results
OSC-7	Yes	Section 8.4.1, Tables 8-6A, 6B	Agreement between HPGe and laboratory data is assessed in terms of RPD as defined in Section 4.3

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Crosswalk Between U.S. EPA Comments and Location in 1998 Comparability Study

U.S. EPA Comment	Comment Addressed in 1998 Comparability Study?	Location in 1998 Comparability Study Document	Explanation
Comments on Radium-226 Addendum			
GC-1	Yes	Section 7.6.2, Table 7-9	The effect of error propagation on counting errors is incorporated into the radium-226 correction process.
GC-2	Yes	Section 7.4.3 and 8.4.1	Data from measurements taken near Sewage Treatment Plant provide additional data per agreement in Technical Workgroup meetings
GC-3	Yes	Section 2.7	Environmental effects on radium-226 concentration discussed. Addressing issues such as soil type is fine if we were attempting to develop a theoretical model for the radon disequilibrium process. However, a study of soil types is beyond the scope of this report given that it incorporates an empirical model for the radon disequilibrium process.
GC-4	Yes	Certification Comparability Study Section 5.5 of User's Manual	Numerous corrected radium-226 data points show overall good comparabilty with laboratory data in relatively homogeneous areas such as A1P1, A1P2, A8P1, and A1P1 Sediment Traps. Section 5.5 of the User's Manual discusses heterogeneity effects relative to HPGe measurements.
OSC-1	No	Section 7.2	The second set of laboratory data was not thought to be necessary since the average of laboratory alpha and gamma spectrometry is used as the basis for assessing comparability instead of just laboratory data alone. This lessons the relative importance of a given alpha spectrometry data set. A discussion of the effect of soil type on the data would be speculative at best
OSC-2	Yes	Section 7.3	Overall TPU for radium-226 is discussed
OSC-3	Yes	Section 7.6.2	The empirical approach toward developing a correction factor was suggested in a USEPA comment to the 1997 Comparability Study. 100 cm and 31 cm data are averaged to avoid having multiple correction algorithms. No data have been excluded from the analysis.

Crosswalk Between U.S. EPA Comments and Location in 1998 RTRAK Applicability Study

U.S. EPA Comment	Comment Addressed in 1998 Comparability Study?	Location in 1998 Comparability Study Document	Explanation
Comments on RTRAK Applicability Study			
GC-1	Yes	Section 4.1	The total uncertainty estimate has been refined and the uncertainty discussion extensively rewritten. Additional data points at high concentrations have not yet been collected; as noted in the "Response to Comments to U.S. EPA Technical Review Comments," June 30, 1998, additional data will be collected, when feasible, as appropriate higher concentration locations are identified.
GC-2	Yes	Section 3.3	A discussion of detector heights used in the calibration has been added.
GC-3	Yes	Section 4.5	The discussion comparing RTRAK with HPGe measurements was revised as suggested by the commentor to base the comparison on the relative percent differences (RPD) using the same criteria used in other comparability documents.
GC-4	Yes	--	As explained in the "Response to Comments to U.S. EPA Technical Review Comments," June 30, 1998, no action to this comment is necessary.
GC-5	Yes	--	The tables, figures, and text have been reviewed to correct citations.
OSC-1	Yes	--	As explained in the "Response to Comments to U.S. EPA Technical Review Comments," June 30, 1998, no action to this comment is necessary.

U.S. EPA Comment	Comment Addressed in 1998 Comparability Study?	Location in 1998 Comparability Study Document	Explanation
OSC-2	Yes	Section 4.5	A discussion of the effects of differing fields of view on the agreement between HPGe and RTRAK has been included in the report.
OSC-3	Yes	Section 4.5.2	Comparisons between individual HPGe and average RTRAK measurements in the Drum Baling Area.
OSC-4	Yes	Section 4.1	The discussion of the total uncertainty has been extensively revised and a term related to environmental effects has been added. The uncertainty may be further refined as additional data are collected.
OSC-5	Yes	Section 4.1	The discussions of uncertainty contributors and the total uncertainty has been extensively revised to better explain the systematic uncertainties.
OSC-6	Yes	Table 4-13	The table has been revised and the column related to 4 sec measurements is now correctly labeled.
OSC-7	Yes	Section A3.2	This version of the report was revised such that all RTRAK results are now determined using the revised calibration equations. The estimated quality parameters and discussions are based on those results. Consequently, comparisons with the original equations are not as important as in the draft report and the discussion of the comparisons was de-emphasized.
OSC-8	Yes	Section A.5	The text was revised to reflect the currently preferred operating conditions.
OSC-9	Yes	Appendix B	The graphics file was revised to ensure that all lines on the figures are visible.