Department of Energy

Ohio Field Office
Fernald Area Office
P. O. Box 538705
Cincinnati, Ohio 45253-8705
(513) 648-3155

JUL 11 1997

DOE-1191-97

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

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

Dear Mr. Saric and Mr. Schneider:

TRANSMITTAL OF SITE-WIDE EXCAVATION PLAN, INSITU RADIOLOGICAL CHARACTERIZATION COMPARABILITY STUDY REPORT, RADIATION TRACKING SYSTEM APPLICABILITY STUDY

The purpose of this letter is to transmit, for your review and approval, the Site-Wide Excavation Plan (SEP), the In-situ Radiological Characterization Comparability Study Report, and the Radiation Tracking (RTRAK) System Applicability Study. These three documents are being transmitted to you separately in two parts with a copy of this cover letter included with each package. The draft SEP is being transmitted directly from Brown & Root Inc. (Fluor-Daniel Fernald teaming partner). The Department of Energy, Fernald Environmental Management Project (DOE-FEMP), is transmitting the draft RTRAK Applicability Study and the revised draft In-situ Characterization Comparability Study Report. Included with the In-situ Characterization Comparability Study Report are draft responses to the comments which had been previously provided to us from the U. S. Environmental Protection Agency (U.S. EPA), Ohio Environmental Protection Agency (OEPA), and Ohio Department of Health (ODOH) through our partnering real-time radiological work group meetings. We appreciated these comments and, hopefully, our draft responses will help you in your review as well as help to accelerate the overall program.

The development of these three draft reports completes two major milestones (addressing site-wide soil excavation and certification strategies and in-situ radiological characterization methodologies) necessary for the successful implementation of the Operable Unit 5 (OU5) and Operable Unit 2 (OU2) Soil Remedial Action Programs. As you are aware, the

Recycled and Recyclable

development of comprehensive soil excavation and certification strategies and the demonstration of in-situ radiological measurement techniques has been difficult, laborious, and long overdue. Hopefully, with the submittal of these documents and our continued efforts working together (both on addressing the SEP technical issues and continuing our real-time radiological work group meetings), the FEMP can "turn the corner" with the soils remediation program. With that said, I want to point out to you, from my staff's review, that although the major issues and concerns that the Department of Energy (DOE) had with the first internal draft of the document have been addressed, there are still issues which will likely need considerable discussion between the FEMP and EPA in order for us to achieve a common understanding and definitive path forward.

We believe the SEP and the In-situ Radiological Characterization Reports represent the foundation and starting point to building a technically sound and comprehensive Soils Remediation Program. Through our development of the Integrated Remedial Design Packages (IRDPs), the proceduralization of the In-situ Radiological Characterization Program, and with your continued involvement, I am confident that the implementation of our Soils Remediation Program will be successful. Additionally, the FEMP is looking forward to meeting with you on August 6, 1997, to continue our soils remediation discussions, focusing the afternoon soils discussions primarily on the status of the soils program in light of these documents.

If you should 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: As Stated

cc w/encs:

S. Fauver, EM-42/CLOV
N. Hallein, EM-42/CLOV
C. Purdy, EM-53/CLOV
J. Paulson, DOE-CH
K. Miller, DOE-EML
E. Armstrong, DOE-ID
J. Walker, DOE-SRO
J. Wright, DOE-SRO
G. Jablonowski, USEPA-V, 5HRE-8J
R. Beaumier, TPSS/DERR, OEPA-Columbus
M. Rochotte, OEPA-Columbus
T. Schneider, OEPA-Dayton (total of 3 copies of enc.)
F. Bell, ATSDR
D. S. Ward, GeoTrans
R. Vandegrift, ODOH
R. Geiger, PRC
M. Davis, ANL
R. Johnson, ANL
K. Picel, ANL
D. Carr, FDF/9
J. D. Chiou, FDF/52-5
T. Hagen, FDF/65-2
A. Hunt, FDF/52-5
C. Sutton, FDF/35
AR Coordinator/78

cc w/o encs:

S. Hinnefeld, FDF/2
C. Little, FDF/2
EDC, FDF/52-7

Draft Responses to U.S. EPA, Ohio EPA and Ohio Department of Health Draft Comments on the HPGe Comparability Study

Note:

The U. S. EPA review comments were paraphrased, primarily sets 1 and 2, but also to some degree set number 3.

U. S. EPA Review Set 1 (General Comments Only)

1. Comment suggests using statistical testing, such as the Wilcoxon Signed-Ranks test on the paired results in Table D.1, to improve discussion of bias.

   Response. The QC acceptance criteria for bias has been incorporated into the acceptance criterion for accuracy; therefore, no further evaluation of bias seems necessary.

2. The conclusion in Sec F.1 that level D type results are possible with HPGe are not adequately supported and are in conflict with EML 4/9/97 memo to the contrary.

   Response. The results of the study, in total, would seem to support the use of the HPGe measurement system for the described purposes. The basic question related to the ASL D applications boils down to whether HPGe can be used confidently for certification. The combined results of the Part A and Part B studies strongly suggest that it can.

   In response to the comment on the EML Study, after the EML comparability study publication EML recognized that the comment could be misunderstood and, as a result, sought to clarify their position with respect to the role of HPGe in certification by developing the subsequent publication, "EML Suggested Sampling Protocol." This suggested sampling protocol paper was enclosed with the original draft HPGe Comparability Study report and now, in the present version, has been incorporated into the document (Appendix F).

3. Need more data near the FRL (and WAC) to justify substituting HPGe for lab analysis.

   Response. Agree partially. For use of HPGe for identifying WAC materials, additional data near WAC levels are highly desirable and are being sought. However, in the absence of such data it is still possible to use the HPGe in a conservative mode, identifying any readings above the current maximum range as potential WAC materials and confirming these readings by another means. With respect to FRLs, the criticism in the comment applies only to

4

the Part A study, an admittedly limited data set, and mainly to uranium, which has an FRL well above background. The Part A results for Ra-226 and Th-232 are near the respective FRLs, as FRLs are roughly about twice background for these radionuclides. These results establish that decision outcomes for conditions just below the decision point for the two methods are in fact quite similar. For uranium, there are several test areas in the Part B study that are above, near and below FRLs for all the test analytes that may be used to make similar inferences. That data set is generally useful for evaluating the comparability of field and lab methods both above and below FRLs. The combination of the two parts of the study, therefore, should be sufficient for evaluating the comparability of decision outcomes near FRLs.

Getting actual certification data near the FRL decision points for Part A-type comparisons cannot be controlled; such results, if they occur, can only be examined in retrospect. To the contrary, the actual practice of remediation, particularly in the air plume, results in residual levels near background. Therefore, evaluating the comparability of certification decision outcomes by the two methods, at least initially, will have to rely somewhat on the extrapolated results of the Part B study.

4. Inconsistencies in lab analysis of Th-232 by alpha spec and gamma spec, respectively, must by corrected before "any conclusion can be reached on the value of the HPGe system for that isotope."

Response. Agree to the extent that indeed these alpha and gamma inconsistencies need to be better understood, however, they are independent of the HPGe comparability study .

The laboratory inconsistencies, although not large, are troublesome. The apparent cause, as described in the draft Area 1, Phase I Certification Report (July, 1997), is a suspected high bias in the lab gamma method employed. Primarily one of the three contract labs produced gamma spectrometry results which were consistently higher than the other two labs. Moreover, lab gamma results indicated CU failures in areas that would be expected to be at or very near background. The draft certification report describes some of the reasons for the discrepancies and also commits to a letter report detailing the current status of the investigation and path forward (the letter report is being submitted under a separate transmittal). Preparation, analysis and use of a known site-specific soil reference material (currently being developed by DOE-EML) is one of the tasks being pursued to help resolve this issue.

Clearly, further discussions are needed between DOE and EPA concerning the path forward for gamma spectrometry in the certification program. On a related note, discussions also need to take place with respect to EPA identified issues and concerns associated with the specific gamma spectrometry methodologies which are to be employed. As outlined in the draft Site-Wide Excavation Plan, the future plan is to use gamma spectrometry instead of alpha.

Reviewer Set 2 - General Comments

1. Comparability data from CU O20 suggest that "HPGe measurements and analytical data are not comparable for heterogeneously distributed radionuclides."

   Response. The O20 result is both expected and instructive. 020 initially failed certification because of the 2x FRL hotspot criterion. It did not fail the FRL. A local heterogeneity was detected in one each of the 12 HPGe readings and of the 12 discrete samples analyzed. The two sets of readings were taken independently; samples were not co-located. Although both results were clearly anomalies, the discrete sample had a much higher result than did the anomalous HPGe reading. This outcome would be expected for results compared for a hotspot significantly smaller than the field of view of the HPGe. The point-by-point comparability of the two methods would not be good because the HPGe would average the hotspot over the entire field of view, while the discrete sample would represent the full intensity of the hotspot. The question here, however, relates to how this kind of localized disagreement might affect certification decisions. As the reviewer points out, the O20 data suggest that conflicting outcomes may be possible. In such cases, HPGe results should be considered to more accurately reflect the true average condition for all but the smallest of areas; a single discrete sample would not be representative of a heterogeneous area.

2. This comment raises concerns about Part B (point-by-point) comparability in heterogeneous areas, primarily on the basis of the result from area 3" (PBC-3). In that area, one of the 16 lab results for total uranium was almost an order of magnitude higher than the other 15, which fell in a fairly narrow range. Including this result in the weighted average of the lab results reduces comparability markedly. The comment suggests, therefore, that the two methods are not comparable in heterogeneous areas. It further suggests comparing weighted and un-weighted results to see if comparability improves.

   Response. The anomalous result in Area 3 is attributed to a "very radioactive piece of cement, thereby skewing the weighted average of the entire PCB-3(p. 3-5). Such is an extreme example of a small intense hotspot. As discussed above

6

in the response to comment 1 of this set, such small, intense, hotspots will lead to poor comparability of HPGe and discrete samples owing to the large field of view of the former. Again, it is argued that HPGe would give a more accurate result by effectively averaging the anomaly over the field of view, while the discrete sample result (a piece of concrete) would skew results high, resulting in poor comparability. The suggestion of comparing weighted and un-weighted HPGe results is a good one and could shed light on how the HPGe results are influenced by small hotspots (additional discussions are suggested prior to initiating such an evaluation). However, geometry dictates that areas directly under the detector have a greater influence on detector response than peripheral areas, so appropriate weighting must be applied in accordance with the detector characterization protocol to obtain accurate results. The results from PBC-3 are useful in that they represent an area of elevated contamination as well as a hotspot extreme. They bring into contrast the basic differences in the two methods compared -- the averaging area. The resulting unfavorable comparison (when the anomaly is included) could be characterized as a reasonable worst case. Such areas would not be expected to exist post remediation. Additionally, similar random sampling programs to that implemented in Area 1, Phase I would also not compare favorably.

3. The comment raises concerns regarding subsurface or buried contamination and suggests further evaluation of the performance of the HPGe for contamination at depth.

   Response. Vertical profiles for several radionuclides have been measured to a depth of at least 15 cm in three areas of the site. Profiles were found to be fairly uniform to this depth (Section 4.4). Gamma rays cannot effectively penetrate more than about 10 cm of soil (gamma-rays above 2,000 keV can, however). The current conversion algorithm for the HPGe detector assumes a homogeneous distribution over an averaging depth of 3 cm in soil. The discrete sampling method collects soil to a depth of 4 inches (10 cm). Therefore, both methods assume surficial contamination and require fairly uniform profiles for accurate results. Contamination extending continuously beyond these depths would be detected after excavation of the surface soil if it exceeded the depth of excavation. Questions regarding contamination initiating at depths greater than about 4 inches must be addressed by other means, such as through Geoprobe sampling. The intended application of the two methods compared in the study is surficial soil characterization.

4. The comment says, in effect, that because HPGe averages small area hotspots and cannot accurately determine variable contamination at depth, it is a semi-quantitative approach at best. It goes on to say that unless HPGe gives comparable results to discrete sampling in

7

areas with short-range heterogeneity, it is better used as a qualitative tool to identify large areas of elevated contamination.

Response. The comment is unfair. As mentioned several times above, HPGe cannot be expected to give comparable results to discrete sampling in areas of extreme short-range heterogeneities. Random discrete sampling can not provide comparable results unless conducted using an extensive sampling program. Poor comparability is the result of bias due to generally insufficient numbers of discrete samples, not of a fault in the in situ method. But, more to the point, the intended application of HPGe is primarily in post excavation where such areas would rarely exist. HPGe also has advantages in identifying WAC materials. The field of view can be opened up (or moved around) to screen large areas, then reduced to a scale of a reasonable unit of WAC material volume for final determination. A similar effort using discrete samples would require a very large number of samples. Also, the requirement that HPGe accurately determine variable contamination at depth is unreasonable. The intended application is surface soil characterization. Finally, the results of this study and others clearly show that HPGe is a quantitative method and, in fact, can produce more representative results than discrete sampling in inhomogeneous areas.

5. This comment asks for more detail on the HPGe concentration algorithm. It specifically questions the use of linear attenuation coefficients to establish mass attenuation coefficients.

Response: Comment 5 and the first sentence of Comment 6 are related because the "HPGe concentration algorithm" and the "HPGe detector characterization equation" are the same. The response to these comments is below.

The "HPGe concentration algorithm" referred to is the equation used to perform an HPGe detector characterization. This equation does use mass attenuation coefficients. The terms $(\mu/\rho)_a$ and $(\mu/\rho)_s$ are mass attenuation coefficients for air (a) and soil (s). Some assumptions were made in generating and using this equation. Two of the most important assumptions are that the activity is homogeneously distributed in the soil and that the best general or default value for Fernald soil density is 1.5 g/cm^3. What this equation determines is the detector measurement efficiency for measurements at standard heights above a measurement surface. At Fernald there are two standard measurement heights, 30.48 cm (1 foot) and 1 meter. Detectors are characterized on an individual basis by measuring the detectors' angular response (0-90 degrees) (at 1 foot or 1 meter) to NIST traceable gamma calibration sources that cover the energy range of interest. The results of all the angular responses at each photopeak energy

are integrated using the equation to determine a "Characterization Conversion Factor" (efficiency factor). These individual Conversion Factors are then used to create a "Conversion Factor Graph or Curve" for the entire gamma energy range of interest. The equations and characterization techniques for the HPGe detectors were generated from several years of research by DOE and other agencies. These equations with variations to fit the measurement conditions are recognized as applicable to general categories of in-situ measurements such as homogeneous distribution, heterogeneous distribution etc.

6. This comment also asks for a detailed discussion of the HPGe detector characterization. It asks for a discussion of the conversion algorithm, geometry factors, efficiency as a function of gamma ray energy. It also observes that linearity should be demonstrated with sources of variable activity, rather than with "manipulated data" (presumably, figs. D-3 and D-4).

   Response. Also, see response number 2 associated with Comment number 5 above. Measurement linearity has been demonstrated for Fernald HPGe detectors by measuring calibration sources at varying source to detector distances in the laboratory. The calibration sources used were the Am-241, Cs-137 and Co-60 NIST traceable sources that are used on a daily basis for HPGe detector energy calibrations. Each of these sources contain 100 μCi of activity. During the linearity check , the three sources were measured together at distances of 0.5, 1.0, 2.0, 4.0, 6.0 and 8.0 meters. Linearity was determined by comparing expected and measured net counts.

   The observed results, however combined (not manipulated), do correlate well with lab measurements over several orders of magnitude. The two figures are not intended to prove linearity, but merely to confirm it with available data. The kind of test suggested in the comment would be done during detector characterization. The results would be reflected in the derived conversion algorithm.

7. This comment questions the assumption of secular equilibrium at the FEMP for the Th-232 series. It suggests further evaluation by comparing the activity of Ac-228, the immediate daughter of Ra-228, to that of later progeny.

   Response. The issue of secular equilibrium has been examined in detail and the basis for assuming secular equilibrium has been documented in a letter to EPA (DOE-0962-97).

8. This comment asks for further evaluation of the effects of enrichment on the analysis of total U by either method, and thus, on comparability. It suggests that determinations are sensitive to the enrichment assumption, citing an example from Savannah involving 6% enrichment.

Response. This comment is not relevant to the comparability study but rather concerns the basis and reasonableness of the derivation of the uranium soil Final Remediation Levels.

Considerable discussion is provided in the Operable Unit 5 Feasibility Study (FS) concerning this issue (see final FS, page 2-54 and Appendix A, March 1995). In summary, the range of uranium enrichments processed at the FEMP was .2 to 2 weight percent uranium-235. Natural uranium is 0.72 weight-percent uranium-235. Over the 38 year production history of the plant, the weighted average enrichment was determined to be in the range of natural uranium for the major uranium isotopes. The Remedial Investigation data set was evaluated and showed that the average enrichment of uranium in collected soil samples was 0.69 weight-percent, which is slightly depleted. Therefore, in order to simplify the FS approach and be conservative the preliminary remediation levels (PRLs at the FS stage) were developed based on a natural uranium distribution.

9. This comment suggests that additional radionuclides, several fission products, need to be considered in the study.

Response. The mentioned fission products have been thoroughly considered at the FEMP. They conceivably exist due to the reprocessing of uranium and thorium targets. However, extensive characterization of the site and careful analysis of potential health risks have not identified the mentioned nuclides, with the exception of Tc-99, as contaminants of concern in soils. Tc-99 is not included in the comparability study because it is not readily detectable through gamma emissions.

Review Set 2 - Specific Comments:

1. Sec B.2.2, p. B-3: HPGe assumes equal activities for U-234 and U-238, i.e., "natural" uranium. This assumption should be reevaluated in light of historical processing of depleted and enriched forms of uranium. Also, verification is needed of secular equilibrium in the thorium decay series. Finally, it is not clear how the HPGe system calculates Th-232 (from multiple progeny in secular equilibrium).

   Response. For issues related to enriched/depleted uranium, see response to general comment 8 of this set; for issues related to secular equilibrium, see response to general comment 7.

   For in-situ HPGe analysis, primarily three gamma emitting daughters of Th-232 are used to determine the activity of Th-232. These daughters are Pb-212 @ 238.6 keV; Tl-208 @ 583.1 keV and Ac-228 @ 911.1 keV. Individual measured peak results are incorporated into a final result using weighted averages of the net peak areas. The weight of each peak area is based on the peak area measurement uncertainty.

2. Sec B.2.2.3, p. B-5: This comment reiterates general comments 2 and 4 of Set 2, above. It centers on the uranium anomaly in Part B area 3 (sample PBC-03-01). The thrust is that poor comparability in this the most heterogeneous area study effectively disqualifies HPGe for quantitative work.

   Response. The comment is not fair. See responses to Reviewer Set 2 general comments 2 and 4, above.

3. Table D-5, p. D-14: The comment questions the relative values for various FRLs, expecting greater differences between FRLs for Cs-137 and Th-232.

   Response. The comment is not relevant to the comparability study. The FRLs were developed following EPA methodology and consider multiple pathways. The two nuclides mentioned are not directly comparable. Cs-137 is a gamma emitter while Th-232 is an alpha emitter.

Review Set 3 - General Comment

1. The data generated in Parts A and B of the study should be subjected to a more rigorous statistical analysis to gain better insight into the comparability of the methods and to have some definitive evaluation of the likelihood of false positive and false negative indications.

Response. We agree with the comment about calculating false negative and false positive error rates. We intend to use data from our Field Quality Control System (FCS) to establish system measurement uncertainties for each of the analytes. These system uncertainties can be used as the basis for calculating error rates relative to the FRLs. We regard the control chart standard deviations as initial standard deviations. As noted in Section 5, we are collecting data through the summer in order to take advantage of hot, dry conditions. When we establish final HPGe system measurement uncertainties, we will be able to calculate more realistic error rates.

With regard to the use of more rigorous statistics in the correlation section of the report (Section 3.3), note that in Appendix D we have included a statistical evaluation of the linear regressions using SYSTAT, a well-known, commercial statistics program. The evaluation included an Analysis of Variance (ANOVA), calculation of 95% prediction and confidence limits, an analysis of influence, and standard errors, T-statistics, and P-values for the calculated intercept and slope.

Wilcoxon Signed Rank Tests were performed. These calculations appear in Appendix G and follows the step by step process outlined in the National Bureau of Standards Handbook 91, entitled "Experimental Statistics," Chapter 16.

The general approach of this report has been to adopt existing criteria for quality control elements from SW-846 and CLP-SOW laboratory methods and demonstrate that HPGe data meet these criteria. While this approach is not inherently statistically rigorous, it is extremely practical and results in the establishment of quality control acceptance limits that are familiar to the regulatory agencies. Table 5-1 was added to the report, summarizing SW-846 and CLP-SOW criteria for accuracy and precision of metals, to help support justification for our statistics and quality control guidelines.

Review Set 3 - Specific Comments

1. Sec B.2.1-Part A, p B-1, line 27: Cites apparent inconsistencies in statements.

   Response. The two cited statements refer to different studies, so the statements are not inconsistent. Part A study sample locations were selected randomly within certification units, while Part B study areas were selected quite purposefully in order to assure a reasonable range of conditions.

2. Sec C.1.1: Points out additional variability introduced by the different sample sizes used by lab gamma spec (100s of grams) and alpha spec (1 gram).

   Response. The comment is quite valid. More importantly, perhaps, is that the comment calls attention to the vast difference in the scale of the samples analyzed by HPGe and laboratory methods. This matter of scale is at the heart of the comparability issue in any but the most homogeneous areas.

3. Sec C.1.1, p. C-2, lines 15-23: Paragraph should be revised.

   Response. Paragraph was revised, clarified.

4. Sec C.3: Reiterates general comment calling for more rigorous statistical analysis.

   Response. See response to Review Set 3 general comment.

5. Sec C.3, Table C-6 thru C-10: Asks that the direction (+ or -) of deviations be shown.

   Response. Agreed. The direction of deviations is shown in the tables.

6. Sec D.2: Same as comment 4.

   Response. See response to Review Set 3 general comment.

7. Sec E.2, p. E-2, line 22: The "mean bar" is missing in this equation:

   Response. The equation was corrected in the revised version.

8. Sec E.4, p. E-4, lines 13,14: Observes that, outwardly, laboratory gamma spectrometry would be expected to compare better to HPGe than would lab alpha, while the reverse was actually observed.

Response. The point is well taken. In general and for most analytes both laboratory methods agree well with HPGe. However, a distinct high bias seems be present in the lab gamma results. The root cause of this bias is being pursued with the involved laboratories.

9. Appendix E: References to concave and convex surfaces seem to have the meanings reversed. Also, importance of the radius of curvature and surface-to-detector distance need to explicitly discussed.

Response. The current usage of the terms concave and convex are correct. The dependence on the degree of curvature and associated effect on surface-to-detector distance would seem to be implied in the qualitative discussion. The purpose here is simply to acknowledge these effects and measures taken to minimize them.

10. Appendix E, eqn 3: Equation 3 is incomplete.

Response. Equation 3 has been corrected.

11. Appendix E, eqn 4: Equation 4 is incomplete.

Response. Equation 4 has been corrected.

12. Appendix E, Sec 2.1: Inconsistent statements on drying time and temperature.

Response. The inconsistent statements have been corrected.

13. Appendix E, Table E-2: The table lists gamma rays for radon progeny used to determine Ra-226. Concerns for radon disequilibrium are implied.

Response. The concern raised regarding determining Ra-226 from progeny of radon is well taken. Discussions of radon disequilibrium issues and corrections for application to the FEMP will be detailed in a future report when the evaluations have been completed.

A response to this disequilibrium issue with Radon-222 progeny being used to determine Ra-226 is provided in Appendix F (EML Study) of the Comparability Report. This issue was addressed by Peter Shebell of DOE-EML. He recognizes some general factors that contribute to a large part of the disequilibrium; the escape of Rn-222 from the soil disrupting equilibrium; precipitation scavenging of Rn-222 from the atmosphere; masking of disequilibrium effects between Ra-226 and its progeny Bi-214 and

Pb-214 by precipitation. Furthermore, Peter states that on average, disagreements between data due to disequilibrium effects range between 10-30% and that comparison of Fernald results yields data disagreements between 17-28% which falls within the expected range. Ultimately, it will be recommended that these data differences be managed by determining and applying appropriate correction factors and making measurements well after precipitation events.

Ohio EPA Comments (Geotrans)

1. The referenced sentence should be reworded as follows: "Contract Laboratory Program (CLP) statements of work and SW-846 guidelines for relative precision requirements for metals state that data are considered acceptable when the percent relative difference between duplicates is less than 20 percent for data that are five times the MDA. For data less than five times MDA, the precision requirements are ± MDA."

   Response: Agreed. The subject sentence has been reworded.

2. An explanation for why individual measurements are "out of control" should be provided (total uranium on 4/23 at 15:05, for example). Plots of relative humidity, air density, soil moisture, soil density, and air temperature measurements, coincident with the HPGe concentration data, should also be provided. All plots should be constructed with the same time scale for direct comparability.

   Response: Plots of humidity, temperature, and moisture are provided on the same scale. Some additional explanation has also been provided in the discussion to explain the individual "out of control" points.

3. All of the CUs investigated pass certification according to both laboratory based and HPGe data. This may simply be attributable to the low-level contamination CUs considered in the study that the laboratory methods rightly declare clean but HPGe is insensitive to. If this is the case, the study results are inconclusive regarding comparability of certification decisions based on the two methods. The study should be revised to include low-level contamination CUs that fail certification based on HPGe results with laboratory data verifying the failure.

   Response: As pointed out in comment response number 3 from set number 1 of U.S. EPA comments, getting certification data near the FRL decision points for Part A-type comparisons cannot be controlled; such results, if they occur, can only be examined in retrospect. The actual practice of remediation, particularly in the air plume, results in residual levels near background.

   Field methods, depending on the detector height, give average concentrations over areas of several square meters while discrete sampling methods give essentially point concentrations. For homogeneous distributions, both physical sample-based laboratory measurements and in-situ measurements yield mean values close to the true value. One key component of either laboratory or field-based gamma spectrometry is detector efficiency. Detector efficiencies increase when discrete measurements (whether they are physical samples analyzed in the laboratory or in-situ measurements performed in the field) are performed at higher concentrations, i.e above the respective FRL. As long as field methods give verifiably accurate results, e.g., by good agreement with representative discrete sampling and analysis (Part B study), then they should perform as well or better than the physical sample laboratory analysis in certification decisions.

4. It has been indicated in previous work plans that HPGe could be used for scanning areas that are hard to access because of irregular topography. The referenced text discusses the effects of varying topography on detector response. The topographic limitations of the HPGe detector should be presented in detail. Guidelines defining appropriate versus inappropriate conditions (such as grade) for use of HPGe should be discussed.

Response: As Tom Ontko points out, grade is probably limited more by tripod instability or worker safety than theory. Concave surfaces like ditches or gullies are biased high. Convex surfaces like mounds or high spots would be biased low. Both of these considerations are based on the geometry that the instrument "sees".

It is agreed that field procedures must specify terrain limitations.

5. The text indicates that the primary factors that impact detector response are soil density, soil moisture, relative homogeneity, and air density. The comparability study should present graphically detector response as a function of each of these parameters over their range of expected variability during deployment. In addition, the term "relative homogeneity" should be defined and a discussion of how this property is measured should be presented. Is it dependent on the relative grain size distribution, organic content, or other factors?

Response: Again, as Tom Ontko points out, we discussed some of these issues in the real-time work group meetings. Copies of the reference materials prepared by Kevin Miller can be provided which illustrate, graphically, detector response as a function of some parameters. We agree that plots of detector response as a function of soil moisture should be developed for the FEMP. Plotting detector response as a function of soil density would be considerably more difficult with a minimum of two variables: soil density and uranium concentration. Soil density and air density do not vary as much as soil moisture. They are not critical to the measurements.

6. The indicated "temperature instability for field radiological systems" of "<50 ppm/°C" is potentially a significant amount of instability. Please clarify the sensitivity of HPGe to temperature variations and discuss the linearity of this sensitivity.

Response: Additional discussions were provided in Section 5 (pages 5-10 and 5-11) to discuss the influences of temperature variations.

Ohio Department of Health Comments

1. For HPGe, the necessity to test out to higher known Uranium concentrations (1000 ppm and greater) to determine if linearity exists at these contaminant levels for potential WAC use for the OSDF.

Response: Agree. Also, see comment response to U.S. EPA comment number 3 of Review Set number 1.

2. Status of the development and supporting technical justification of a site-specific radon emanation correction factor as proposed for use in inferring radium-226 concentrations from progeny. Alternately, plans for resolving how this COC is to be quantified should be developed in parallel as the former appears difficult to achieve within the constraints of OSDF construction deadlines.

Response: It is agreed that additional efforts are necessary to address the apparent radium-226 disequilibrium which exists in the environment.

3. The need to reach consensus on gamma intensity values as used by all parties involved in the analysis.

Response: Agreed.

4. It is not clear what the assumptions are from the recommendations of the BIPM Working Group on Uncertainties for adopting bands of ± 20% as the limit for demonstrating comparability. It seems this value is composed of systematic and random error.

Response: The + or - 20% uncertainty bands include both systematic (bias) and random errors. It is not clear to DOE who the "BIPM" work group is and what their role is. Additional discussions are needed.

5. Several equations in Appendix E are missing in the text of the Comparability Study. See pages E-2, 6, and 7.

Response: Additional equations have been incorporated into the revised report.

6. Independent measurement of gamma dose rate in air at measurement sites with a PIC can be performed and then compared to the summed contribution from nuclides in soil as calculated by the HPGe software. This would serve as another quality control check and should be considered.

Response: The FEMP uses the Bicron Micro Rem survey meter with the extended range option to measure the radiation exposure rate in the environment for a reference HPGe measurements. The purpose of measuring exposure rates in the field is to detect radiological interferences which may affect the HPGe spectral results. Interferences may include shine from thorium and/or uranium storage buildings, direct or indirect radiation from moisture/density gauge operations, field use check sources and others.

The low range of the meter is 0 to 20 microrem/hour. The energy response range is from 17 keV to 1.3 meV. The survey meter uses a tissue equivalent, organic scintillation detector. The low end response capabilities enables the meter to detect at environmental levels. A study has not been performed to equate microrem meter response to HPGe results in the soil. However, field survey results indicate a potential for this application. Levels of 50 to 100 ppm total uranium will give a difference in the meter response. The meter may not be able to distinguish the difference of 10 ppm in the soil. A qualifier to this correlation would be that any external interferences will be displayed in both the meter and in the HPGe units.