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OPERABLE UNIT 4 DRAFT FINAL REMEDIAL INVESTIGATION/BASELINE RISK ASSESSMENT REPORT

08/20/93

DOE-FN/EPA
RESPONSES
OU4

4697

Department of Energy
Fernald Environmental Management Project
P.O. Box 398705
Cincinnati, Ohio 45239-8705
(513) 738-6357

AUG 20 1993

DOE-2789-93

Mr. James A. Saric, Remedial Project Manager
U.S. Environmental Protection Agency
Region V - 5HRE-8J
77 W. Jackson Boulevard
Chicago, Illinois 60604-3590

Mr. Graham E. Mitchell, Project Manager
Southwest District Office
Ohio Environmental Protection Agency
Dayton, Ohio 45402-2086

Dear Mr. Saric and Mr. Mitchell:

OPERABLE UNIT 4 DRAFT FINAL REMEDIAL INVESTIGATION/BASELINE RISK ASSESSMENT REPORT

Attached for your review and approval is the Operable Unit (OU) 4 Draft Final Remedial Investigation (RI)/Baseline Risk Assessment (BRA) Report. Also attached are minor revisions to the Comment Response Document that was submitted for your review on August 12, 1993.

As you are aware FERMCO assumed contractual responsibility for the preparation of the RI Report in December 1992. As part of the transition process, FERMCO has assembled a data validation organization to perform, in cooperation with Ebasco as a support subcontractor, data validation on all FEMP generated data. In April 1993 FERMCO completed a peer review of the criteria being employed by the FEMP for radiochemical data validation. As a result of this review, FERMCO identified several issues regarding the logic behind the validation criteria for radiochemical data. These issues stemmed from apparent inconsistencies between the existing validation criteria and comparable EPA validation criteria. FERMCO implemented revisions to the validation criteria to address these inconsistencies (reference attachment 3).

FERMCO performed a peer review of the Operable Unit 4 data set as presented in the draft RI Report. This review was completed in July 1993 utilizing the revised validation criteria discussed in attachment 3. The results of this peer review resulted in the requalification of a number of results. The net effect of this process was the increase in the number of results for Operable Unit 4 considered useable, and no longer rejected. This increase in useable data has resulted in revisions to the summary statistics presented in Chapter 4 and Appendix D of the draft Final RI Report. These qualifier changes are

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reflected in the attached revised report. These changes have not affected the overall conclusions reached in the report. These revisions have, in some cases, resulted in higher concentrations for some constituents but did not change the number and types of constituents to be quantitatively evaluated in the Baseline Risk Assessment (BRA) for OU4.

If you or your staff have questions, please contact Randi Allen at (513) 648-3102.

Sincerely,

Johnny Reising

for Jack R. Craig
Fernald Remedial Action
Project Manager

FN:Allen

Attachments: As Stated

cc w/att:

K. A. Chaney, EM-424, TREV
D. R. Kozlowski, EM-424 TREV
G. Jablonowski, USEPA-V, AT-18J
P. VanLeeuwan, USEPA-V
J. Kwasniewski, OEPA-Columbus
P. Harris, OEPA-Dayton
M. Proffitt, OEPA-Dayton
T. Schneider, OEPA-Dayton
J. Michaels, PRC
L. August, GeoTrans
K. L. Alkema, FERMCO
P. F. Clay, FERMCO/19
F. Bell, ATSDR
AR Coordinator, FERMCO

cc w/o att:

R. L. Glenn, Parsons
J. W. Thiesing, FERMCO/2

ATTACHMENT 2

CHANGE PAGES FOR COMMENT RESPONSE DOCUMENT

considered making data gaps and deficiencies of much greater concern. This should be addressed.

Response: Consistent with the discussion presented in Chapter 1 of the RI and the approved ISA Report for Operable Unit 4, non-removal alternatives are being considered in the FS for the residues within Silos 1, 2, and 3. While these alternatives are not precluded at this time, current evaluations being performed under the FS show these alternatives not to be viable.

Action: None.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 7 Pg. #: NA Line #: NA Code:
Original General Comment #13

Comment: Section 7 should contain a table listing preliminary remediation goals (PRG) for the chemicals of potential concern (CPC). The levels of contamination in each medium should then be compared to the PRGs. It is not clear whether action is needed for all media, including surface soil, subsurface soil, perched groundwater, silos and contents, decant sump tank or radon treatment system units. This section could be greatly improved with the addition of specific remedial action objectives (RAO) per RI/FS guidance for each medium, CPC, and PRG. The RAOs are too general to be useful.

Response: The preliminary remediation goals (PRGs) will be presented and fully discussed in the Operable Unit 4 Feasibility Study. Remedial action objectives (RAOs) for each medium and the Remedial Alternatives put forth to achieve these objectives will also be fully presented and discussed in the FS.

Action: Section 7-6 was revised to present a brief summary of specific RAOs for the affected media material. The developmental process for PRGs will also be briefly summarized in this section.

these reasons that DOE feels the sample results do not represent a hot spot within the berm soils.

Action: Text will be revised to include the above discussion.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 4-28 Pg. #: 4-71 Line #: NA Code:
Original Specific Comment #46
Comment: Table 4-28 summarizes the inorganic results of the berm soils analyses. The data and corresponding text should be presented in terms of depth (instead of mean) so that any trends can be evaluated.

Response: An additional table will be included that presents the data by sample depth to facilitate evaluation of trends in the distribution of contaminants. Appendix B presents data by depth. Since most constituents were at background levels, trends are not readily apparent.

Action: None required.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.2.3.1 Pg. #: 4-76 Line #: 14-16 Code:
Original Specific Comment #47
Comment: The text states that radiological concentrations significantly above background were detected in slant borings 1615 and 1616. This is misleading. Significant (above background) contamination was seen in all slant borings. This discrepancy should be addressed.

Response: Agree.

Action: Text in Section 4.2.3.1 (page 4-76, lines 14 & 16) will be revised to read "Although concentrations significantly greater than background for these constituents were detected in samples collected from all slant borings, slant borings 1615 and 1616 have relatively higher concentrations of certain radionuclides than those in the other borings.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.2.3.1 Pg. #: 4-83 Line #: 12-13 Code:
Original Specific Comment #48
Comment: This sentence lists the inorganics that were detected above background concentrations in the slant borings. Copper, cyanide, and sodium should be added to this list.

Response: Agree.

Action: Copper, cyanide, and sodium will be added to the text in Section 4.2.3.1 (page 4-83, line 12). These inorganics will also be added to text in Section 7 (page 7-8, lines 14 and 15).

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.3.1.1 Pg. #: 4-93 to 4-96 Line #: NA Code:
Original Specific Comment #51

Comment: This section describes several distinct perched water zones encountered in the slant borings. Accurate cross sections depicting the subsurface hydrogeology in the silo area should be prepared to aid the reader in data interpretation. The cross sections provided in Section 3 do not indicate two distinct water bearing zones in the glacial overburden.

Response: DOE did not mean for the text to imply that there are multiple distinct and separate perched groundwater zones in the glacial overburden beneath the silos. The glacial overburden in the OU 4 Study Area comprises low permeability clay, overlain by a laterally continuous silty clayey sand, in turn overlain by clay and/or loess. The silty clayey sand is conceptualized as a continuous unit with relatively little horizontal or vertical variation in hydraulic conductivity. However, the silty clayey unit does contain scattered and discontinuous thin lenses of clay. During drilling of the slant borings, the low drilling angle created a false illusion of separate water bearing zones. In some cases, a groundwater sample would be collected because water had collected in the open boring. Subsequently, the boring would be advanced through a thin non-water-bearing low permeability lense (note that a 5-inch-thick clay lense would be 57 inches of core in a 5-degree slant boring) and then into an apparent second water yielding zone. Multiple samples were collected in slant boring 1616 because of a scenario similar to that outlined above. Despite the presence of a number of small discontinuous low permeability lenses in the clayey silty sand unit, DOE believes that the unit is a distinct hydrogeologic unit that is best conceptualized as one large perched groundwater zone.

Action: DOE will review and edit discussions of the multiple groundwater samples collected in slant boring 1616 to ensure that the text does not imply that there are multiple distinct perched groundwater zones.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 4.3.1.1 Pg. #: 4-96 Line #: 9 Code:
Original Specific Comment #52

Comment: The text indicates that borings 1617 and 1618 encountered perched groundwater below Silo 1. Boring 1617 did not. This discrepancy should be addressed.

Response: The use of the term "below" appears to be the issue since perched groundwater was encountered by Boring 11617 at an elevation lower than the bottom of Silo 1 but offset by 24 feet from the vertical projection of Silo 1. This imprecise term should be replaced.

Action: Change "below" to "near" in line 9 on page 4-96.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: Table 4-39 Pg. #: 4-98 Line #: NA Code:

Comment: Table 5-5 presents results which indicate the maximum uranium concentration in the GMA at the FEMP boundary is about 10 μg/L; Figure 5-32 indicates the maximum uranium concentration at the FEMP boundary is about 1 μg/L. Figure 5-6 and should be checked for accuracy.

Response: Disagree. Table 5-5 and Figure 5-6 present the modeling results for two different situations. Table 5-5 presents vadose zone modeling results concerning constituents of concern that will reach the aquifer in 1000 years from Silos 1 and 2. Figure 5-6 presents the modeling results for groundwater beneath the FEMP after 400 years due to loading from Silos 1 and 2. The concentrations presented in this figure account for many different factors including but not limited to dilution by groundwater. As a result, the concentration contours in Figure 5-6, (groundwater) are not expected to match the concentrations presented in Table 5-5 for the vadose zone.

Action: No action required.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: 7.3.4 Pg. #: 7-9 Line #: 8 Code:
Original Specific Comment #62

Comment: The RI report states that perched groundwater with U-238 contamination in the range of 69 to 77 pCi/L is present under the silos. However, Section 4.3.1.1 presents data indicating much higher levels of uranium contamination in the perched groundwater in the OU4 area. Section 7.3.4 should be changed to be consistent with data presented earlier.

Response: DOE agrees.

Action: The range of U-238 will be changed to read 1.1 to 1313 pCi/l.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.4.1 Pg. #: D-4-6 through D-4-9 Line #: NA Code:
Original Specific Comment #58

Comment: Because only unit risks were provided for arsenic and methylene chloride in the referenced documents, the methods used to convert unit risks to inhalation cancer slope factors in Table D.4-2 should be explained.

Response: Agreed that the justification and rationale for converting an inhalation unit risk to the mathematical equivalent of an inhalation cancer slope factor should be added.

Action: The following was added to page D-4-1, line 28: "Inhalation cancer toxicity values are usually expressed as inhalation unit risks in units of reciprocal $\mu g/m^3$ ($1/\mu g/m^3$). Because cancer risk characterization requires an estimate of reciprocal dose in units of 1/mg/kg-day, the inhalation unit risk must be converted to the mathematical equivalent of an inhalation cancer slope factor, or risk per unit dose (mg/kg-day). This is done by assuming humans weigh 70 kg and inhale 20 m^3 of air/day, i.e., the inhalation unit risk ($1/\mu g/m^3$) divided by 20 m^3/day, multiplied by 70 kg and multiplied by 1000 μg/mg yields the mathematical equivalent of an inhalation slope factor (1/mg/kg-day)." In addition, a footnote was added to the table explaining the origin of the inhalation cancer slope factor.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.4.1 Pg. #: D-4-7 Line#: NA Code:
Original Specific Comment #59

Comment: The reference in Table D.4-2 is incorrectly footnoted as Health Effects Assessment Summary Table (HEAST) ("e"). The correct reference is IRIS; therefore, the footnote should be changed to "d" to indicate IRIS.

Response: It is unclear for which chemical(s) the reviewer noted that the reference was incorrect.

Action: All the toxicity values in Table D.4-1 and D.4-2 were updated and all references were checked.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.4.1 Pg. #: D-4-10 Line #: NA Code:
Original Specific Comment #60

Comment: Table D.4-3 should include a footnote indicating the reference used to prepare the table.

Response: Agree.

Action: The appropriate references to HEAST will be added as a footnote to Table D.4-3.

Comment: These lines state that most model parameter values used in modeling efforts maximize estimates of transport (and hence risk). This discussion should be revised to give some examples of such parameters.

Response: Agree.

Action: Modeling parameters that tend to maximize risk, such as the low uranium 1.8 ml/g K_d, will be discussed in Section D.6.2.1.2.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.6.4 Pg. #: D-6-7 Line #: NA Code:
Original Specific Comment #92
Comment: All of the specific examples of OU4 uncertainties discussed in this section should also appear in Table D.6-1. Some examples, such as soil-to-plant transfer factors (B_{iv}) do not appear in this table.

Response: Agreed.

Action: The following examples of uncertainty were added to Table D.6-1: Continuous location of the receptor at the point of highest concentration; Heterogeneity of waste form; Assumption that UCL concentration is uniformly distributed in the mass of contaminated medium; Development of the leachate source term; Selection of exposure parameters

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.6.4 Pg. #: D-6-8 Line #: NA Code:
Original Specific Comment #93
Comment: The specific uncertainties presented in Table D.6-1 should be grouped by the general source of the uncertainty (exposure assessment, toxicity assessment, and risk characterization).

Response: Agreed, the entries in Table D.6-1 should be grouped by category and should follow the organization of the text.

Action: The entries in Table D.6-1 were grouped by category and arranged according to the organization of the text.

Commenting Organization: U.S. EPA Commentor: Saric
Section #: D.6.4 Pg. #: D-6-10 Line #: 29 Code:
Original Specific Comment #94
Comment: This line refers to Version 6.0 of the U.S. EPA UBK model used to estimate blood lead levels. This sentence should be revised to include a reference for this model.

Response: The reviewer noted that a reference was not provided for version 0.5 of the EPA UBK model.

Action: The requested reference was provided (EPA, 1990d, 1991e).

ingestion pathways, and footnote "e", when expanded to indicate the February 25, 1993 teleconference between Mike Bollenbacher, IT, and Pat Van Leeuwen, U.S. EPA Region V, was found to be the correct citation for the incidental ingestion of soil pathway. Agreed, that footnote "j" is confusing because of reference to specific sections, pages and tables of the 1992 Dermal Guidance document. When footnote "j" is clarified, footnote "m" is no longer needed.

Action: The names of the RME On-property Resident Farmer and the CT On-property Resident Farmer were made consistent throughout the document. The soil ingestion rate (g/day) for the RME On-property Farmer was estimated as the reviewer suggested: 0.48 g/day for 50 years of occupational exposure, 0.2 g/day for 6 years as a child, and 0.1 g/day for the remaining 14 years. The time-weighted average, 0.18 g/day, was used as the average soil ingestion rate. Citation of records of the teleconferences between Mike Bollenbacher, IT, and Pat Van Leeuwen, U.S. EPA Region V were included in the appropriate footnotes. Footnotes "d" and "e" were expanded to include references to the specific IT-U.S. EPA Region V teleconferences during which the indicated parameter values were decided. All the exposure parameters attributed to the 1992 Dermal Guidance document were checked and found to be correct; the reference in the footnote was simplified to eliminate reference to table, section, and page number. With the simplification of footnote "j", footnote "m" is no longer needed and was removed.

Commenting Organization: U.S. EPA Commentor: PVL
Section #: D.3 Pg. #: D-3-54 Line #: 2 Code:
Original Comment #2.
Comment: "Decimally absorbed dose" is not the correct meaning for DAD; the correct term here is "dermally absorbed dose."

Response: Agreed.

Action: "Decimally absorbed dose" was changed to "dermally absorbed dose."

ECAO showed that absorption of barium salts from drinking water followed the order of chloride > sulfate > carbonate. A study not reviewed by ECAO showed that the bioavailability of orally administered barium chloride was equivalent to that of barium chloride in Brazil nuts to young rats (Lisk et al., Nutrition Reports International, 38: 259-262). Other animal studies reviewed by ECAO yielded GI absorption efficiencies of ~ 10% and 85%. The higher value was obtained with younger animals. Age appears to be a very critical factor in determining the efficiency of GI absorption of barium. Another literature review reported GI absorption efficiencies of barium from barium chloride in hamsters ranging from 11 to 32% (Friberg et al., 1986, Handbook on the Toxicology of Metals, Volume II). Of particular interest in this review is the observation that addition of sodium alginate to the diet of rats greatly enhanced barium absorption. Sodium alginate probably formed organic complexes with barium that facilitated GI absorption. Generally, chemical form is more important than animal species in evaluating pharmacokinetics. This is particularly true if the species compared are both mammals (with the exception of comparing monogastric animals and ruminants), and if the chemical in question is an inorganic element (such as barium) that is not subject to species differences in biotransformation. The ATSDR profile on barium reported GI absorption values in humans of ~ 5% and in adult animals of ~ 7%. The human value of 5% was based on a paper by Tipton et al., 1969 (Health Physics 16: 455-462), which identified 5% absorption from the GI tract as a maximum figure for net retention of dietary barium in natural foodstuffs, evaluated over a 50-week period. ATSDR noted that the barium GAF for young animals is about 10-fold greater than that for adults. This is consistent with the ECAO review. The best study of barium absorption is the paper by Tipton et al., because the study evaluated net retention of barium chloride in adult humans over a 50-week period. The human study by Lisk et al. was based on a single dose with a form of barium probably quite different from that used in the study from which the RfD was derived. Although other values may be defensible, the value of 100% absorption will be used.

Action: Recalculate risks using 91% absorption for barium.

Commenting Organization: U.S. EPA Commentor: PVL
Section #: D.5 Pg. #: D.5-2 Section: D.5.2.1 Code:
Original Comment #1.

Comment: This discussion is misleading. Actually EPA specifies the use of the linearized multistage model at low risk levels; when chemical intakes are high and risk levels exceed 0.01, the one-hit model is used instead.

Response: The text is revised to clarify the fact that the EPA specifies the one-hit model instead of the slope factor model when the carcinogenic risk using the slope factor exceeds 0.01.

Action: Revise line 30 on Page D-5-2 to read: "When carcinogenic risk exceeds 1×10^{-2} using the slope factor methodology U.S. EPA (1989) specifies the one-hit equation."

Attachment 3: Revisions to Validation Criteria

1) Rejection of Radiochemical Data When Quality Control Information From the Laboratory Was Incomplete:

The criteria previously employed required rejection of all associated data in the instance this quality control information was lacking. Consistent with the standard application of the National Functional Guidelines For Data Validation for comparable analyses, it was determined that such samples should not be rejected, but considered either estimated (J) or, where there is doubt as to the qualitative presence of a radionuclide, qualified as tentative (N).

2) Assignment of U Qualifier for Non-Detected Radionuclides:

A standard component of EPA functional guidelines is the assignment of the U qualifier for non-detected analytes. FERMCO implemented the usage of this qualifier for all non-detected radionuclides, instead of the previously employed "<".

3) Utilization of Laboratory Control Spike and Sample Matrix Spike Recovery For the Qualification of Data:

Utilization of this type data provides additional information as to the method performance in terms of specific radionuclide isolation/efficiency, as well as overall instrument performance. The examination of this information allows a more informed decision on the part of the validator, when used in conjunction with other QC data, on the proper assignment of qualifiers. This information was previously not taken into consideration during the validation of radiochemical data.

4) Standardization of Definition and Application of Qualifier Codes:

FERMCO implemented the application of standard qualifier codes to radiochemical data in accordance with EPA functional guidelines (U,J,N,R). Usage of these codes ensure consistency in the application, use and interpretation of the qualified results. Previously, usage of these codes was not consistent with the functional guideline definitions.

5) Effect of Multiple "J" Codes on Data:

Previous validation criteria called for the rejection of a data point if their were three or more causes for the application of the "J" qualifier signifying estimation or imprecision of the data point. FERMCO rejected this logic and adopted the position that the data point would be considered estimated and imprecise for multiple QC deficiencies. This revised logic is consistent with the functional guidelines. Attached to these criteria is the radiochemistry data validation checklist employed to evaluate the Operable Unit 4 data set. This checklist reflects the revisions discussed above and is consistent with the National Functional Guidelines for Data Validation for comparable analyses (organics and inorganics).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST

Release Number_____
Project _____
Sample Numbers_____
_____
Analytical Support Level_____

1.1 GENERAL PACKAGE REVIEW	YES	NO	NA
NOTE: [ ] is the desired response for the following checklist.			
NOTE: In any of the following steps, if required information is missing a "Request for Additional Information/Resubmittal" should be submitted before the action to qualify the data is initiated.			
1.1.1 Has a QC Review Checklist and Field Data Validation Summary been completed for every sample?	[ ]	__	__
ACTION: If no, note on Request for Additional Information/ Resubmittal Form.			
ACTION: If no, review Field Data Validation Summary and use professional judgement in qualifying any data. All field data validation discrepancies will be addressed and justified in Comments section. The reviewer shall review the Field Data Validation Checklist and the Data Validation Plan in the SCQ if problems are identified.			
1.1.2 Were any transcription errors discovered?	__	[ ]	__
NOTE: This question cannot be employed until review/validation is completed.			
ACTION: If yes, note on the Request for Additional Information/Resubmittal form.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
1.1.3 Was a method reference listed for each analysis?	[ ]	—	—
ACTION: If no, note on the Request for Additional Information/Resubmittal Form.			
1.1.4 Are the Offsite COC Transfer Records (OCTR) present for all samples?	[ ]	—	—
ACTION: If no, note on Request for Additional Information/ Resubmittal Form.			
1.1.5 Do the OCTR or Lab Narrative indicate any problems with sample receipt, condition of samples, analytical problems or special circumstances affecting the quality of the data?	—	[ ]	—
ACTION: Use professional judgement to evaluate the effect on the quality of the data.			
2.1 Initial and Continuing Calibration			
2.1.1 Is initial calibration data present for each technique (i.e., Gamma Spectrometer) for each detector system used in the analyses?	[ ]	—	—
NOTE: Routine (e.g., annual) initial calibrations may not be necessary if the continuing calibrations demonstrate that the energy, efficiency, and resolution (as appropriate) have remained within the control limits.			
ACTION: If initial calibration data is missing or count data cannot be verified, qualify all associated results as unusable (R).			
2.1.2 Were NIST, NIST-traceable, or equivalent, certified standards used for calibration?	[ ]	—	—

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
ACTION: If the standards used for calibration are not certified or traceable, or cannot be positively identified, qualify all associated data as unusable (R).			
2.1.3 Did the standards used for calibration have sufficient activity, i.e., did each peak, window, or energy region of interest used in the efficiency calibration have at least 800 net counts and/or was the reported error for each calibration peak, window, or energy region of interest less than or equal to 10%?	[ ]	___	___
ACTION: If the standards used for calibration did not provide sufficient activity, qualify all associated data as unusable (R).			
2.1.4 Were the standards for calibration used within their expiration dates?	[ ]	___	___
ACTION: If the standards used for calibration have missed their expiration date by more than six months and associated QCs (LCS, spikes, tracers) were not within acceptable limits, qualify associated data as unusable (R). If QC results are acceptable, qualify the data as estimated (J).			
2.1.5 Are the geometry (i.e. petri dish, beaker, etc.) and the matrices of standards used for calibration similar to those used for analysis of samples?	[ ]	___	___
ACTION: If both geometry and matrix match between samples and standards are radically different, qualify all associated results as unusable (R).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
ACTION: If geometry match is acceptable and matrices are dissimilar, but associated QCs (LCS, spikes, tracers) are acceptable, then no qualification of associated data is required.			
ACTION: If geometry match is unacceptable and matrix matches acceptable, associated data should be qualified unusable (R).			
2.1.6 Was a check source counted daily or before each batch (whichever is more frequent)?	[ ]	___	___
ACTION: If no check source was counted on the same day or just before analysis of samples and QCs (LCS, spikes, tracers) are unacceptable, then qualify associated data as unusable (R).			
ACTION: If check source analysis frequency is outside the acceptable range, but the QCs (LCS, spikes, tracers) are acceptable, qualify the data as estimated (J).			
2.1.7 Was the result of the check source counts within established limits?	[ ]	___	___
NOTE: The check source counts shall be within the control limits provided by the laboratory but no greater than plus or minus 3 standard deviations of the mean.			
ACTION: If check source counts are confirmed to be outside of acceptable range for both original and subsequent recounts, qualify all associated data as unusable (R).			

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	YES	NO	NA
ACTION: If original check source count was outside acceptable range, but at least one additional recount was within acceptable range and QCs are acceptable, do not qualify any associated data.			
ACTION: If original check source was outside acceptable range, but at least one additional recount was within acceptable range and QCs were not acceptable, qualify associated data as estimated (J).			
2.1.8 Was the check source identified by activity and radionuclide(s)?	[ ]	—	—
NOTE: Activity may be the certified activity in dpm, uCi, or other unit provided by the vendor, or a laboratory established mean value.			
ACTION: If the activity and identity of the radionuclide(s) used in the check source(s) cannot be obtained, qualify all associated data as unusable (R).			
2.1.9 Were background counts performed?	[ ]	—	—
ACTION: If no background count information can be obtained, but method blank is available and acceptable, qualify associated data as estimated (J).			
ACTION: If no background count information can be obtained and there is no method blank or unacceptable method blank count, qualify associated data as unusable (R).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.10	Were background counts done for reasonable time, at a reasonable frequency, and were the counts obtained within acceptable ranges?	[ ]	___	___

NOTE: The length of the background checks varies with techniques utilized. Generally, solid state alpha detectors should be counted for relatively long times (i.e., > 24 hours) while proportional alpha/beta counters may suffice with less than one hour counts.

NOTE: The frequency of background checks varies with techniques utilized. The following should be used as counter guidelines:

- alpha/beta proportional-daily or before batch, whichever is less frequent
- liquid scintillation-daily or before batch, whichever is less frequent
- gamma spectrometers-minimum of weekly
- alpha solid state detectors-minimum of weekly

NOTE: The background counts shall be within the control limits provided by the laboratory but no greater than ±3 standard deviations (or normalized deviations) of the mean.

ACTION: Using professional judgement, qualify associated data as estimated (J) if significant problem(s) were found with either count times, frequency, and/or counts obtained, but there is an associated/acceptable method blank.

ACTION: Using professional judgement, qualify associated data as unusable (R) if significant problem(s) were found with either count times, frequency, and/or counts obtained and there is no associated/acceptable method blank.

2.1.11 Supplemental Calibration Requirements for Gas Proportional Counters

NOTE: The analytical methods for strontium-90 radium-228 typically require the use of self-absorption curves, which are developed specifically for each radionuclide.

NOTE: The validator must use professional judgement for calibrations that involve banks of detectors (i.e. assemblies of detectors that may use averaged parameters, rather than single detectors or detector systems. In this document a detector system is intended to mean the single detector and be associated electronics, which may be part of an assembly of such systems but calibrated as a unit.

RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.11.1	Do self-absorption curves exist for each radionuclide determined?	[ ]	___	___
	NOTE: Although considered a part of calibration, self-absorption curves are validated and results qualified during the review of yields, Section 5.1.			
	ACTION: If self-absorption curves do not exist for each radionuclide determined, qualify all associated results as unusable (R).			
2.1.11.2	Are the data for the beta plateau determination present for each detector or detector system?	[ ]	___	___
	ACTION: Qualify all associated results as unusable (R) if the plateau data do not exist.			
2.1.11.3	Does the beta plateau for each detector or detector system extend a minimum of 300-400 volts and has a slope less than 8%?	[ ]	___	___
	ACTION: If voltage/slope requirements are not met and associated QCs are acceptable, qualify associated data as estimated (J).			
	ACTION: If voltage/slope requirements are not met and associated QCs are not acceptable, qualify associated data as unusable (R).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.11.4	Was the beta efficiency (for a beta Emax approximately the same energy as the one(s) of interest) for the initial calibration for each detector or detector system greater than 20%?	[ ]	___	___
	ACTION: If beta efficiency is less than 20% and associated QCs are acceptable, qualify associated data as estimated (J).			
	ACTION: If beta efficiency is less than 20% and associated QCs are unacceptable, qualify associated data as unusable (R).			
2.1.11.5	If the sample results were not corrected for crosstalk, was the crosstalk factor (beta counts that end up in the alpha window) for the initial calibration for each detector or detector system less than 5%?	[ ]	___	___
	ACTION: Qualify all associated results as estimated (J) if the crosstalk is greater than 5%.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

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		YES	NO	NA
2.1.11.6	Was a check source counted daily or were chi square tests performed to demonstrate continuing calibration for each detector or detector system?	[ ]	—	—
	ACTION: If the daily check source or routine chi square test is not performed, qualify all associated results as estimated (J).			
2.1.11.7	Did the check source counts remain within 3 standard deviations (or normalized deviations) from the established mean or did results from the chi square test have a probability between 0.10 and 0.90?	[ ]	—	—
	NOTE: The probability values are taken from standard references (e.g., Knoll, Radiation Detection and Measurement, 1979).			
	ACTION: Qualify all associated results as estimated (J) if the check source counts (or chi square test results) are beyond the control limits or 3 standard deviations (or 0.10 and 0.90 probability).			
2.1.11.8	Were stability checks (e.g., single point plateau checks) made after each gas bottle change?	[ ]	—	—
	ACTION: Qualify all associated results as estimated (J) if the stability checks were not performed.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.12	Supplemental Calibration Requirements for Alpha Spectrometry Analyses			
	NOTE: The variation of detection efficiency of solid state alpha spectrometry detectors, as a function of energy, is sufficiently constant that a single mixed nuclide (i.e. U-233/U-235/U-238, or Pu-238/Pu-239/Pu-230) efficiency calibration is usually sufficient.			
2.1.12.1	Was a nominal value of 90 keV FWHM obtained for resolution for the detector system?	[ ]	—	—
	ACTION: If the resolution of the system is greater than 90 keV FWHM, qualify all results as estimated (J).			
2.1.12.2	Could accurate identification of the peak centroid be made for each of the peaks used for the calibration?	[ ]	—	—
	NOTE: A minimum of 3 peaks covering an energy span of at least 1 MeV should be utilized to determine efficiency calibration of alpha spectrometry.			
	ACTION: If the centroids of the peaks used for calibration cannot be determined from the initial calibration, qualify all results as unusable (R).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 4697

		YES	NO	NA
2.1.12.3	Did the check source counts for the detector and analysis date in question fall within the control limits or 3 standard deviations from the established mean?	[ ]	___	___
	ACTION: If the check source count for the date in question exceeds the control limits or established mean by 3 standard deviations and associated QCs are acceptable, qualify associated data as estimated (J).			
	ACTION: If the check source count for the date in question exceeds the control limits or established mean by 3 standard deviations and associated QCs are not acceptable, qualify associated data as usuable (R).			
2.1.12.4	Did the efficiency obtained from the check source counts for the detector and analysis date in question fall within 5% of the initial calibration efficiency OR within the control limits or 3 standard deviations from the established mean of check source efficiencies?	[ ]	___	___
	ACTION: If the check source efficiency for the date in question exceeds stated criteria limits and associated QCs are acceptable, qualify associated data as estimated (J).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
	ACTION: If the check source efficiency for the date in question exceeds stated criteria limits and associated QCs are unacceptable, qualify associated data as unusable (R).			
2.1.13	Supplemental Calibration Requirements for Gamma Spectrometry Analyses			
	NOTE: The review of the geometry and matrix factors is contained in step 2.1.5.			
2.1.13.1	Did the calculated efficiencies form a smooth curve that increased slightly, peaked before 200 keV, and then decreased with energy?	[ ]	—	—
	NOTE: Some Ge detectors (e.g., those with a Be window or N-type) will show a flatter response at the low energies than other detectors.			
	ACTION: If the efficiency calibration does not approximate a smooth curve that rises, peaks, (or plateaus for N-type), and falls with energy, then qualify all results as unusable (R).			
2.1.13.2	Was the reported error for each calibration peak less than or equal to 5%?	[ ]	—	—
	NOTE: This reported error should be part of ID report and error result is outputted by software. If not available then request lab to submit data.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
	ACTION: If the reported % error for the peak is greater than 5%, qualify the associated results as estimated (J).			
2.1.13.3	Was the detector system deadtime less than or equal to 20% for the efficiency and energy calibration(s)?	[ ]	___	___
	ACTION: Qualify all sample results as unusable (R) if the printouts show a deadtime greater than 20%.			
2.1.13.4	Did an independent computation of the detection efficiency for one of the peaks used in the calibration result in a number which is ± 15% of the efficiency calculated by the gamma spectrometry software?	[ ]	___	___
	NOTE: Correct for decay from the standard's assay date to the counting date, if necessary.			
	ACTION: If the recalculation of efficiency varies by more than 15% from software calculated value, qualify all associated sample results as unusable (R).			
2.1.13.5	Did the peaks used for the energy calibration(s) cover the range of interest, i.e., 0-2 MeV?	[ ]	___	___
	NOTE: Typically the low energy end of the calibration is 0.088 MeV and the high energy end is 1.836 MeV.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
	ACTION: If the energies of the gamma emitters in the samples fall outside the calibrated range but QCs meet acceptable criteria, qualify associated data as estimated (J).			
	ACTION: If the energies of the gamma emitters in the samples fall outside the calibrated ranges and QCs did not meet acceptable criteria, qualify associated data as unusable (R).			
2.1.13.6	Was the resolution of the peaks used for the calibration acceptable, i.e., could accurate identification of the peak centroid be made, and were the peaks distinct and separate from each other?	[ ]	—	—
	NOTE: A maximum value of 5 keV FWHM is used to gauge resolution.			
	ACTION: If the resolution of the system is greater than 5 keV FWHM for any of the peaks used for calibration, qualify all results as unusable (R).			

RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.13.7	Was the energy calibration checked each day of operation or before each batch, whichever is more frequent.	[ ]	___	___

NOTE: The energy calibration check may be combined with the daily check source count identified in step 2.1.6.

ACTION: If the energy calibration is not checked at proper frequency but associated QCs are within acceptable ranges, then qualify associated data as estimated (J).

ACTION: If the energy calibration is not checked at proper frequency and associated QCs are not within acceptable ranges, then qualify associated data as unuseable (R).

2.1.14 Supplemental Calibration Requirements for the Analysis of Radium-226 by Scintillation

NOTE(S): 1-A counting system consists of a scintillation cell and associated photomultiplier tube, electronics and scaler, which should be calibrated as a unit.

2-The calibration constant includes the de-emanation efficiency of that system and the counting efficiency of the scintillation cell.

3-The calibration constant should be established for every new cell before use and every cell after every 20 uses or semi-annually, whichever occurs first.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
	4-The calibration must be done after every repair or replacement of a system component that could affect the calibration.			
	5-The scintillation cell should be uniquely identified to allow its association with a specific counting system to be identified.			
2.1.14.1	Was each complete counting system uniquely identified?	[ ]	—	—
	ACTION: If the counting system can not be definitely identified, qualify the associated sample results unusable (R).			
2.1.14.2	Was calibration performed on the identified Counting system?	[ ]	—	—
	ACTION: If no calibration data are associated with the specific counting system, qualify associated sample results unusable (R).			
2.1.14.3	Was the calibration constant established for each cell and/or system at the frequency specified above?	[ ]	—	—
	ACTION: If the cell and/or counting system is not calibrated at the specified frequency, qualify associated results as estimated (J).			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.14.4	Was each system calibrated each time the scintillation cell was replaced?	[ ]	—	—

ACTION: If the counting system was not calibrated upon replacing the scintillation cell, but the cell had a previously determined (acceptable) calibration constant, qualify associated results estimated (J).

ACTION: If no constant is applicable for the replacement cell, qualify associated results as unusable (R).

2.1.15 Supplemental Calibration Requirements for the Analysis of Uranium by Fluorometry

NOTE: If method of standard additions is not utilized, then a calibration should be performed before sample analysis to confirm the linear relationship between the fluorometer readings and uranium concentrations.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
2.1.15.1	Was a calibration curve (i.e., minimum of 5 points) developed before sample analyses and did the curve establish that the instrument had a linear response?	[ ]	___	___

NOTE: The standard concentrations used for calibration purposes must bracket the range of concentrations of the samples to be quantified.

ACTION: If a calibration was not performed before analysis and/or there were less than 5 points used in the calibration curve and/or the linearity was not within 0.9-1.1 slope by least squares method, but associated QCs (LCS, spikes) are acceptable, qualify associated data as estimated (J).

RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

ACTION: If calibration was not performed before analysis and/or there were less than 5 points used in the calibration curve and/or the linearity was not within 0.9-1.1 slope by least squares method, but associated QCs (LCS, spikes) are unacceptable, qualify associated data as unusable (R).

3.1 BLANKS

NOTE(S):

1-As a minimum one reagent (or method) blank of the same aliquot size as the samples must be processed like a sample and analyzed with each analytical batch of samples on the same detectors or detector system.

2-One blank is sufficient for all radionuclides analyzed by gamma spectrometry.

3-In data packages where more than one blank analysis has been done for a radionuclide use the blank analysis with the highest levels of contamination for assigning qualifiers. For example, if two alpha isotopic blanks were analyzed, pick the one with the highest uranium contamination to apply to uranium results and the one with the highest thorium contamination for thorium results. However, do not apply the alpha uranium blank to the U total result if the total U result was determined by gamma spectrometry.

RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
4-Any blank with a negative result whose absolute value is greater than the LLD must be carefully evaluated to determine its effect on sample data. Review all the QC data specific to the method to evaluate the possibility of false negatives.			
3.1.1 Was at least one blank for each method analyzed for every analytical batch of 20 or less samples on the same detectors or detector system as the samples?	[ ]		
NOTE: If different batches (i.e., lot number) of reagents utilized to prepare samples are not the same in the analytical batch, then additional method blanks should have been analyzed to assure that reagent contribution to method blank was consistent. This is especially significant in analysis of radium due to the fact reagents have significant quantities of this radionuclide.			
ACTION: Qualify all positive sample results (detects) as estimated (J) if no relevant blank QC data can be applied to the samples in question. List affected samples.			
3.1.2 Was any contamination detected in the blank samples?		[ ]	
NOTE: The net blank value (i.e., the results from the blank analysis corrected for background) is usually used as the measure of contamination. It should be less than the MDA. Sample results are not qualified if the net blank value is less than the MDA.			

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

ACTION: If the net blank value is equal to or greater than the MDA, verify the calculation or method of calculating the net blank value.

ACTION: Qualify all associated results reported which are statistically greater than background but less than the MDA as nondetects (U).
List radionuclides and sample numbers.

_____

_____

_____

ACTION: Qualify all associated results greater than or equal to the MDA and less than 10X the blank concentration as estimated (J). List radionuclides and sample numbers.

_____

_____

_____

_____

NOTE: Generally, no action is taken for radionuclides detected in a blank but not in a sample, although the validator must be vigilant for situations when a radionuclide in a blank but not in a sample may cause interference with other radionuclides of interest in the sample.

ACTION: Determine that no interference is occurring in samples where radionuclides not being quantitated are found in the blank.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
4.1 Sample Results and Detection Limits			

NOTE(S): 1-All positive results (detects or results not qualified with a (U)) reported are compared to the detection limits stated in the SCQ and are verified to be above the MDA for the analysis or method.

2-Some laboratories may use different terms for the LLD and MDA, or may reverse the meanings of the terms as stated here, or may use somewhat different concepts (e.g., decision limit). The validator must determine what definition the laboratory is using with what term. The general equations specified at step 4.1.3 can be used to establish consistent application of terms.

	YES	NO	NA
4.1.1 Were the results calculated correctly and does the calculated activity match the reported activity?	[ ]	—	—

NOTE: If not specified in the analytical method, for most analyses with sample results > MDA, the activity concentration (pCi/L or g) can be manually recalculated by the following formula:

Activity (pCi/L or g) =(TSC - BKG) x SD/(SC - SBKG) x SVOL x 2.22 where

TSC = Total sample counts in region of interest
BKG = Background counts in region of interest
SD = dpm of standard (aliquot) added
SC = Counts from standard
SBKG = background counts for standard
SVOL = sample volume in liters (1 liter=1000 mL)
2.22 = conversion from dpm to pCi

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 4697

	YES	NO	NA
Assumption:			
1) Count times are the same for standard and unknown.			
ACTION: For total uranium sample results > MDA, manually recalculate using only the activity for Th-232. Use 9.2 ug/pci as conversion factor.			
NOTE: Recalculation of results based on raw data typically yields results which are close (< 15%) but not identical.			
ACTION: Qualify all results that do not agree within 15% of the calculated value as unusable (R) if attempts to rectify the discrepancy with the laboratory are unsuccessful.			
4.1.2 Was the Lower Limit of Detection (LLD) or Minimum Detectable Amount (MDA) listed for each radionuclide less than the result reported?	[ ]	—	—
ACTION: If the lower limit of detection or minimum detectable amount is greater than the reported result, qualify the result as (U), non-detect.			
4.1.3 Can the LLD or MDA be verified?	[ ]	—	—
NOTE: If the LLD or MDA for each analytical method is not contained in the data package or cannot be obtained from the laboratory, then recalculate the LLD or the MDA with the following equations:			

$LLD = 4.66\ (\text{background counts})^{1/2} + 3$

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

YES NO NA

$$MDA = \frac{4.66\ (\text{blank counts})^{1/2} + 3}{(\text{volume})(\text{yield})(\text{efficiency})(\text{conversion factors})}$$

NOTE: The "3" is added as a Poisson correction for low counts.

NOTE: If a comparison is made, the recalculated result should agree within 15% of the reported result.

ACTION: If the Lower Limit of Detection or Minimum Detectable Amount can not be verified to be within ±15% of submitted value, qualify the associated results as estimated (J).

4.1.4 Sample Results/Detection Limits Requirements for Gamma Spectrometry Analyses

4.1.4.1 For each radionuclide reported as a detect, were sufficient counts recorded so the propagated counting error remained below 80% at 2 Sigma Confidence limit for at least one of the peaks used for the reported radionuclide? [ ] — —

ACTION: If the % error reported for the net peak area for one or more of the peaks used to calculate the result is not ≤ 80%, qualify the associated result as estimated (J).

NOTE: The validator must judge each case since some radionuclides may have several usable peaks (as defined by the software).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

		YES	NO	NA
4.1.4.2	Was the detector system deadtime for the sample counts less than or equal to 10%?	[ ]	___	___

ACTION: If the deadtime for the sample is greater than 10%, qualify the sample result as estimated (J).

5.1 Radiometric or Gravimetric Yields

5.1.1	Was an appropriate spike, tracer, or carrier used for each sample or batch?	[ ]	___	___

ACTION: If no spike, tracer or carrier was analyzed per SCQ guidelines, but acceptable duplicates were obtained, qualify the associated data as unusable (J).

ACTION: If no spike, tracer, or carrier was analyzed per SCQ guidelines, but an acceptable duplicate was not obtained, qualify all associated data as unusable (R).

5.1.2	Was the sample gravimetric or radiometric yield (recovery) acceptable?	[ ]	___	___

NOTE(S): 1-Only a single yield will be reported if samples were analyzed for only total strontium, i.e., no separation for yttrium would be performed.

2-For spikes used to gauge matrix interference, not to calculate a yield factor, if the sample activity is greater than 4x the spike activity, the limits do not apply.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 4697

YES NO NA

ACTION: Qualify results according to the following criteria:

All Matrices Except Water

> 110% unusable (R)
> 100% but ≤ 110% estimated (J)
45-100% no qualifiers
< 45% unusable (R)

Water Matrix

> 110% unusable (R)
> 100% but ≤ 110% estimated (J)
50-100% no qualifiers
< 50% unusable (R)

5.1.3 Is the reported yield correct based on recalculation? [ ] ___ ___

NOTE(S): 1-Gravimetric yield is determined by dividing the recovered precipitate weight by the added carrier weight.

2-Radiometric yields are determined by dividing the net found activity by the known added activity. Corrections for decay and/or in growth of progeny may also be necessary.

3-Self-absorption corrections may not be necessary for electrodeposited sample preparations. For precipitated sample preparations check that the appropriate self-absorption factor was used. The self-absorption factor is obtained from the data reports or from the laboratory. The limits on sample preparation weight should also be available from the analyzing laboratory.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 4697

YES NO NA

ACTION: If the yield is determined to be incorrect (allow for rounding difference), recalculate activity based on correct yield, report corrected result, and submit "Request for Additional Information/Resubmittal" to verify the correction(s).

Example calculation for Sr-90:

Sr-90 activity (dpm) =

$$\frac{\text{total sample counts/minute} - \text{background counts/minute}}{\text{(efficiency) (yield) (self absorption) (Y ingrowth)}}$$

Y ingrowth = $1 + (1-e^{-\lambda t})$, where t = time from the beginning of ingrowth to midpoint of counting time, and $\lambda = \ln 2 / T_{1/2}$ of ^{90}Y

NOTE: A different equation is used for the yttrium precipitation.)

5.1.4 Supplemental Requirements for Radiometric Yields for Alpha Spectrometry Analyses

NOTE: A NIST, or NIST-traceable, or equivalent agency standard material is used as an internal tracer for each sample analysis.

5.1.4.1 Can the tracer for each alpha isotopic analysis be traced to a NIST or equivalent standard? [ ] ___ ___

ACTION: If the traceability to a NIST (or equivalent) standard cannot be established, but other QCs are acceptable, qualify the associated data as unusable (J).

ACTION: If the traceability to a NIST (or equivalent) standard cannot be established, but other QCs are unacceptable, qualify associated data as unusable (R).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 46

	YES	NO	NA
5.1.4.2 Is the tracer percent recovery acceptable as determined with the following equation?	[ ]	___	___

$$\text{percent recovery} = \frac{\text{net tracer cpm}}{\text{tracer dpm added}} \times E \times 100$$

where E = detector efficiency in dpm/cpm

NOTE: For uranium isotopic analyses, it may be necessary to correct the DPM added of the U-232 tracer for decay.)

ACTION: Qualify results according to the following criteria for yields:

All Matrices Except Water

> 110% unusable (R)
> 100% but ≤ 110% estimated (J)
45-100% no qualifiers
< 45% unusable (R)

Water Matrix

> 110% unusable (J)
>100% but ≤ 110% estimated (J)
50-100% no qualifiers
< 50% unusable (R)

5.1.5 Supplemental Requirements for Yield for Radium-226 Analyses by Scintillation

	YES	NO	NA
5.1.5.1 Did the laboratory provide information on typical recoveries achieved with the method and evidence that sample results were corrected as appropriate?	[ ]	___	___

ACTION: If information is not provided on the determination of the yield for each sample, qualify the results as estimated (J).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

YES NO NA

6.1 Duplicates

NOTE(S): 1-At least one duplicate processing and analysis must be performed for each method for every 20 samples or each analytical batch.

2-Samples identified as field blanks are not be used for duplicate sample analysis. If the field blank was used for duplicate analysis, all other QC data must be carefully checked and professional judgement exercised when evaluating the data. Document if the field blank was used but do not qualify data on this alone.

6.1.1 Was a duplicate analyzed for every 20 samples or analytical batch to determine the precision of the radiochemical and counting methods? [ ] ___ ___

NOTE(S): 1-Duplicates may be counted on different detectors.

2-For gamma spectrometry analyses a duplicate may contain only one of the radionuclides of interest.

ACTION: If no duplicate analysis results can be obtained for data package but calibration and all other required QCs (LCS, spikes, tracers, blanks) are present and acceptable, do not qualify the associated data.

ACTION: If no duplicate analysis results can be obtained for data package but calibration and/or some other required QCs (LCS, spikes, carriers, tracers, blanks) are missing or unacceptable, qualify associated data as estimated (J).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
6.1.2 Was the relative error ratio (RER) within acceptance criteria?	[ ]	___	___

Acceptance Criteria: Measurements are acceptable if RER is ≤ 2, questionable if RER is > 2 but ≤ 3, and not acceptable if RER is > 3.

$$RER = [C_1 - C_2] / [(TPU_1)^2 + (TPU_2)^2]^{1/2}$$

Where: C_1 and C_2 are measured concentrations for sample and duplicate and TPU_1 and TPU_2 are respective total propagated errors supplied by the analyzing lab.

ACTION: If the RER is ≥ 2, qualify associated results as estimated (J). Record the radionuclide, sample number, and RER.

Radionuclide	Sample Number	RER
_____	_____	_____
_____	_____	_____
_____	_____	_____

(Attach extra sheet if required.)

7.1 Laboratory Control Samples

NOTE(S): 1-Laboratory Control Samples (LCS) may be prepared by the same laboratory performing the analyses or by a reference laboratory or agency and are equivalent to internal or external control samples.

2-Some laboratories may use the terms "QC samples" or "spikes" to identify Laboratory Control Samples.

3-Performance samples from the EPA or DOE or other agency may be used as LCSs.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.) 4697

	YES	NO	NA
7.1.1 Was at least one Laboratory Control Sample analyzed for each method, each analytical batch or every 20 samples?	[ ]	___	___

NOTES:

1-LCS for gamma spectrometry analyses do not have to have each of the radionuclides for which results are reported. However there should be at least one spiked radionuclide that matches a radionuclide on the request for analysis form.

2-For alpha spectrometry, a LCS that contains a single radionuclide may be used for each set (i.e., Th-232 for all the thorium isotopes, Pu-239 for all the plutonium isotopes, and uranium-234 and/or uranium-238 for all uranium isotopes.

ACTION: If there are no LCS data in the data package, qualify all associated radionuclide results as estimated (J). List radionuclides and sample numbers.

_____

_____

_____

7.1.2 Was the LCS recovery acceptable?	[ ]	___	___

NOTE: The validator must check the applicable SOQ performance based criteria for method specific acceptance ranges.

ACTION: Recalculate the LCS recovery and qualify results for the associated radionuclide according to the following:

> 125% unusable (R)
75-125% no qualifier
50% to 74% estimated (J)
< 50% unusable (R)

NOTE: LCS % recovery = $\frac{\text{LCS found}}{\text{LCS added}} \times 100$

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

YES NO NA

ACTION: Record the radionuclide, sample number, and % recovery.

_____
_____
_____
_____
_____

8.1 Holding Times and Sample Preservation

NOTE(S): 1-The holding times for all samples are 5 half-lives of the radionuclide of interest or as specified in Appendix A of the SCQ, whichever comes first.

2-Holding times are calculated from the date of collection to the date of analysis.

3-Samples shall be properly contained and preserved (e.g., acidified) in accordance with Appendix A of the SCQ, to ensure that sample integrity is maintained.

8.1.1 Were holding times exceeded for any sample analysis? ___ [ ] ___

ACTION: If hold time has been exceeded by factor of 1-2X, qualify all associated data as estimated (J).

ACTION: If hold time has been exceeded by factor > 2X, qualify all associated data as unusable (R).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
8.1.2 Were any samples not correctly preserved?	[ ]	—	—

NOTE: Aqueous samples are generally preserved by adjusting the pH to < 2 with nitric acid. The holding time requirements depend on the time of preservation. If the sample was preserved at the time of collection, the requirements in Steps 8.1.1 and 8.1.2 apply. If the sample was not preserved at the time of collection, the time from sampling to receipt at laboratory should not exceed 5 days, and the laboratory must preserve the sample, in the original container, upon receipt and hold for at least 16 hours prior to analysis.

ACTION: Qualify all results as estimated (J) for samples not preserved correctly, or documented as such. Professional judgement must be used to qualify results if the lack of preservation could cause much lower results than those reported.

ACTION: List all samples which are not preserved properly.

_____

_____

_____

RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

YES NO NA

9.1 Method Specific and Other Quality Control

NOTE: Areas that may be addressed under other Quality Control include, but are not limited to, the following:

- Biases or trends observed in QC or field sample results, the performance of an instrument, method, or the laboratory over the course of the Release Group or past history
- Anomalies associated with the Chain-of-Custody documentation
- Anomalies associated with the shipment or receipt of samples.

9.1.1 Are there any other factors noted by the validator that result in qualifiers applied to results or other criteria that apply to some results, such as samples with very high activities or specific modifications to the standard protocol? ___ [ ] ___

ACTION: Review on a case by case basis and fully document in the comments section.

9.2 Isotopic Ratios for Uranium Analyses by Alpha Spectrometry

NOTE: Uranium isotopic ratios should fall within the ranges expected for most samples. Values outside the ranges are not qualified as estimated or unusable, but are documented in the Comments section for the users attention.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

	YES	NO	NA
9.2.1 Are both U-235 and U-238 results for a sample > 10X the MDA?	[ ]	___	___

ACTION: Determine if the percent enrichment of U-235 falls within the range of 0.2 to 1.3% expected for most samples.

NOTE: $\frac{\text{U-235 pCi/L}}{\text{U-238 pCi/L}} \times 15.6 = \%$ enrichment

ACTION: Do not qualify the U-235 result if the calculated enrichment is outside the range of 0.2 to 1.3%, but list the sample numbers and results.

_____

_____

	YES	NO	NA
9.2.2 Are both U-234 and U-238 results > 10X the MDA?	[ ]	___	___

ACTION: Determine if the ratio of U-234 to U-238 falls within the range of 0.4 to 1.3% expected for most samples.

NOTE: Calculate the U-234/U-238 ratio:

$\frac{\text{U-234 pCi/L}}{\text{U-238 pCi/L}} = \text{Ratio}$

ACTION: Do not qualify the U-234 result if the calculated ratio is outside the range of 0.4 to 1.3%, but list the sample numbers and results.

_____

_____

_____

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

YES NO NA

9.2.3 Method Standardization for Uranium by Fluorometry

NOTE: The fusion operation is the most critical step in the fluorometric procedure. Small variations in the duration of the fusion temperature of the fusion, and in the method of cooling the fused disk can cause large variations in the fluorescence yield. Each step of the fusion process should be standardized to obtain reproducible results.

9.2.3.1 Did the analytical laboratory provide a description of the method for fusion standardization? [ ] __ __

ACTION: If the fusion process is not standardized, or information is not provided to allow the independent assessment of the standardization process, qualify associated results estimated (J).

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

10.1 Radionuclide Qualifier Summary Sheet

ACTION: Complete the following form for each sample which has been qualified in steps 1.1-9.1 above.

Release No._____ Sample No._____

Radionuclide	Qualifier	Remarks
Cs-137		
Ra-226		
Ra-228		
U Total		
Sr-90		
Tc-99		
U-234		
U-235/236		
U-238		
Pu-238		
Pu-239/240		
Pu-241		
Th-227		
Th-228		
Th-230		
Th-232		
Np-237		
Pb-210		
Po-210		
Am-241		
Gross α/β		

Signature:_____ Date:_____

Definitions of qualifiers:

J - estimated result
R - unusable (reject) data
U - non-detect (MDA > reported value)

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

Comments Section

11.1.1 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.

NOTE: Attached Radionuclide Qualifier Summary Forms from step 10.1 above may be attached.

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RADIOCHEMISTRY DATA VALIDATION CHECKLIST (cont.)

11.1.1 (Continuation)

Reviewer: _____ DATE ___/___/___