DoD/DOE QSM 6.0 Module 6 Radiochemical Testing Checklist

Checklists used for this assessment activity:

- ☐ **M1/M2 PT/QMS**
- ☐ **M3 Asbestos Testing**
- ☐ **M4 Chemical Testing**
- ☐ **M5 Microbiological Testing**
- ☐ **M6 Radiochemical Testing**
- ☐ **M7 Toxicity Testing**
- ☐ **M8 Industrial Hygiene Testing**

This checklist is only a tool, and not considered as the requirements of the standard(s)!

If there is a disagreement between this checklist and the standard(s), the standard(s) shall prevail.

Identify conformity for each requirement along with comments/objective evidence for each clause assessed.

A *clarifying statement* provides additional information to help understand a requirement.

A *permission* is an approach that a conformity assessment body can use to achieve compliance.

Assessment Number:

CAB Name:

Physical Address:

Assessment Date(s):

Assessors(s):

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6	Quality Systems for Radiochemical Testing		
M6: 4.0	Method Selection		
M6: 4.0	The requirements in Module 2 Section on “Selection, Verification and Validation of Methods” apply.		Clarifying Statement
M6: 5.0	Method Validation		
M6: 5.1	Validation of Methods		
M6: 5.1.1	Before acceptance and institution of any method for which data will be reported, are all methods validated?		
M6: 5.1.1	Are methods validated across the range of physical and chemical parameters (e.g., density, Test Source		

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	composition, and analytical configurations) and activities that will be encountered in samples?		
M6: 5.1.1	Where applicable, does the activity range include zero activity?		
M6: 5.1.2	Are the methods validated in each quality system matrix for which it is applicable by demonstrating the method's detection capability, precision, bias, Measurement Uncertainty, and selectivity using the procedures specified in the Detection Capability, Evaluation of Precision and Bias, Measurement Uncertainty, and Evaluation of Selectivity Sections of Module 6?		
M6: 5.1.3	Are method validations performed for each method for which documented data are not available to demonstrate that the above requirements are met?		
M6: 5.1.3	For reference methods, published data, if available, may be used to satisfy these requirements.		Permission
M6: 5.1.4	Is the quality system matrix used in the initial method validation recorded?		
M6: 5.1.4	Are all supporting records retained for the initial study in a readily retrievable format for the lifetime of the method?		
M6: 5.1.5	For all methods, does the validation meet the requirements in the Module 2 Section on "Selection, Verification, and Validation of Methods" as well as all criteria in this module?		
M6: 5.1.6	Are records of the results obtained, the procedure used for the validation, and a statement as to whether the method is suitable for the intended use maintained?		
M6: 5.1.7	Do validation procedures include, whenever available, externally-produced quality control samples obtained from a Reference Material Producer accredited to ISO 17034 or a National Metrology Institute (NMI)?		
M6: 5.1.7	When such reference materials cannot be obtained, that laboratory may use materials from a Proficiency Testing Provider accredited to ISO/IEC 17043 or from another authoritative source.		Permission
M6: 5.1.7	Are the results of these analyses evaluated to determine its ability to produce acceptable data?		
M6: 5.2	Detection Capability		
M6: 5.2.1	Has the detection capability for each method/matrix/instrumentation combination been established?		
M6: 5.2.1	Detection Capability may refer to the Decision Level, MDA, or SDWA detection level.		Permission
M6: 5.2.2	Is the procedure used to determine the detection capability documented?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 5.2.3	Does the procedure used to determine the detection capability of a method comply with the specific requirements of the Minimal Detectable Activity, Decision Level, and Required Detection Limit for Drinking Water Compliance Sections of Module 6?		
M6: 5.2.4	Do method validation records include identification of software used for detection capability calculations?		
M6: 5.2.4	Does the software conform to the requirements in Module 2?		
M6: 5.2.5	Minimal Detectable Activity		
M6: 5.2.5	Are the methods capable of providing an MDA that is appropriate and relevant for the intended use of the data?		
M6: 5.2.5	Are MDAs determined using the procedure specified in mandated methods?		
M6: 5.2.5	If no procedure is specified, was a procedure selected that reflects instrument limitations and the intended application of the method?		
M6: 5.2.5.a	Unless specified otherwise in the mandated method, are all sample-processing steps of the analytical method included in the determination of detection capability?		
M6: 5.2.5.b	Is the detection capability of each method initially determined for the analytes of interest in a quality system matrix free of target analytes and interferences at levels that would impact the results?		
M6: 5.2.5.c	Is the detection capability determined each time there is a change in the test method or when there is a change in instrumentation that affects the analytical detection capability?		
M6: 5.2.5.d	Are equations used to calculate the decision level and the minimum detectable concentration (or activity) included in the analytical procedures or management system procedures?		
M6: 5.2.5.e	MDA Factors and Conditions Are MDAs determined based on factors and conditions such as instrument settings and matrix type, which influence the measurement?		
M6: 5.2.5.e	Is the MDA used to evaluate the capability of a method relative to the required Decision Level?		
M6: 5.2.5.e	Are sample size, count duration, tracer chemical recovery, detector background, blank standard deviation, and detector efficiency optimized to result in sample MDAs less than or equal to the Decision Levels.		
M6: 5.2.5.e	If Decision Levels are not achieved, is the cause discussed comprehensively in the case narrative?		

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M6: 5.2.5.f	MDA Calculation Is the basic MDA calculation based on the concepts developed by L. A. Currie from his paper "Limits for Qualitative Detection and Quantitative Determination," Analytical Chemistry, March 1968, Vol. 40, or from Chapter 20 of the MARLAP Manual, Volume III (EPA 402-B-04-001C)?		
M6: 5.2.5.f.i	MDA Calculation with a Blank Population The following general equations derived from the work of L. A. Currie may be used to calculate the MDA: Equations may need to be modified depending on the measurement technique in use. $$MDA = \frac{3.29 * S_b}{KT_s} + \frac{3}{KT_s}$$ Where: K = efficiency*$e^{-\lambda t}$*aliquot fraction*tracer recovery*Yield T_S = count time of the sample in minutes S_b = standard deviation of the blank population where the blank population is in net blank counts in count time T_S		Permission
M6: 5.2.5.f.i.a	Is an implementation method (e.g., identification of blanks to be used in the population, number of blanks to use in the population, changes in the blank population and limitations on the deletion of blanks) selected when blank populations are used for calculation of MDAs?		
M6: 5.2.5.f.i.b	Does the method of implementation not introduce any statistical bias?		
M6: 5.2.5.f.i.c	Is the blank subtraction the mean blank value of the blank population?		
M6: 5.2.5.f.i.d	Is the implementation of blank populations for calculation of MDAs described in detail in a procedure?		
M6: 5.2.5.f.i.e	If a constant factor of 2.71 used, is permission obtained from the customer and does the case narrative discuss the use of 2.71 (or is it documented in procedures available to the customer)? Note: In the original Currie derivation, a constant factor of 2.71 was used. Since that time, it has been shown and generally accepted that a constant factor of three is more appropriate (Multi Agency Radiation Survey and Site Investigation Manual, Aug. 2000). However, it is acceptable to use a constant of 2.71 in situations where that factor is built into instrument software without an option to use 3.		
M6: 5.2.5.f.ii	MDA Calculation without a Blank Population		Permission

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
	The following general equations derived from the work of Currie or MARLAP calculations may be used to calculate the MDA. $$MDA = \frac{3.29 * \sqrt{\frac{b}{T_S} + \frac{b}{T_B}}}{K} + \frac{3}{K * T_S}$$ Where: K = efficiency*$e^{-\lambda t}$*aliquot fraction*tracer recovery*Yield T_S = count time of the sample in minutes T_B = count time of the background in minutes b = background count rate in cpm Note: The above equation is used when sample and background count times are different. Other equations, where sample and background count times are the same may also be used. Note: The above equation for MDA has the units of dpm/sample. Any other units will require appropriate conversion.		
M6: 5.2.5.g	MDA Requirements for Elevated Samples: Are samples with elevated activities handled according to the following requirements?		
M6: 5.2.5.g.i	Is the appropriate sample size determined based on the activity level in the sample?		
M6: 5.2.5.g.i	Is the sample size large enough to generate data, which meet the following criteria?		
M6: 5.2.5.g.i.a	Is measurement uncertainty not greater than 10% (1 standard deviation) of the sample activity? and		
M6: 5.2.5.g.i.b	Is the MDA for the analysis a maximum of 10% of the sample activity?		
M6: 5.2.5.h	Are sample-specific MDAs calculated and reported?		
M6: 5.2.5.h	If MDAs are reported as a nominal detection capability of the measurement process, is it clearly stated in the data package?		
M6: 5.2.5.i	Are the MDA calculations confirmed to meet the customer's expectations for alpha and beta probability factors? Note: The definition of the MDA presupposes that an appropriate detection threshold (i.e., the decision level) has already been defined. In the most commonly used equation for the MDA, the alpha probability of 5% used for the decision level is also used for beta probability.		
M6: 5.2.6	Decision Level		
M6: 5.2.6.a	Decision Level Factors and Conditions Are decision levels determined based on sample-specific sample size, count duration, tracer chemical recovery, detector background, blank standard deviation, and detector efficiency?		

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M6: 5.2.6.b	Decision Level Calculation Is the basic decision level calculation based on concepts developed by L. A. Currie, "Limits for Qualitative Detection and Quantitative Determination," Analytical Chemistry, March, 1968, Vol. 40, or MARLAP Chapter 20?		
M6: 5.2.6.b	Decision Level Calculation Are decision levels used as the default detection threshold?		
M6: 5.2.6.b	The following general equation below may be used to calculate the decision level. The decision level may either be based on • the Combined Standard Uncertainty (CSU) of the blank (preparation/or method/instrument type) or the standard deviation determined from a set of appropriate blanks. or • the standard deviation determined from a set of appropriate blanks.		Permission
M6: 5.2.6.b.i	Decision Level Calculation with a Blank Population When determined from the standard deviation of a set of appropriate blanks, does the decision level evaluate the level at which the blank results will not exceed more than 5% of the time (or other specified level of confidence)?		
M6: 5.2.6.b.i	When determined from the standard deviation of a set of appropriate blanks, the decision level may be estimated by the following equation: $$DL = \frac{(txS_B) + \overline{R_B}}{ExRxIDFxW}$$ Where: DL = the decision level in disintegrations per minute per unit volume or weight (dpm/unit); S_B = the standard deviation of a set of appropriate blanks net count rate after background subtraction for blanks counted for the same length of time as the sample; R_B = the average blank count rate in counts per minute (cpm); t = the student t factor for appropriate degrees of freedom and confidence level; E = the fractional detector efficiency (c/d) for the sample; R = the fractional chemical yield for the sample; IDF = the ingrowth or decay factor for the sample; and W = the weight or volume of the sample.		Permission
M6: 5.2.6.b.ii	Decision Level Calculation without a Blank Population.		Permission

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
	Decision levels for samples without a blank population may be determined if based on appropriate L. A. Currie or MARLAP calculations using combined standard uncertainty (CSU).		
M6: 5.2.7	Required Detection Limit for Drinking Water Compliance If performing radiochemical testing of drinking water samples for SDWA compliance monitoring, are the requirements of 40 CFR Part 141 met?		
M6: 5.2.7	If performing radiochemical testing of drinking water samples for SDWA compliance monitoring, are only approved methods used that provide sufficient detection capability to meet the detection limit requirements established in 40 CFR Part 141?		
M6: 5.2.7	Is the detection capability expressed in terms of the Decision Level instead of Method Detection Limit?		
M6: 5.3	Evaluation of Precision and Bias		
M6: 5.3	Are results of precision and bias measurements determined during validation compared with criteria established by method, regulation, contract, or as established in the laboratory's quality system (if there are no established mandatory criteria)?		
M6: 5.3.1	Is a method utilized that provides precision and bias data for each of the analytes of interest that is appropriate and relevant for the intended use of the data?		
M6: 5.3.1	Are precision and bias characterized across the range of activities that brackets those applicable in samples, including zero activity?		
M6: 5.3.2	Are validation samples processed through the entire measurement system for each analyte of interest?		
M6: 5.3.2	Are validation samples evaluated for precision and bias in each relevant quality system matrix?		
M6: 5.3.3	Are precision and bias of a method determined each time there is a change in the test method that affects the performance of the method or when a change in instrumentation occurs that affects the precision and bias?		
M6: 5.3.4	Where there are no established criteria, is acceptance criteria developed for precision and bias based on one or more of the following?		
M6: 5.3.4.a	Intended use of the data?		
M6: 5.3.4.b	Applicable regulations? or		
M6: 5.3.4.c	Guidelines in publications such as MARLAP, Validation and Peer Review of U.S. Environmental Protection		

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	Agency Radiochemical Methods of Analysis (FEM Document Number 2006-01), and/or The Fitness for Purpose of Analytical Methods, A Laboratory Guide to Method Validation and Related Topics (Second Edition, 2014)?		
M6: 5.4	Measurement Uncertainty		
M6: 5.4.1	Are all radiochemical measurement results reported with an estimate of Total Uncertainty expressed either as a standard deviation (i.e., a Standard Uncertainty) or a multiple thereof (i.e., an Expanded Uncertainty)?		
M6: 5.4.1.a	Is Total Uncertainty documented by the laboratory's quality system consistent with the Guide to the Expression of Uncertainty in Measurement, the recommendations in Chapter 19 of MARLAP Volume III (EPA 402-B-04-001C), or other equivalent approaches?		
M6: 5.4.1.b	For purposes of compliance with the SDWA, or in order to comply with specific requirements established by method, regulation, contract, or as established by the laboratory's quality system (if there are no established mandatory criteria), laboratories may report the Counting Uncertainty in lieu of the Total Uncertainty as specified in the appropriate method, regulation contract, or as documented in the laboratory's Quality System.		Permission
M6: 5.4.2	Does the report clearly specify the type of uncertainty reported?		
M6: 5.4.2.a	Does the report express the uncertainty in the same unit of measurement as the measurement result unless the report clearly states otherwise?		
M6: 5.4.2.b	Does the report indicate whether the uncertainty is a Total Uncertainty or Counting Uncertainty?		
M6: 5.4.2.c	Does the report indicate whether the uncertainty is the Standard Uncertainty (e.g., "1 standard deviation") or an Expanded Uncertainty (e.g., "k standard deviation")? and		
M6: 5.4.2.d	Does the report, for Expanded Uncertainties, indicate the coverage factor (k) or the level of confidence?		
M6: 5.4.3	Are the results of the precision evaluation evaluated against the uncertainty estimates as a check on the validity of the uncertainty evaluation procedures?		
M6: 5.4.3.a	Is the experimentally-observed standard deviation from the initial precision evaluation at any testing level not statistically greater than the maximum Standard Uncertainty of the measurement results at that level, although it may be somewhat less?		

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M6: 5.4.3.a	If the experimentally-observed standard deviation at each testing level statistically exceeds the Standard Uncertainty, is the uncertainty estimate re-evaluated?		
M6: 5.4.3.b	A comparison of the experimentally-observed precision evaluation need not be performed for measurements that are required to be reported only with Counting Uncertainty.		Statement
M6: 5.4.4	Combined Standard Uncertainty		
M6: 5.4.4.a	Are all measurement uncertainties propagated and reported with each result?		
M6: 5.4.4.b	Is the formula for calculating the CSU of a result documented in the appropriate procedure?		
M6: 5.4.4.b	Does the CSU include both systematic and random uncertainty?		
M6: 5.4.4.c	Is the CSU 1 standard deviation?		
M6: 5.4.4.d	Are results reported at the 95% confidence level, which is 1.96 standard deviations (often abbreviated as 2 standard deviations)?		
M6: 5.4.4.e	When there are zero counts, is the uncertainty of a count not estimated as the square root of counts?		
M6: 5.4.4.f	In the case of zero counts, is the uncertainty of the count assumed to be the square root of one count? Note: The uncertainty of a net count would have to propagate the uncertainty of the sample and background. Thus, the uncertainty for a zero-count background and zero count sample is assumed to be 1.4 (square root of 2).		
M6: 5.4.4.g	If MARLAP (equation 19.57) is used for counting methodologies where very low counts are possible, is it accepted by the customer?		
M6: 5.4.4.g	Are records maintained of the customer acceptance?		
M6: 5.4.5	Does the Systematic Uncertainty component of the reported uncertainty include, but is not necessarily limited to the following?		
M6: 5.4.5.a	The uncertainty from all measurement devices, including pipettes, balances, etc.? and		
M6: 5.4.5.b	The uncertainty of known values of tracer solutions, calibration uncertainties, etc.?		
M6: 5.4.6	Does the Random Uncertainty component of the reported uncertainty include, but is not necessarily limited to, the total random counting uncertainty associated with each sample?		
M6: 5.4.6	Is the Random Uncertainty component of the reported uncertainty appropriately propagated when more than one variable is used to determine the result?		

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M6: 5.5	Evaluation of Selectivity		
M6: 5.5.1	Is selectivity qualitatively evaluated, if applicable, by addressing the following sample and matrix characteristics?		
M6: 5.5.1.a	The effect of matrix composition on the ability of the method to detect analyte?		
M6: 5.5.1.b	The ability of the method to chemically separate the analyte from the interfering analytes? and		
M6: 5.5.1.c	Spectral and instrumental interferences?		
M6: 5.5.2	The evaluation of selectivity may be accomplished by testing matrix blanks, spiked matrix blanks, worst-case samples, or certified reference materials.		Permission
M6: 5.5.2	If applicable, is a qualitative selectivity statement included in the procedure?		
M6: 6.0	Demonstration of Capability (DOC)		
M6: 6.1	General		
M6: 6.1.1	Does an individual who performs any activity involved with preparation and/or analysis of samples have constant, close supervision (as defined in the laboratory's training procedure) until a satisfactory initial DOC is completed?		
M6: 6.1.2	Thereafter, does the individual perform ongoing DOCs?		
M6: 6.1.3	In cases where an individual has prepared and/or analyzed samples using a method that has been in use by the laboratory for at least one year before applying for accreditation, and there have been no significant changes in instrument type or method, is the ongoing DOC acceptable as an initial DOC? Does the laboratory maintain records to demonstrate that an initial DOC is not required?		
M6: 6.1.4	Are all DOCs documented?		
M6: 6.1.4	Is all data applicable to the DOC retained and available at the laboratory?		
M6: 6.2	Initial DOC		
M6: 6.2	Is an initial DOC made prior to using any method and at any time there is a change in instrument type, personnel, or method; or any time that a method has not been performed by the laboratory or analyst in a 12-month period?		
M6: 6.2.1	Does the laboratory have a procedure for performing an initial DOC?		
M6: 6.2.2	Is each initial DOC documented in a manner such that the following information is readily available for everyone?		

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M6: 6.2.2.a	individual(s) involved in preparation and/or analysis;		
M6: 6.2.2.b	Matrix?		
M6: 6.2.2.c	analyte(s), class of analyte(s), or measured parameters(s)?		
M6: 6.2.2.d	identification of method(s) performed?		
M6: 6.2.2.e	identification of laboratory-specific procedure used for analysis, including revision number?		
M6: 6.2.2.f	date(s) of analysis? and		
M6: 6.2.2.g	summary of analyses?		
M6: 6.2.3	If the method, regulation, or contract does not specify an initial DOC, are the other approaches to initial DOC documented to be adequate?		
M6: 6.2.3	For methods where spiking is not a viable option (e.g., leaching procedures), is there observation and evaluation of negative controls?		
M6: 6.2.3.a	Are four Test Samples prepared consistent with Section 7.2.3?		
M6: 6.2.3.a	Are four blank samples of clean quality system matrix in which no target analytes or interferences are present prepared at activities that will impact the results of a specific method?		
M6: 6.2.3.b	Where gamma-ray spectrometry is used to identify and quantify more than one analyte, does the Test Sample contain gamma-emitting radionuclides that represent the low (e.g., Americium-241), medium (e.g., Caesium-137), and high (e.g., Cobalt-60) energy range of the analyzed gamma-ray spectra? Note: As indicated by these examples, the nuclides need not exactly bracket the calibrated energy range or the range over which nuclides are identified and quantified.		
M6: 6.2.3.c	Are the samples prepared and analyzed according to the method?		
M6: 6.2.3.d	Using all of the results, are the mean recovery of the spiked samples and the mean of the blank results in the appropriate reporting units and the standard deviations of the population sample (in the same units) calculated for each parameter of interest?		
M6: 6.2.3.d	When it is not possible to determine means and standard deviation, does the laboratory assess performance against established and documented criteria?		
M6: 6.2.3.e	Is the information from (d) above compared to the corresponding acceptance criteria for precision and		

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	accuracy specified by method, regulation, contract, or as established by the laboratory's quality system (if there are no established mandatory criteria)?		
M6: 6.2.3.e	Does the analysis of field samples begin after all parameters meet the acceptance criteria?		
M6: 6.2.3.f	When one or more of the tested parameters fall outside at least one of the acceptance criteria, is the test repeated for the parameters that exceed acceptance criteria? Note: If test results fall outside acceptance criteria again, this confirms there is a general problem with the method and/or measurement system.		
M6: 6.2.3.f	If test results fall outside acceptance criteria again, does the laboratory locate and correct the source of the problem and repeat the test for all parameters of interest?		
M6: 6.2.3.g	When an analyte not currently found on the laboratory's list of accredited analytes is added to an existing accredited method, is an initial DOC performed for that analyte? Note: When analytes are added to gamma-ray spectrometry, this is not required.		
M6: 6.3	Ongoing DOC		
M6: 6.3.1	Is there a procedure for ongoing DOC that includes how the laboratory will identify data associated with ongoing DOCs?		
M6: 6.3.1	Is on-going capability demonstrated by the individual by routinely meeting the QC requirements of the reference method, laboratory procedure, customer requirements, and/or this standard?		
M6: 6.3.1	If the method has not been performed by the individual in a 12-month period, is an initial DOC performed?		
M6: 6.3.1	Are other approaches to ongoing DOC documented to be adequate?		
M6: 6.3.1	For methods where spiking is not a viable option (e.g., leaching procedures), does the approach include observation and evaluation of negative controls?		
M6: 6.3.2	Does the on-going demonstration include one of the following?		
M6: 6.3.2.a	Acceptable performance of blank(s) and sample(s) that have known, accepted values, single blind to the individual?		
M6: 6.3.2.b	another initial DOC?		

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M6: 6.3.2.c	At least four consecutive spiked samples (e.g., batch laboratory control samples) each with levels of precision and accuracy consistent with those specified in the method scope?		
M6: 6.3.2.c	Four consecutive blank samples, each with activity consistent method performance specified in the method scope (e.g., generally activity less than Decision Level)?		
M6: 6.3.2.c	Are four consecutive passing Laboratory Control Samples (LCS) and four consecutive blank samples for each method for each individual performed within the last 12-month period tabulated (or able to readily retrieve)?		
M6: 6.3.2.c	Are acceptable limits specified for precision and accuracy prior to analysis?		
M6: 6.3.2.d	A procedure of reviewing ongoing QC samples by an individual or a predefined group of analysts relative to the QC requirements of the reference method, laboratory procedure, customer specifications, and/or this standard? or		
M6: 6.3.2.d	This review should be used to identify patterns for individuals or groups of analysts and identify the need for corrective action or retraining as necessary.		Clarifying Statement
M6: 6.3.2.e	if a) through d) are not technically feasible, is analysis of real-world samples with results within a pre-defined acceptance criterion (as defined by the laboratory or method) performed?		
M6: 7.0	Technical Requirements		
M6: 7.1	Instrument Set-Up, Calibration, Performance Checks, and Background Measurements		
M6: 7.1	This section addresses requirements for the proper set-up, calibration, calibration verification, and instrument performance checks of radiation measurement systems, as well as the requirements for background subtraction measurements and short-term background checks. These requirements ensure that the measurements will be of known and appropriate quality for meeting regulatory and contractual requirements and for supporting decision making. This section does not specify detailed procedural steps for these operations but establishes essential elements for selection of the appropriate technique(s). This allows flexibility and permits employment of a wide variety of analytical procedures and statistical approaches.		Clarifying Statement

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M6: 7.1	At a minimum, does the instrument QC program incorporate requirements imposed by the reference method, laboratory procedure, customer specifications, and/or this standard?		
M6: 7.1	Where imposed regulations are more stringent than this standard, do the imposed regulations take precedence?		
M6: 7.1	If it is not apparent which standard is more stringent, does the laboratory follow the requirements of the regulation or the method in that order?		
M6: 7.1	Where there are no established mandatory requirements, does the laboratory incorporate guidelines consistent with MARLAP or other consensus standard organizations?		
M6: 7.1.1	Initial Set-Up of Instrumentation		
M6: 7.1.1.a	Are the required radiation measurement systems for each method it performs maintained?		
M6: 7.1.1.a	Do the radiation measurement systems produce consistent, comparable results across multiple detectors used for a common method?		
M6: 7.1.1.a	Have the configuration and operating parameters been established for each radiation measurement system used consistent with the method requirements?		
M6: 7.1.1.b	Is the radiation measurement system configuration and maintainable values for hardware-and software-related operational parameters prior to initial calibration documented?		
M6: 7.1.1.b	If a specific method or application requires that system configuration or operational parameters deviate from the manufacturer recommended specifications, are the modifications identified and the rationale for such changes documented?		
M6: 7.1.1.b	Is approval obtained from the customer prior to sample analysis and records of the approval maintained?		
M6: 7.1.1.c	Are user-maintainable values for operational parameters periodically verified to ensure consistency with values recorded at the time of initial calibration to ensure the continued integrity of system configuration?		
M6: 7.1.1.c	If system configuration or operating parameters have changed, is the nonconforming work process implemented to determine and ameliorate any potential impact?		
M6: 7.1.2	Initial Calibration		
M6: 7.1.2	This section specifies the essential elements that define the procedures and documentation for initial calibration of radiation measurement systems.		Clarifying Statement

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M6: 7.1.2.a	Do procedures describe when calibration of instrumentation is required?		
M6: 7.1.2.a	Are radiation measurement systems calibrated prior to initial use and any time the following conditions occur?		
M6: 7.1.2.a.i	Following replacement of a key detector element (e.g., a photomultiplier tube, silicon barrier detector, gas proportional detector chamber, germanium crystal, etc.).		
M6: 7.1.2.a.ii	After a repair when subsequent performance checks indicate a change in performance?		
M6: 7.1.2.a.iii	After modification of system parameters that affect instrument response?		
M6: 7.1.2.a.iv	When instrument performance checks exceed predetermined acceptance criteria (i.e., limit of a statistical or tolerance control chart or other QC parameters) indicating a change in instrument response since the initial calibration?		
M6: 7.1.2.a.v	When indicated by corrective actions? or		
M6: 7.1.2.a.vi	When calibration is due according to a predetermined frequency?		
M6: 7.1.2.b	Given that the instrument detection efficiency is linear with respect to count rate at all but the highest activity levels (i.e., where detection system dead time becomes significant), calibration curves with standards of varying activity need not be performed for radiometric techniques.		Permission
M6: 7.1.2.b	Are multiple-point calibration curves used to correlate a number of parameters other than activity for applicable techniques? For example:		
M6: 7.1.2.b.i	Channel-energy calibration of alpha or gamma spectrometers?		
M6: 7.1.2.b.ii	Energy-efficiency calibration of gamma spectrometers?		
M6: 7.1.2.b.iii	Mass-efficiency (mass-attenuation) calibration of gas-flow proportional or x-ray detectors?		
M6: 7.1.2.b.iv	Quench-efficiency calibration of liquid scintillation detectors?		
M6: 7.1.2.b.v	Mass-crosstalk calibration of gas-flow proportional? and		
M6: 7.1.2.b.vi	Quench-crosstalk calibration of liquid scintillation detectors?		
M6: 7.1.2.c	Is detected efficiency determined with sources obtained from a reference material producer accredited to ISO 17034 or from a NMI, when available?		
M6: 7.1.2.c	When such materials are not available or not feasible for use, are reference materials obtained from external or internal sources?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.1.2.c	Are there procedures and criteria for ensuring these sources have one or more properties sufficiently well established to be used for calibration or assessment of a measurement method?		
M6: 7.1.2.c	Are records maintained?		
M6: 7.1.2.d	Are instrument calibrations based on physical measurement of reference standards?		
M6: 7.1.2.d	Do these standards have general physical characteristics (e.g., geometry, density, composition, nuclear decay properties, etc.) that match as closely as possible those of the samples to which the calibration will be applied?		
M6: 7.1.2.e	In some cases, calibration standard characteristics do not exactly match sample characteristics. The laboratory may use empirical techniques (e.g., gamma transmission) and/or computational techniques (e.g., Monte Carlo or efficiency modeling techniques) to generate corrections that are applied to calibrations performed with reference standards to account for minor differences between the physical characteristics of the calibration standard (i.e., geometry, density, coincidence-summing, etc.) and the samples to which the correction is to be applied, if 7.1.2.e.i; 7.1.2.e.ii, and 7.1.2.e.iii are met.		Permission
M6: 7.1.2.e.ii	When 7.1.2.e.ii is applicable, does the applied correction consistently minimize measurement bias across the range of physical characteristics?		
M6: 7.1.2.e.iii	When 7.1.2.e.iii is applicable, has the uncertainty associated with the correction been estimated and validated and included in the uncertainty reported with each associated sample result?		
M6: 7.1.2.f	Are the following essential elements of initial instrument calibration met?		
M6: 7.1.2.f.i	Are there procedures for performing initial instrument calibration?		
M6: 7.1.2.f.i	Do the procedures include, at a minimum, the following?		
M6: 7.1.2.f.i.a	The type of calibrations to be performed?		
M6: 7.1.2f..i.b	The number of calibration points required?		
M6: 7.1.2.f.i.c	A description of the calibration standards required?		
M6: 7.1.2.f.i.d	The preparation of the calibration standards?		
M6: 7.1.2.f.i.e	The counting of the calibration standards?		
M6: 7.1.2.f.i.f	The maximum permissible uncertainty for calibration measurements (e.g., a maximum relative combined uncertainty of the calibration parameter or a minimum number of counts collected)? and		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.1.2.f.i.g	all calculations?		
M6: 7.1.2.f.ii	Do procedures contain acceptance criteria appropriate to the calibration technique?		
M6: 7.1.2.f.iii	If the initial instrument calibration results are outside established acceptance criteria, is the nonconforming work process implemented?		
M6: 7.1.2.f.iv	Are sufficient raw data records retained to permit reconstruction of the initial instrument calibration?		
M6: 7.1.2.g	Are sample results quantitated only from the initial instrument calibrations unless otherwise allowed by regulation, method, or contract?		
M6: 7.1.3.	Calibration Verification		
M6: 7.1.3.a	Prior to use of an initial calibration for analysis of samples, is the initial instrument calibration verified with a reference standard?		
M6: 7.1.3.a	Is the standard obtained from a source or a lot independent of the reference standard used in the initial calibration, if available?		
M6: 7.1.3.a	Is the calibration verification taken from one of the two following forms?		
M6: 7.1.3.a.i	Performing a second set of calibration measurements to be evaluated against the initial calibration? or		
M6: 7.1.3.a.ii	Quantifying a set of prepared standards using the initial calibration?		
M6: 7.1.3.b	Do procedures specify the maximum permissible uncertainty for calibration verification measurements (e.g., the minimum number of counts collected for each measurement)?		
M6: 7.1.3.c	Do procedures specify the calibration verification acceptance criteria (e.g., for the relative combined uncertainty of the prepared standard recovery)?		
M6: 7.1.3.c	If the acceptance criteria for the calibration verification are not met, is the nonconforming work process implemented?		
M6: 7.1.4	Instrument Performance Checks		
M6: 7.1.4.a	Are the following essential elements of instrument performance checks met?		
M6: 7.1.4.a.i	Is a check source used for instrument performance checks a reference standard?		
M6: 7.1.4.a.i	The check source used for instrument performance checks need not be a reference standard;		Clarifying Statement
M6: 7.1.4.a.ii	Is the same check source used for ongoing performance checks as the one in the preparation of the tolerance or control chart limits at the point of the initial calibration?		

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M6: 7.1.4.a.iii	Are check sources prepared, handled, sealed and/or encapsulated to prevent damage, loss of activity and contamination?		
M6: 7.1.4.a.iv	Is the uncertainty of the check source count minimized to allow detection of small changes in detector response relative to the acceptance criteria?		
M6: 7.1.4.a.iv	Is the count duration and check source activity sufficient to provide adequate counting statistics over the life of the source?		
M6: 7.1.4.a.v	Where significant, is the radioactive decay in the check source taken into account when evaluating count-rate sensitive parameters such as efficiency?		
M6: 7.1.4.a.vi	Are the results of instrument performance checks monitored using control or tolerance charts to ensure that instrument performance does not change significantly relative to the point of the initial calibration?		
M6: 7.1.4.a.vii	Does the laboratory procedure specify what corrective actions are to be taken when performance check acceptance criteria are not met? and		
M6: 7.1.4.a.viii	When results for instrument performance checks are outside acceptance criteria (i.e., limit of a statistical or tolerance chart or other QC parameters), is the nonconforming work process implemented?		
M6: 7.1.4.b	Is the minimum frequency established for performance checks for specified calibration parameters as follows?		
M6: 7.1.4.b.i	Gamma-ray spectrometry systems Detection efficiency, energy calibration, and peak resolution?		
M6: 7.1.4.b.i.a	Semiconductor detectors At least twice weekly, but not on consecutive days, for a continuously operating detector; day of use for a non-continuously operating detector?		
M6: 7.1.4.b.i.b	Scintillation detectors (e.g., sodium iodide): Day of use?		
M6: 7.1.4.b.ii	Alpha-particle spectrometry systems		
M6: 7.1.4.b.ii.a	Energy calibration: Weekly?		
M6: 7.1.4.b.ii.b	Detection efficiency: Monthly?		
M6: 7.1.4.b.iii	Gas-proportional and semiconductor alpha/beta detectors Alpha and beta efficiency: Day of use?		
M6: 7.1.4.b.iv	Liquid scintillation detectors		
M6: 7.1.4.b.iv.a	Manufacturer system calibration: At the frequency recommended by the manufacturer?		

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M6: 7.1.4.b.iv.b	Efficiency with unquenched Hydrogen-3 and Carbon-14 standards: Day of use?		
M6: 7.1.4.b.v	Solid-state scintillation detectors (e.g., zinc sulfide) used for non-spectrometric measurements Efficiency: Day of use?		
M6: 7.1.4.b.vi	For radon scintillation detectors, is efficiency verified at least annually, when the system is in use.		
M6: 7.1.4.b.vi	Laboratories may rotate batch LCS samples through Cell/Detector pairs to provide evidence of continuing calibration verification.		Permission
M6: 7.1.4.c	Exceptions to minimum frequencies for performance checks:		
M6: 7.1.4.c.i	If an individual Test Source is uninterruptedly measured for a time longer than the required interval between performance checks to allow completion of the count of a Test Source are the instrument performance checks performed at the beginning and end of the measurement period and do the checks meet all applicable acceptance criteria?		
M6: 7.1.4.c.ii	If Test Sources are uninterruptedly measured for a time longer than the required interval between performance checks to allow for completion of a Preparation Batch or Radiation Measurement Batch (RMB) analyzed on an instrument with an automated sample changer (e.g., a liquid scintillation or gas proportional counter), does the period between the checks not exceed seven calendar days, are checks done at the beginning and end of the measurement in question; and do the checks meet all applicable acceptance criteria?		
M6: 7.1.4.d	If the detection system is powered off between performance checks, is a new performance check performed prior to the next Test Source measurement?		
M6: 7.1.5	Background Subtraction Measurements Background subtraction measurements are performed to assess and correct for contributions due to cosmic radiation, naturally-occurring radioactivity, electronic noise, impurities in the detector, shielding, source mounting material, or other sources that are not affected by the analytical processes. Contributions from impurities in the reagents, reference standards, or other sources introduced during the analytical processes are assessed with the use of method blanks.		Clarifying Statement
M6: 7.1.5	Numerous counting configurations may be used to determine background subtraction, depending on the detector and the method, including: counting an empty detector; counting an empty container or blank Test		Permission

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	Source in a detector; or counting a container filled with a surrogate matrix material free of measurable levels of radioactivity.		
M6: 7.1.5.a	Is the background subtraction specific to each detector and appropriate to the method?		
M6: 7.1.5.b	Is the background subtraction counting time at least as long as the longest associated sample counting time and ensures a representative determination of the background rate?		
M6: 7.1.5.c	Is the background subtraction measurement accomplished in one of the following ways?		
M6: 7.1.5.c.i	Paired measurements in which the background subtraction measurement is counted before or after the Test Source measurement or batch of Test Source measurements?		
M6: 7.1.5.c.ii	Measurements performed at a fixed frequency, in which Test Sources may be measured between successive background subtraction measurements. In this case, the laboratory shall perform background subtraction measurements at the following minimum frequencies? or		
M6: 7.1.5.c.ii.a	Gamma-ray spectrometry systems: Monthly?		
M6: 7.1.5.c.ii.b	Alpha-particle spectrometry systems: Monthly?		
M6: 7.1.5.c.ii.c Supplemental Information: 03/11/2024	Gas-proportional and semiconductor alpha/beta detectors: Monthly?		
M6: 7.1.5.c.ii.d	Liquid scintillation detectors		
M6: 7.1.5.c.ii.d.1	Individual quenched background: Once per Preparation Batch?		
M6: 7.1.5.c.ii.d.2	Quenched background curve: According to frequency specified in laboratory procedures?		
M6: 7.1.5.c.ii.e	Solid-state scintillation detectors (e.g., zinc sulfide) used for non-spectrometric measurements: Day of use?		
M6: 7.1.5.c.ii.e	The frequency of background subtraction measurements may be increased from the above requirements when there is a low tolerance for unacceptable data due to being outside background subtraction measurement acceptance.		Permission
M6: 7.1.5.c.iii	Composite measurements, in which the background subtraction is determined by combining background measurements collected in a manner that results in a representative determination of the background with a combined counting time at least as long as the longest associated Test Source count time?		

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M6: 7.1.5.d	Are there procedures for performing and evaluating background subtraction measurements?		
M6: 7.1.5.d	Do these procedures include the following?		
M6: 7.1.5.d.i	Indicate the frequency and length of background subtraction measurements?		
M6: 7.1.5.d.ii	Establish control or tolerance charts and acceptance criteria of background subtraction measurements? and		
M6: 7.1.5.d.iii	Ensure that the background subtraction measurement counts or count rate of a detector or an analytical region of interest is monitored for significant changes that introduce bias significant enough that could compromise the use of these measurements?		
M6: 7.1.5.e	When the background subtraction has changed since the previous determination such that significant bias is imparted to intervening Test Source measurements, is the nonconforming work process initiated?		
M6: 7.1.5.e	If the bias cannot be resolved, are all affected results qualified?		
M6: 7.1.5.f	Are Background Subtraction Count (BSC) measurements conducted after calibration and thereafter at the minimum frequencies identified in this module?		
M6: 7.1.5.g	Are measurements monitored for trends to ensure that a laboratory maintains its capability to meet required project objectives?		
M6: 7.1.5.h	Is a background subtraction collected before and after any counting chamber changes are made (i.e., cleaning, liner replacement, or instrument modification)?		
M6: 7.1.6	Short Term Background Checks		
M6: 7.1.6	Short-term background checks, performed between background subtraction measurements, are QC measures used to verify the integrity of background subtraction measurements, check for possible detector contamination, electronics noise and to monitor each detector for trends and deviations from Poisson statistics. These background checks may be shorter in duration, yet more frequent than the background subtraction measurements, and therefore they may not always effectively identify every discrepancy that could compromise Test Source measurements (e.g., low-level contamination).		Clarifying Statement
M6: 7.1.6	Are short-term background checks performed between background subtraction measurements?		
M6: 7.1.6.a	Are there written procedures for performing and evaluating short-term background checks?		
M6: 7.1.6.a	Do these procedures include the following?		
M6: 7.1.6.a.i	Indicate the frequency and length of checks?		

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M6: 7.1.6.a.ii	Establish control or tolerance charts and acceptance criteria of short-term background checks? and		
M6: 7.1.6.a.iii	Ensure that the short-term background counts or count rate of a detector or an analytical region of interest is monitored for significant changes that would indicate background bias significant enough that could compromise Test Source results?		
M6: 7.1.6.b	Exceptions to minimum frequencies for short-term background checks:		
M6: 7.1.6.b.i	If an individual Test Source is uninterruptedly measured for a time longer than the required interval between short-term background checks to allow completion of the count of a Test Source, are short-term background checks performed at the beginning and end of the measurement period meeting all applicable acceptance criteria? and		
M6: 7.1.6.b.ii	If Test Sources are uninterruptedly measured for a time longer than the required interval between short-term background checks to allow for completion of a Preparation Batch or RMB measured on an instrument with an automated sample changer (e.g., a liquid scintillation or gas proportional counter), does the period between the checks not exceed seven calendar days, are the checks done at the beginning and end of the measurement period, and do the checks meet all applicable acceptance criteria?		
M6: 7.1.6.c	When short-term background has changed since the previous determination, such that significant background bias is imparted to intervening Test Source measurements, is the nonconforming work process initiated?		
M6: 7.1.6.c	If the bias cannot be resolved, are all affected results qualified?		
M6: 7.1.6.d	If background subtraction measurements are performed with sufficient frequency for a given method or detector type, such that they ensure background integrity and are capable of identifying detector contamination, the background subtraction measurements may be substituted for short-term background checks, in which case the short-term background checks shall not be required.		Permission
M6: 7.1.6.e	For liquid scintillation detectors, is the short-term unquenched background checked each day of use?		
M6: 7.1.6.f	If the background check is conducted less frequently than daily, are any associated sample results not released for use until a (bracketing) background check is measured and has met all acceptance criteria?		

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M6: 7.1.6.g	Is a background check collected before and after any counting chamber changes are made (i.e., cleaning, liner replacement, or instrument modification)?		
M6: 7.1.7	Contamination Monitoring		
M6: 7.1.7	Are there written procedures that address cases where radiation detectors have been contaminated, as determined by the background subtraction measurements, short-term background checks, or method blanks?		
M6: 7.1.7	Are detectors not brought back into service until corrective actions are completed?		
M6: 7.2	Quality Control for Radiochemistry		
M6: 7.2.1	General		
M6: 7.2.1.a	Is there a documented QC program followed that monitors and assesses the performance of the laboratory's measurement systems?		
M6: 7.2.1.a	At a minimum, does the QC program incorporate requirements imposed by the reference method, laboratory procedure, customer specifications, and/or this standard?		
M6: 7.2.1.a	Where imposed regulations are more stringent than this Standard, do the imposed regulations take precedence?		
M6: 7.2.1.a	If it is not apparent which requirement is more stringent, are the requirements of the regulation or the mandated method followed?		
M6: 7.2.1.a	Where there are no established requirements, the laboratory may reference guidelines consistent with MARLAP or other consensus standard organizations in its quality system.		Permission
M6: 7.2.1.b	Is a sample Preparation Batch or an RMB employed to determine the grouping of samples and assignment of batch QC?		
M6: 7.2.1.b.i	Is a sample Preparation Batch initiated where sample testing is performed that involves physical or chemical processing which affects the outcome of the test?		
M6: 7.2.1.b.i	Are samples and associated QC assigned to a Preparation Batch prepared together using the same processes, personnel, and lot(s) of reagents?		
M6: 7.2.1.b.ii	Where testing is performed that does not involve physical or chemical processing which affects the outcome of the test (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors), an RMB may be initiated in lieu of a Preparation Batch. The samples and associated QC in the RMB shall share similar physical and chemical parameters, and analytical		Permission

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	configurations (e.g., analytes, geometry, calibration, and background correction).		
M6: 7.2.1.b.iii	Samples may be added to the RMB for 14 calendar days from the start of the first sample count, or until 20 environmental samples have been counted, whichever occurs first.		Permission
M6: 7.2.1.b.iv	The laboratory may combine samples and associated QC within an RMB that share a range of physical and chemical parameters, and analytical configurations (e.g., analytes, geometry, calibration, density) that conform to the ranges of physical and chemical parameters, and analytical configurations demonstrated by method validation studies.		Permission
M6: 7.2.1.b.iv	Do laboratory procedures document how method validation is performed?		
M6: 7.2.1.b.iv	Do laboratory records document any corrections (e.g., for efficiency, density, cascade summing, and background) applied to physical calibrations?		
M6: 7.2.1.c	Does the QC program document the frequency required for QCs? Note: Minimum QC requirements are specified below.		
M6: 7.2.1.d	Are all batch QC samples processed together with, and under the same conditions, as the associated samples and are the same processes and procedures used for preparation, analysis, data reduction and reporting of results? Note: Although samples in a Preparation Batch shall be prepared together, they need not be analyzed concurrently on a single detection system, rather they may be analyzed on different detection systems as long as the detection systems are calibrated for the technique in question and instrument QCs indicate that the systems are in control.		
M6: 7.2.1.e	Are specific detectors, equipment or glassware for the analysis of QC samples not systematically or preferentially used? Note: This should not preclude laboratories from segregating detectors, equipment, or glassware to minimize the risk of cross-contamination of samples or equipment as long as the criteria for segregation applies equally to batch QC samples and samples.		
M6: 7.2.1.f	Does the QC program document acceptance criteria for batch QC samples, sample-specific QCs, and for the evaluation of long-term trends and the methods used to establish these criteria?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.1.g	Are the results of the QC samples assessed against acceptance criteria documented in the QC program?		
M6: 7.2.1.g	Where there are no established criteria in regulations, the method, or contract, is acceptance criteria developed consistent with guidelines in MARLAP or other consensus standards, or other criteria such as statistical control charts developed by the laboratory?		
M6: 7.2.1.h	Are the results of batch QC samples tracked and trended using statistical or tolerance control charts?		
M6: 7.2.1.i	When results do not meet acceptance criteria, is the nonconforming work process implemented?		
M6: 7.2.1.i	Are samples associated with a Method Blanks and Laboratory Control Samples that are outside acceptance considered as suspect and, wherever possible, the samples are reprepared and analyzed?		
M6: 7.2.1.i	Where samples cannot be reprepared and analyzed, are results reported with appropriate data qualifiers?		
M6: 7.2.1.i	Where sample specific quality controls are outside acceptance limits, is the data evaluated to determine if the source of the failure is analytical error? If so, are the affected quality control and field samples reprepared and analyzed if sufficient sample material is available?		
M6: 7.2.1.i	Where samples cannot be reprepared and analyzed, are specific analytes qualified in the parent sample and is the occurrence of a QC sample falling outside acceptance criteria and any associated actions noted in the laboratory report?		
M6: 7.2.1.j	Method specific QC requirements are located in Appendix B of this standard.		Clarifying Statement
M6: 7.2.1.j	Do all method QC samples follow customer requirements or Appendix B requirements?		
M6: 7.2.2	Negative Control – Method Performance: Method Blank (MB) The MB assesses the process of handling, preparation and analysis for cross-contamination and for low-level analytical bias. For methods with minimal physical treatment or no chemical processing (e.g., drying, grinding and homogenization of solid samples, or preparation of sample Test Sources for swipe or air filter samples for non-destructive gamma spectrometry or alpha-beta counting), the MB assesses sample handling and the analytical process.		Clarifying Statement
M6: 7.2.2.a	Is a method blank analyzed at a minimum of one per Preparation Batch or RMB?		
M6: 7.2.2.b	Does the MB sample Test Source simulate quality system matrix characteristics that significantly affect		

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	results, such as geometry, size, and other factors, as appropriate?		
M6: 7.2.2.b.i	Is the MB prepared using materials that are free of analytes of interest at levels that will interfere with the evaluation of the results?		
M6: 7.2.2.b.i	If an analyte-free matrix is not available, is a surrogate matrix used to simulate the quality system matrix?		
M6: 7.2.2.b.ii	Is the sample aliquot used for the MB similar to that of routine samples?		
M6: 7.2.2.b.ii	If the sample aliquot in a Preparation Batch varies (e.g., due to differences in sample density or restrictions on the activity or mass residue that may be processed), does the acceptance criteria used compensate for differing aliquot sizes (e.g., z-score per Section 18.4.1 of MARLAP Vol. III (EPA 402-B-04-001C))?		
M6: 7.2.2.c	Are there procedures in place to determine if a MB result is significantly different from zero or impacts the analytical results? Examples are below.		
M6: 7.2.2.c.i	The MB exceeds the pre-established upper or lower bounds for the measurement, where the upper and lower bounds are plus x times the Standard Uncertainty and negative y times the Standard Uncertainty (x and y are the coverage factors for the confidence interval as established by the laboratory's quality system). The upper and lower bounds are not necessarily symmetrical; and		Example
M6: 7.2.2.c.ii	When applicable, the sample-specific MDA for the MB is greater than the required MDA.		Example
M6: 7.2.2.d	Is the nonconforming work process implemented if it is determined that a MB result is significantly different from zero and associated sample results are less than five times the MB activity, or if a MB result may impact the analytical results?		
M6: 7.2.2.e	Are results of MBs evaluated for long term trends, absolute bias, possible contamination, or interferences that may affect sample results?		
M6: 7.2.2.f	Is the batch MB not subtracted from sample results in the associated Preparation Batch or RMB?		
M6: 7.2.2.f	The laboratory may subtract the average historical activity of MB measurements to address a demonstrated bias.		Permission
M6: 7.2.2.f	Is the uncertainty of the subtracted value accounted for in its estimate of uncertainty for the final result?		
M6: 7.2.2.g	Are batch blanks counted for a sufficient time to meet the required detection limit, except in the case where the achieved MDA is calculated from the standard deviation of a blank population? In this case, the batch		

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	blanks shall be counted for the same count time as the samples.		
M6: 7.2.2.h	Are the following batch blank matrices used for all radiochemistry analyses?		
M6: 7.2.2.h.i	For aqueous samples: Distilled or deionized water, analyte free, as demonstrated in Method Blanks?		
M6: 7.2.2.h.ii	For solid samples: Characterized solid material representative of the sample matrix?		
M6: 7.2.2.h.iii	For filter samples: Preferably use a customer supplied filter blank from the same production lot number as the collected samples. Alternately, use filters physically and chemically identical to that collected by the customer (analyte free)?		
M6: 7.2.3	Positive Control – Method Performance: Laboratory Control Sample (LCS)		
M6: 7.2.3	The LCS is used to evaluate the performance of the measurement system, including all preparation and analysis steps. For methods with minimal physical treatment and no chemical processing (e.g., drying, grinding and homogenization of solid samples, or preparation of sample Test Sources for swipe or air filter samples for nondestructive gamma spectrometry or alpha-beta counting), the LCS assesses the analytical process for bias.		Clarifying Statement
M6: 7.2.3.a	Is a LCS analyzed at a minimum of one per Preparation Batch or RMB?		
M6: 7.2.3.a	For RMBs, a calibration verification standard may be analyzed in lieu of the LCS.		Permission
M6: 7.2.3.b	Does the LCS Test Source simulate quality system matrix characteristics that significantly affect results, such as geometry, size or other factors?		
M6: 7.2.3.b.i	Is the material used to create the LCS free of analytes of interest at levels that will interfere with the evaluation of the results?		
M6: 7.2.3.b.i	If an analyte-free matrix is not available, is a surrogate matrix used to simulate the sample matrix?		
M6: 7.2.3.b.i	If analyte-free materials are not available for the LCS, are the materials characterized and documented for the analyte(s) of concern and accounted for in the evaluation of the LCS?		
M6: 7.2.3.b.ii	Is the aliquot used for the LCS similar to that of routine samples?		
M6: 7.2.3.b.ii	If the aliquot in a Preparation Batch varies (e.g., due to restrictions on the activity or mass residue that may be processed), is an acceptance criterion for samples used that compensates for differing aliquot sizes (e.g., z-score per MARLAP, Vol. III, Chapter 18, Section 18.4.3)?		

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M6: 7.2.3.c	For methods with minimal physical treatment and no chemical processing, the laboratory may prepare the LCS a single time and reuse the standard with subsequent batches of samples.		Permission
M6: 7.2.3.d	Is the LCS spiked at a level such that the uncertainty of the analytical result is less than 1/3 of the acceptance criteria? For example, if it is required that the LCS result be within +/-30% of the known value, the laboratory shall spike the LCS at a level such that the uncertainty of the analytical result is less than or equal to 10%.		
M6: 7.2.3.d	Is the LCS spiked at a level comparable to the action level if known; or that of routine samples if the activities are expected to exceed 10 times the Decision Level?		
M6: 7.2.3.e	When available, does the standard used to prepare the LCS meet the requirements for reference standards?		
M6: 7.2.3.e	The final prepared LCS need not be traceable to a NMI.		Permission
M6: 7.2.3.e	Does the LCS include all of the radionuclide(s) being determined with the following exceptions?		
M6: 7.2.3.e.i	For methods that measure gross activity (e.g., gross alpha, gross beta), is appropriate surrogate analyte used? Note: This will generally be the radionuclide(s) used to calibrate the detector.		
M6: 7.2.3.e.ii	For alpha spectrometry measurements, when multiple individual radionuclides with similar chemical characteristics are determined simultaneously with a single measurement and calibration, is only one of the analytes/isotopes included in the LCS at the activity level? and		
M6: 7.2.3.e.iii	Where a non-destructive gamma-ray spectrometry measurement is made using a multipoint energy/efficiency calibration curve which covers the energy range of the analyte(s) of interest, is either of the following applied by the laboratory?		
M6: 7.2.3.e.iii.a	A radionuclide with similar gamma energies as those of the analyte(s) of interest may be used (e.g., Barium-133 may be used in place of Iodine131)? or		Permission
M6: 7.2.3.e.iii.b	Does the LCS contain gamma-emitting radionuclides that, at a minimum, represent the low (e.g., Americium-241) and high (e.g., Cobalt-60) energy range of the analyzed gamma-ray spectra?		

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	Note: Commonly a medium energy radionuclide is also included in the LCS (e.g., Caesium-137). As indicated by these examples, the nuclides need not exactly bracket the calibration energy range or the range over which radionuclides are identified and quantified.		
M6: 7.2.3.f	Are the results of the batch LCS evaluated using a statistical technique such as the percent recovery or z-score that allows comparison to acceptance criteria documented in the laboratory QC program?		
M6: 7.2.3.g	Where more than one analyte is spiked at a level that meets the LCS requirements, is each assessed against the specified acceptance criteria?		
M6: 7.2.3.h	Is the LCS counted for a sufficient time to quantify the activity level of the LCS?		
M6: 7.2.3.i	Based on specific project or program requirements or when there is insufficient sample available, the laboratory may choose to analyze a LCS in duplicate in place of a MD. The LCS and its duplicate will provide a measure of analytical precision. However, they will not provide information on matrix effects.		Permission
M6: 7.2.4	Sample-Specific QC Measures		
M6: 7.2.4	Are there documented procedures for determining the effect of the sample matrix on the analytical results?		
M6: 7.2.4	These procedures relate to the analyses of specific QC samples and are designed as data quality indicators for a specific sample using the designated method. Examples of sample-specific QC include: Matrix Spike (MS); Matrix Spike Duplicate (MSD), Matrix Duplicate (MD), Tracers, and Carriers. The laboratory shall have procedures in place for tracking, managing, and handling sample-specific QC criteria including spiking radionuclides at appropriate activities, calculating recoveries, determining variability (e.g., relative percent difference and/or z-score), and evaluating and reporting results based on the performance of the QC samples.		Clarifying Statement
M6: 7.2.4.a	Matrix Spike		
M6: 7.2.4.a.i	MS recoveries are an indication of effects of the matrix on sample result accuracy using the selected method. The MS results are employed by the data user to determine if an MS issue has any impact on the related batch samples. This QC check is not typically employed for non-destructive methods (e.g., gamma spectrometry or direct counting of samples for alpha or beta radioactivity), or for methods that employ a chemical yield tracer or carrier for each sample.		Clarifying Statement

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.4.a.ii	Is the frequency of the analysis specified by the method, a regulation or determined as part of the contract review process?		
M6: 7.2.4.a.iii	Are the radionuclides spiked as specified by the mandated method, regulation or as determined as part of the contract review process?		
M6: 7.2.4.a.iii	At minimum, are the radionuclide spikes consistent with those specified for the LCS?		
M6: 7.2.4.a.iv	Is the quantity of the aliquot used for the MS similar to that of routine samples analyzed in the Preparation Batch?		
M6: 7.2.4.a.iv	If the sample size in the Preparation Batch varies (e.g., due to restriction on the activity or mass residue that may be processed), are appropriate corrections applied to compensate for differing aliquot sizes when applying the acceptance criteria for the batch?		
M6: 7.2.4.a.v	When an MS is required, is the lack of sufficient sample aliquot to perform an MS explained in the case narrative?		
M6: 7.2.4.a.vi	Is the activity of the MS analyte(s) greater than five times the MDA?		
M6: 7.2.4.a.vii	Are the acceptance criteria for MS recoveries established as specified by the method, regulation or contract?		
M6: 7.2.4.a.vii	Where there are no mandatory acceptance criteria established in the method, regulation or contract, are the acceptance criteria based on industry practices and guidelines, or consistent with the guidelines of MARLAP or other consensus standards?		
M6: 7.2.4.a.vii	Are these criteria documented or referenced in the laboratory's quality manual?		
M6: 7.2.4.a.viii	When available, does the standard used to prepare the MS meet the requirements for reference standards?		
M6: 7.2.4.a.viii	The final prepared MS need not be traceable to a NMI.		Permission
M6: 7.2.4.a.ix	Is the MS prepared by adding a known activity of target analyte prior to performing any processes that affect the analyte of interest (e.g., chemical digestion, dissolution, ashing, separation, etc.)?		
M6: 7.2.4.a.x	Are the matrix spikes run on a separate sample aliquot using the same analyte as that being analyzed?		
M6: 7.2.4.a.xi	Matrix Spike Selection and Level		
M6: 7.2.4.a.xi.a	Is the matrix spike added at a concentration of at least five times, but not greater than 20 times the Decision Level?		
M6: 7.2.4.a.xi.b	For samples having known significant activity of the targeted radionuclides, more than 20 times the Decision Level may be added to minimize the effect of		Permission

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
	the sample activity on determination of spike recoveries.		
M6: 7.2.4.a.xi.c	When other customer specifications are required, is the customer direction recorded?		
M6: 7.2.4.a.xii	Counting		
M6: 7.2.4.a.xii.a	Is the matrix spike counted for a sufficient time to quantify the activity level of the spiking?		
M6: 7.2.4.b	Matrix Duplicates/Matrix Spike Duplicates		
M6: 7.2.4.b.i	A duplicate is defined as a second aliquot of the same sample taken through the entire analytical procedure. The results of this analysis provide indications of the measurement precision of the analyte for the specific sample using the selected method. Duplicate analyses provide a measure of precision when the target analyte is present in the sample chosen for duplication.		Clarifying Statement
M6: 7.2.4.b.ii	Are acceptance criteria for duplicates established as specified by the reference method, laboratory procedure, customer specifications, and/or this standard?		
M6: 7.2.4.b.ii	Where there are no mandatory acceptance criteria established in the method, regulation or contract, are acceptance criteria developed based on industry practices and guidelines, such as control charting developed by the laboratory, or consistent with the guidelines of MARLAP or other consensus standards?		
M6: 7.2.4.b.ii	Are these criteria documented or referenced in the laboratory's quality manual?		
M6: 7.2.4.b.iii	At a minimum, is one MD analyzed per Preparation Batch or RMB?		
M6: 7.2.4.b.iii	For RMBs, does the MD consist of a second measurement of one sample?		
M6: 7.2.4.b.iii	If the batch is counted on more than one detector, is the MD performed on a second detector?		
M6: 7.2.4.b.iv	When samples have low-levels of activity (less than approximately three times the MDA), the laboratory, at its discretion, may analyze MS/MSD to determine reproducibility within a Preparation Batch in place of a MD.		Permission
M6: 7.2.4.c	Chemical Yield Tracers and Carriers		
M6: 7.2.4.c.i	For those methods that employ a radioactive Tracer or a stable Carrier as a chemical yield monitor in the analysis, does each sample have an associated chemical yield calculated and reported?		
M6: 7.2.4.c.i	Is the chemical yield one of the QC measures used to assess the associated sample result acceptance?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.4.c.ii	Does the selection of a Tracer or Carrier not significantly interfere with the analyte(s) of interest nor cause bias in its measurements?		
M6: 7.2.4.c.ii	When such a Tracer or Carrier is unavailable, is the interference or bias caused quantifiable and an appropriate correction applied to the sample results?		
M6: 7.2.4.c.iii	Is the Tracer or Carrier used to monitor chemical yield added to the sample prior to performing any processes that affect the analyte of interest (e.g., chemical digestion, dissolution, ashing, separation, etc.) unless otherwise specified by the method?		
M6: 7.2.4.c.iv	Is the chemical yield assessed against acceptance criteria specified in the method, regulation, contract or laboratory procedure?		
M6: 7.2.4.c.iv	Are the criteria for data acceptance based on guidelines established in the MARLAP or other criteria such as control charting developed by the laboratory?		
M6: 7.2.4.c.iv	Does the assessment meet established project or program MQOs?		
M6: 7.2.4.c.v	When the established chemical yield acceptance criteria are not met, is the nonconforming work process implemented?		
M6: 7.2.4.c.v	Are the occurrence of a chemical yield outside acceptance and the actions taken explained in the case narrative?		
M6: 7.2.4.c.vi	When tracers or carriers are used, is each sample (including any batch associated QC samples) also spiked with the same materials and individual sample yields determined?		
M6: 7.2.4.c.vii	Requirements for indirect yield measurements		
M6: 7.2.4.c.vii.a	When used, are radiometric results corrected for chemical yield using 'indirect' yield measurement techniques such as a second radiometric measurement of added tracer or gravimetric measurement of added carriers?		
M6: 7.2.4.c.vii.b	Do the acceptance criteria for the chemical yield for each sample determined using an indirect yield measurement method fall between 30% -110% or as specified by the customer?		
M6: 7.2.4.c.vii.c	Is the technique used for the indirect yield measurement sufficient to maintain relative uncertainties associated with the yield correction below 10% at 2 standard deviations?		
M6: 7.2.4.c.vii.d	When tracer impurities or peak tailing from the tracer effectively raise the detection limit of an intended analyte, are smaller tracer activities used to achieve an acceptable detection limit with customer approval?		

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M6: 7.2.4.c.vii.d	Are records of customer approval maintained?		
M6: 7.2.4.c.viii	Are sample results with yields below 30% considered quantitative and acceptable if the following are met?		
M6: 7.2.4.c.viii.a	The relative uncertainty associated with the yield correction is less than 10% (2 standard deviations)?		
M6: 7.2.4.c.viii.b	Spectral resolution requirements are met and there are no indications of spectral interferences (alpha spectroscopy)? and		
M6: 7.2.4.c.viii.c	Detection limit requirements are met?		
M6: 7.2.4.c.ix	Reporting yield measurement uncertainties		
M6: 7.2.4.c.ix.a	Is the uncertainty associated with chemical yield corrections incorporated into the CSU of the associated sample results?		
M6: 7.2.4.c.x	Tracer yield requirements for isotope direct yield methods (usually alpha spectroscopy)		
M6: 7.2.4.c.x.a	Are the acceptance criteria for chemical yield for isotope direct yield methods 30% -110% or as specified by the customer?		
M6: 7.2.4.c.x.b	Are tracer activity and sample count duration adequate to achieve relative uncertainties for the tracer measurement of less than 10% at 2 standard deviations?		
M6: 7.2.5	Data Reduction		
M6: 7.2.5.a	Are the procedures for data reduction documented?		
M6: 7.2.5.b	Is detection capability (e.g., MDA or Critical Level) calculated as described in Section 5.2?		
M6: 7.2.5.c	Measurement uncertainties shall be calculated and reported		
M6: 7.2.5.d	Negative Numbers:		
M6: 7.2.5.d.i	Are all negative activities reported as such?		
M6: 7.2.5.d.ii	If the sum of the activity and the measurement uncertainty at ± 3 standard deviations is a negative number, is the cause investigated and evaluated to determine if it is systematic or random uncertainty?		
M6: 7.2.5.d.ii.a	If the cause is systematic, is it corrected?		
M6: 7.2.5.d.ii.b	If the cause is random, is it discussed in the case narrative?		
M6: 7.2.5.d.iii	Recurrent problems with significant negative results suggest that the background subtraction and/or blank subtraction, if applicable, are in question or that the estimate of uncertainty is low.		Clarifying Statement
M6: 7.2.5.d.iv	Does the laboratory investigate the cause of recurrent negative results?		
M6: 7.2.5.d.iv	Are records of these investigations maintained?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.5.d.iv	Are all instances of negative results discussed in the case narrative?		
M6: 7.2.6	Reagent Quality, Water Quality, and Checks		
M6: 7.2.6.a	In methods where the purity of reagents is not specified, are reagents analytical reagent grade or better?		
M6: 7.2.6.a	Are reagents of lesser purity than those specified by the method not used?		
M6: 7.2.6.b	Is the quality of water sources monitored and documented and do they meet method specified requirements?		
M6: 7.2.6.c	Does the QC program establish and maintain provisions for radionuclide standards?		
M6: 7.2.6.c.i	Are reference standards obtained from a NMI or from suppliers of NMI reference standards? Note: Alternatively, reference standards may be obtained from an ISO 17034 accredited reference material provider, or an ANSI N42.22 reference material manufacturer.		
M6: 7.2.6.c.ii	Are reference standards accompanied with a certificate of calibration that meets the requirements of either ISO Guide 31, or ANSI N42.22, Section 8, Certificates, and include at least the following information: manufacturer, radionuclides calibrated, identification number, calibration method, activities or emission rates with associated uncertainties and the confidence limits, standard quantity, activity reference time (date or time as appropriate to the half-life of the radionuclide), physical and/or chemical description of the source, and radionuclide impurities?		
M6: 7.2.6.c.iii	Are standards prepared or derived from externally-obtained reference materials verified against an independent standard obtained from a second manufacturer prior to use for analysis of samples?		
M6: 7.2.6.c.iii	The use of a standard from a second lot obtained from the same manufacturer is acceptable for use as a second-source standard.		Permission
M6: 7.2.6.c.iii	Are discrepancies between observed and expected values investigated and appropriate measures taken that document the validity of standards prior to use?		
M6: 7.2.6.c.iv	Is radioactive decay/ingrowth accounted for whenever decay/ingrowth has occurred between the Activity Reference Date and use that could impact use of the results?		
M6: 7.2.6.c.v	Are there written procedures for handling, storing, and establishing expiration dates for reference standards?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.6.c.vi	If there is no known provider of a particular standard (e.g., non-routine radionuclide or non-standard matrix) that is traceable to the International System of Units (SI), the laboratory may have no alternative but to use a standard with less rigorously established traceability. In this event, is the minimum information obtained from the provider? Does the laboratory independently verify the activity of these standards prior to use and document the verification?		
M6: 7.2.6.c.vii	If the laboratory's verification indicates a significant deviation from the original information from the provider, does the laboratory not use the standard unless the discrepancy is resolved? If the standard is used for analysis of sample unknowns, is the source and any other known limitations of the standard disclosed in the final report?		
M6: 7.2.6.d	Standards shall be verified prior to initial use		
M6: 7.2.6.d.i	Are preparations of standards solutions used for a period exceeding one year verified annually, at a minimum, and the records of the verification maintained?		
M6: 7.2.6.d.ii	Are at least three verification measurements of a standard used to determine the mean value and standard deviation of the verification results?		
M6: 7.2.6.d.iii	Is the mean value within 5% of the decay corrected certified value?		
M6: 7.2.6.d.iv	Does the 2 standard deviations used for the 95% confidence interval of the mean not exceed 10% of the mean value of the three verification measurements?		
M6: 7.2.6.d.v	If the above criteria are met, is the certified value used?		
M6: 7.2.7	Constant and Consistent Test Conditions		
M6: 7.2.7.a	Are test instruments ensured to consistently operate within the specifications required of the application for which the equipment is used?		
M6: 7.2.7.b	Is labware shall be cleaned to meet the sensitivity requirements of the method?		
M6: 7.2.7.b	Are any cleaning and storage procedures that are not specified by the method documented in the laboratory's quality system and records? Note: Some applications may require single-use glassware.		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.2.7.c	Is a radiological control program maintained that addresses analytical radiological control?		
M6: 7.2.7.c	Does the radiological control program explicitly define how low-level and high-level samples will be identified, segregated and processed to identify and minimize sample cross-contamination?		
M6: 7.2.7.c	Does the radiological control program include the measures taken to monitor and evaluate background activity or contamination on an ongoing basis?		
M6: 7.2.7.d	Are background contamination monitoring samples analyzed at a sufficiently low level of detection to confirm that no impacts to customer samples have occurred due to cross-contamination?		
M6: 7.2.7.e	Are samples segregated by activity levels in sample receipt, processing areas, and storage areas?		
M6: 7.3	Data Evaluation and Reporting		
M6: 7.3.1	Negative Control – Method Performance: Method Blank (MB)		
M6: 7.3.1.a	Are MB results evaluated for long term trends, absolute bias, possible contamination or interferences that may affect results for samples in the batch?		
M6: 7.3.1.b	If acceptance limits are not met, is the nonconforming work process implemented to investigate the source of contamination or other bias?		
M6: 7.3.1.b	If sample activity levels are greater than five times the activity found in the MB, lacking other requirements, it is acceptable to report qualified results for the samples associated with the MB. Otherwise, are the associated samples reprepared and analyzed?		
M6: 7.3.1.c	When sample results associated with a MB falling outside acceptance are reported, is the nonconforming work process implemented and is this explained in the case narrative?		
M6: 7.3.1.d	Are blank acceptance criteria: $\lvert Z_{Blank} \rvert \leq 3$ (MARLAP 18.4.1) or a MB laboratory-developed acceptance criteria of ± 3 standard deviations of the mean is used?		
M6: 7.3.1.e	When utilizing MARLAP, is the following equation, defined in Section 18 (Equation 18.1) for Method Blank evaluations, used? $$ZBlank = \frac{x}{uc(x)}$$ Where: x denotes the measured blank activity $u_c(x)$ denotes its combined standard uncertainty		
M6: 7.3.2	Positive Control – Method Performance: Laboratory Control Sample (LCS)		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.3.2.a	Are LCS recoveries evaluated to assess the performance of the entire measurement system independent of the sample matrix?		
M6: 7.3.2.a	Are LCS results calculated in percent recovery or other appropriate statistical measure that allows comparison to established acceptance criteria?		
M6: 7.3.2.a	Is the LCS calculation documented?		
M6: 7.3.2.b	An LCS that is determined to be within established acceptance limits effectively demonstrates that the measurement system is in control and validates system performance for the samples in the associated batch.		Clarifying Statement
M6: 7.3.2.b	Are samples associated with an LCS that falls outside acceptance limits considered suspect and reprepared and analyzed?		
M6: 7.3.2.b	If samples cannot be reprepared and analyzed, is the nonconforming work process implemented and is this explained in the case narrative?		
M6: 7.3.2.c	Are limits derived using $\lvert Z_{LCS} \rvert \leq 3$ or is the laboratory-developed acceptance criteria of LCS ± 3 standard deviations of the mean used?		
M6: 7.3.2.d	Do laboratory-developed acceptance criteria not fall more than 25% from the known LCS value?		
M6: 7.3.2.e	When utilizing MARLAP, is the following equation defined in Section 18 of MARLAP (Equation 18.3) used for LCS evaluations: $$Z_{LCS} = \frac{x - d}{\sqrt{uc^2(x) + uc^2(d)}}$$ Where: x is the measured value of the spiked sample d is the spike concentration added uc^2 (x) and uc^2 (d) are the squares of the respective standard uncertainties		
M6: 7.3.3	Sample-Specific Controls		
M6: 7.3.3.a	Matrix Spike, Matrix Duplicates, and Matrix Spike Duplicates		
M6: 7.3.3.a.i	MS and MD allow evaluation of the effect of matrix on the accuracy and precision of results.		Clarifying Statement
M6: 7.3.3.a.i	Are results from MS calculated as percent recovery or other appropriate statistical measure that allows comparison to established acceptance criteria?		
M6: 7.3.3.a.i	Are results from MD and MSD precision calculated as relative percent difference, $\mathbf{z}_{Rep}$ (see MARLAP, Vol. III, Chapter 18, Section 18.4.2), or other appropriate statistical measure that allows comparison to established acceptance criteria?		
M6: 7.3.3.a.i	Is the calculation of QC results documented?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.3.3.a.ii	For results outside established criteria, is the nonconforming work process implemented and the data reported with appropriate data qualifiers?		
M6: 7.3.3.a.ii	Are QC results outside acceptance limits explained in the case narrative?		
M6: 7.3.3.a.iii	Are matrix spike recoveries evaluated using the following criteria?		
M6: 7.3.3.a.iv	If the activity of the sample is less than five times the spiking level, are the matrix spike recoveries within the acceptance criteria of 60 -140%, or as specified by the customer?		
M6: 7.3.3.a.v	If the activity of the sample is greater than five times the spiking level, is $\lvert Z_{MS} \rvert \leq 3$ used?		
M6: 7.3.3.a.vi	When utilizing MARLAP, is the following equation defined in Section 18 of MARLAP (Equation 18.4) used for MS evaluations: $$Z_{MS} = \frac{x - xo - d}{\sqrt{uc^2(x) + uc^2(xo) + uc^2(d)}}$$ Where: x is the measured value of the spiked sample d is the spike concentration added xo is the measured concentration of the unspiked sample uc^2 (x), uc^2(d), and uc^2(xo) are the squares of the respective standard uncertainties		
M6: 7.3.3.a.vii	Is the Matrix Duplicate activity not averaged with the corresponding sample activity when reporting results?		
M6: 7.3.3.a.viii	Are samples identified as FB not used for Matrix Duplicate sample analysis?		
M6: 7.3.3.a.ix	Is the Matrix Duplicate counted for the same duration as the corresponding original sample and meets the required detection limit?		
M6: 7.3.3.a.x	Are Matrix Duplicates evaluated using three possible criteria?		
M6: 7.3.3.a.x	Does the management system document which option shall be used for each method?		
M6: 7.3.3.a.x	When the MARLAP, DER or the RPD meet the acceptance criteria, is the Matrix Duplicate considered acceptable?		
M6: 7.3.3.a.x.a	$\lvert Z_{Dup} \rvert \leq 3$ if using MARLAP (equation 18.2): $$Z_{Dup} = \frac{\lvert x_1 - x_2 \rvert}{\sqrt{uc^2(x_1) + uc^2(x_2)}}$$ Where: x_1 and x_2 denote the two measured activity concentrations uc^2 (x_1), and uc^2(x_2) are the squares of the respective standard uncertainties		
M6: 7.3.3.a.x.b Supplemental Information: 03/11/2024	Is the Duplicate Error Ratio (DER) between the sample and the Matrix Duplicate ≤ 3 ? or		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 7.3.3.a.x.c Supplemental Information: 03/11/2024	Is the relative percent difference (RPD) ≤ 25%?		
M6: 7.3.3.b	Tracers and Carriers		
M6: 7.3.3.b.i	For those methods that employ radioactive Tracers or stable Carriers as chemical yield monitors in each sample, are results expressed as percent yield or other appropriate statistical measure that allows comparison to established acceptance criteria?		
M6: 7.3.3.b.ii	For alpha spectrometry, does the evaluation of Tracer acceptability include evaluation of chemical yield (e.g., uncertainty, variability) and peak resolution?		
M6: 7.3.3.b.iii	Are samples associated with Tracers or Carriers that fall outside acceptance limits considered suspect and reprocessed and/or reanalyzed.		
M6: 7.3.3.b.iii	If samples cannot be reprocessed and/or reanalyzed, is the nonconforming work process implemented and is this explained in the case narrative?		
M6: 7.3.4	Evaluation of Sample Results		
M6: 7.3.4.a	Is instrument raw data from energy spectral analysis evaluated to ensure that the target radionuclides are quantified consistent with laboratory procedures and applicable MQOs, and that target radionuclides in the spectra are evaluated for possible interferences?		
M6: 7.3.4.b	Are results reviewed for internal consistency, such as the presence of radionuclides consistent with known parent-progeny relationships and expected or likely decay series?		
M6: 7.3.4.c	Are sample-specific estimates of uncertainty and MDA evaluated to ensure that MQOs have been met?		
M6: 7.3.4.d	If these objectives have not been met, are samples reprepared and reanalyzed?		
M6: 7.3.4.d	If samples cannot be reprepared and analyzed, is the nonconforming work process implemented and is this explained in the case narrative?		
M6: 7.3.5	Reporting Results		
M6: 7.3.5.a	Are reports delivered to the laboratory's customer consistent with the requirements of this Standard?		
M6: 7.3.5.b	Are results reported directly as obtained, with appropriate units, even if the results are negative?		
M6: 7.3.5.c	Are results expressed with an appropriate number of significant figures?		
M6: 7.3.5.d	Are all radiochemical results reported with an estimate of uncertainty?		

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M6: 7.3.5.e	Is the Activity Reference Date reported in association with all radiochemical measurement results?		
M6: 7.3.5.f	Project-or customer-specified reporting requirements can take precedence over the requirements of this Standard.		Permission
M6: 7.4	Sample Handling		
M6: 7.4.1	While it may not be possible to physically verify all methods of preservation (e.g., addition of oxidizing or reducing agents), wherever practicable, are samples verified to have been preserved in compliance with all applicable requirements specified by regulation, method, contract, or as established in the laboratory's quality system (if there are no established mandatory criteria)?		
M6: 7.4.2	Are the required timing, methods for performing measurements to verify preservation, the acceptance range, or any other conditions indicating acceptable preservation documented?		
M6: 7.4.2.a	Where thermal preservation of samples is required, is the temperature of samples verified upon receipt?		
M6: 7.4.2.b	Where chemical preservation of samples is required, is it verified that samples have been preserved using readily available techniques such as pH measurement prior to sample preparation or analysis?		
M6: 7.4.3	If the results of the preservation verification do not satisfy established criteria, is the nonconforming work process implemented (i.e., notification of the customer, preservation of the sample at the time of discovery) and are all impacted test results qualified in the report to the customer?		
M6: 8.0	Method Specific Directions		
M6: 8.1	Isotopic Determinations by Alpha Spectrometry		
M6: 8.1	In the absence of customer specified criteria, is the criteria outlined in Table B-16, Alpha Spectrometry used?		
M6: 8.1.1	Calibration (Initial, Initial Verification, and Continuing Verification)		
M6: 8.1.1.a	Doe the calibration of each alpha spectrometry detector used to produce data include channel vs. energy calibration, detector response, efficiency determination and background determination for each Region of Interest (ROI)?		
M6: 8.1.1.b	Is an energy calibration for each detector performed?		
M6: 8.1.1.b	Is a curve fit for Energy (Y-axis) versus Channel (X-axis) and the equation with the slope and Y-intercept for the fit recorded?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.1.1.c	Are alpha spectrum regions of interest selected with consistency from analyte to analyte?		
M6: 8.1.1.d	Are ROIs clearly indicated either graphically or in tabular form on alpha printouts?		
M6: 8.1.1.d	Are records including spectra with ROIs maintained and made available for review upon request?		
M6: 8.1.1.e	Is the estimated uncertainty in preparing the source propagated into the uncertainty of the efficiency determination?		
M6: 8.1.1.f	Detector Response		
M6: 8.1.1.f.i	Are the response (efficiency) counts for the ROI background corrected using the same ROI for the background?		
M6: 8.1.1.f.i	If the background is less than 0.5% of the total counts in the ROI, no background correction is necessary.		Clarifying Statement
M6: 8.1.1.f.ii	Are records maintained of the detector response and detector response uncertainty?		
M6: 8.1.1.f.iii	Are records maintained of the detector response check as determined by the check source and/or pulser count and the associated uncertainty and limits of acceptability for the check source result?		
M6: 8.1.2	Background Correction		
M6: 8.1.2.a	Are the gross counts in each target analyte and tracer ROI corrected for the particular detector's background contribution in those same ROIs?		
M6: 8.1.2.b	Are the background total counts (or counts per unit time) for each target analyte and tracer isotope ROI determined on each detector at least monthly, prior to initial use or after initial calibration?		
M6: 8.1.2.b	Are the background total counts and tracer isotope ROI records maintained?		
M6: 8.1.2.c	Is the background for each ROI sufficiently low to ensure that required detection limits are met?		
M6: 8.1.2.d	Are the limits of acceptability for each background ROI defined?		
M6: 8.1.2.d	Are these limits set such that Decision Levels can be obtained for backgrounds at the limit of acceptability?		
M6: 8.1.3	Batch Quality Control (Method Blank, Laboratory Control Sample, Matrix Spike, Matrix Duplicate)		
M6: 8.1.3.a	In the absence of customer specified criteria, is the criteria outlined in B-16, Alpha Spectrometry used?		
M6: 8.1.4	Tracer and/or Carrier		
M6: 8.1.4.a	When used for isotope specific analysis by alpha spectrometry, does initial sample preparation include treatment to ensure that tracer/carrier and analyte will undergo similar reactions during processing?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.1.4.b	Are all tracers/carriers of the same element or of an element with the same chemistry as the isotopes of interest for the separations?		
M6: 8.1.4.c	Are all tracers used for alpha spectrometry tested by the laboratory for contribution in the ROI of the analytes of interest.		
M6: 8.1.4.c	If a significant contribution is found, is the method for correction documented and records maintained?		
M6: 8.1.5	Spectrum Evaluation		
M6: 8.1.5.a	Is each sample and QC sample spectrum assessed for correctly chosen ROIs, acceptable spectral resolution, acceptable energy calibration and interferences with the analyte and tracer ROIs?		
M6: 8.1.5.b	Are any manual integration or adjustment of ROIs discussed in the case narrative?		
M6: 8.1.5.c	If the target analyte and tracer peaks are not resolved because the target analyte activity is significantly larger than the tracer activity, is the sample reanalyzed with a smaller aliquot such that the tracer and analyte peaks are resolved?		
M6: 8.1.5.d	If the sample analyte spectrum contains significant interferences with the analyte and/or tracer ROIs, is reanalysis required?		
M6: 8.2	Gamma Spectrometry		
M6: 8.2	Does the gamma detector system consist of any detector suitable for measuring the gamma isotopes of interest with the capacity to attain specified required limits and to meet bias and precision requirements?		
M6: 8.2	Ge detectors of either intrinsic (pure) germanium or lithium drifted germanium are preferred; however, for some specific requirements, another detector type, such as sodium iodide, may be more appropriate.		Clarifying Statement
M6: 8.2	In the absence of customer specified criteria, is the criteria outlined in Table B-17, Gamma Spectrometry used?		
M6: 8.2.1	Calibration (Initial, Initial Verification and Continuing Verification)		
M6: 8.2.1.a	Energy Calibration Requirements		
M6: 8.2.1.a.i	Germanium Detectors		
M6: 8.2.1.a.i.a	Are the energy calibration measurements made using at least six peaks which cover the energy range from 0.059 to approximately 2 MeV?		
M6: 8.2.1.a.i.a	Additional peaks may be used as deemed appropriate by the laboratory.		Permission
M6: 8.2.1.a.i.b	Are at least 10,000 net counts (total counts minus the Compton continuum and ambient background)		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
	accumulated in each full-energy gamma-ray peak of interest (ASTM D 3649-98a)?		
M6: 8.2.1.a.ii	Sodium Iodide Detectors		
M6: 8.2.1.a.ii.a	Refer to ANSI N42.12, Section 4.3.2 for guidance on NaI detectors. Note: Refer to ANSI N42.14, Section 5.1 for guidance on calibrating gamma-ray energy as a function of channel number at a fixed gain.		Clarifying Statement
M6: 8.2.1.b	Efficiency Calibration Requirements		
M6: 8.2.1.b.i	Germanium Detectors		
M6: 8.2.1.b.i.a	Does the efficiency calibration approach selected for broad spectrum gamma analysis cover the energy range of the gamma ray peaks used for nuclide quantification?		
M6: 8.2.1.b.i.b	When establishing an efficiency curve as a function of energy, are the efficiency calibration measurements at least six peaks which cover the typical energy range of approximately 0.059 to 2 MeV?		
M6: 8.2.1.b.i.c	Low Energy Response: If the detector is to be used for emissions below the lowest energy of a broad-spectrum calibration (e.g., below the 0.059 MeV criteria identified above), is additional demonstration of acceptable calibration performed?		
M6: 8.2.1.b.i.c.1	If manufacturer's information indicates that low-energy response below the lowest energy in the calibration standard is expected to be constant, does use of the detector below that point require check sources or LCS quality control checks that contain the isotope to be quantified (or other isotope with lower emission energies)?		
M6: 8.2.1.b.i.c.2	Is acceptable recovery demonstrated for every detector used in that lower range?		
M6: 8.2.1.b.i.c.3	If low-energy response below the lowest energy calibration standard is not expected to be constant, does use of a gamma detector at energies below the lowest calibration point require that a single-isotope efficiency curve or separate low-energy curve bounding the energy of interest established for that isotope?		
M6: 8.2.1.b.i.c.4	In all cases, has it been demonstrated that sample matrix effects (including potential attenuation from sample containers) on low energy emissions have been accounted for?		
M6: 8.2.1.b.ii	Sodium Iodide Detectors:		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.2.1.b.ii.a	Are efficiencies determined when there is a change in resolution, geometry, or system configuration?		
M6: 8.2.1.c	Model Based Efficiency Calibration Requirements		
M6: 8.2.1.c	Software may be used to generate efficiencies for samples where a standard calibration source of known matrix and geometry cannot be specified. This type of calibration technique is preferred for matrices such as waste or debris and shall be validated with a physical reference standard. When such software is used:		Permission
M6: 8.2.1.c.i	Are there detailed records of the selection of parameters used to specify the efficiency calibration and sample models?		
M6: 8.2.1.c.ii	Does each sample type selected for analysis using this model-based calibration have a unique set of model parameters associated with it?		
M6: 8.2.1.c.iii	When such models are used, is the closest model to the actual sample selected?		
M6: 8.2.1.c.iv	Is the model selected for each sample discussed in the case narrative and includes a discussion of actual and predicted peak ratios for isotopes with multiple gamma energies present in the sample?		
M6: 8.2.1.d	Initial Calibration Verification (when required)		
M6: 8.2.1.d.i	Is a minimum of 5,000 net counts accumulated in each peak in at least four calibration verification peaks that bracket the range of use?		
M6: 8.2.2	Background		
M6: 8.2.2.a	Background Subtraction Count		
M6: 8.2.2.a.i	Is the counting interval for the long count between one and four times the nominal counting interval of the test sources?		
M6: 8.2.2.b	Contamination Check		
M6: 8.2.2.b.i	Is the spectrum integrated from about 50 – 2,000 keV to check for gross contamination and information retained in laboratory records?		
M6: 8.2.3	Batch Quality Control		
M6: 8.2.3.a	Are LCS matrices consistent with the associated samples and contain representative nuclides within the energy ranges of those nuclides to be reported?		
M6: 8.2.4	Are detectors calibrated for the specific geometry and matrix considerations used in the sample analysis?		
M6: 8.2.5	Spectral Data Reference		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.2.5.a	Are records maintained of the identification of the reference used for the half-life, abundance, and peak energy of all nuclides?		
M6: 8.2.5.b	Has the laboratory documented, reviewed, and provided configuration control for gamma spectrometry libraries?		
M6: 8.2.5.c	Are assumptions made for libraries [i.e., half-lives based on supported/unsupported assumptions, inferential determinations (e.g., Thorium-234 = Uranium-238 because supported)] maintained in laboratory records, and available upon request?		
M6: 8.2.6	Spectrum Assessment		
M6: 8.2.6.a	Are each sample and QC sample spectrum assessed for acceptability of key peak width and shape and interference due to superimposed peaks or other sources?		
M6: 8.2.6.b	Are any major contributor to the spectrum that is an unidentified peak (e.g., an isotopic peak not requested by the customer, not included in the library for identification, or not included in the client library used) discussed in the case narrative?		
M6: 8.3	Gas Flow Proportional Counting		
M6: 8.3	In the absence of customer specified criteria, is the criteria outlined in Table B-18, Gas Flow Proportional Counting used?		
M6: 8.3.1	Calibration (Voltage Plateau, Initial Efficiency, Cross-Talk, Self-Absorption, Initial Efficiency Verification, and Continuing Calibration Verification)		
M6: 8.3.1.a	Do the calibration sources provide adequate counting statistics over the period for which the source is to be counted?		
M6: 8.3.1.b	Is the source activity in the range expected from routine samples and not be high enough to cause pulse pileups or dead time that impacts the analyses?		
M6: 8.3.1.c	Is the geometry of the calibration sources used for efficiency and self-absorption/cross-talk curves the same planchets, including depth, shape (flat, flanged, ringed, etc.) and diameter as that of the prepared sample and QC sample planchets?		
M6: 8.3.1.d	Are the sources used for the determination of self-absorption and cross-talk of similar isotope content to that of the target analytes? Note: Normally, Americium-241; Polonium-210; or Thorium-230 are used for alpha and Caesium-137or Strontium90/ Yttrium-90 are used for beta.		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.3.1.e	Is the frequency, procedure, and criteria for calibration described in the laboratory procedure or reference method?		
M6: 8.3.1.f	Cross-talk Factors		
M6: 8.3.1.f.i	Is a cross-talk curve established for alpha to beta cross-talk versus residue weight for each nuclide using traceable calibration sources per matrix and method?		
M6: 8.3.1.f.ii	Beta to alpha cross-talk is not significantly affected by planchet residue weight and is generally constant over the applicable weight range. Therefore, this cross-talk correction does not require residue weight consideration.		Clarifying Statement
M6: 8.3.1.f.iii	Is the data used to generate cross-talk curves consisting of at least seven points, well distributed throughout the mass range?		
M6: 8.3.1.f.iv	Crosstalk correction is not necessary when there is no net activity in the opposing channel as is the case when counting chemically separated radionuclides.		Clarifying Statement
M6: 8.3.1.g	Self-Absorption (Mass Attenuation) Curves		
M6: 8.3.1.g.i	Are self-absorption curves determined for both alpha and beta counting?		
M6: 8.3.1.h	Initial and Continuing Efficiency Calibration Verification		
M6: 8.3.1.h.i	Are records maintained of all calibration verifications?		
M6: 8.3.2	Background Correction		
M6: 8.3.2.a	Is the background sufficiently low to ensure that required detection limits are met?		
M6: 8.3.2.b	Is a Long Background Count performed for subtracting background from blanks and test sources?		
M6: 8.3.2.b	Is the counting interval for the long count at least the same as the normal counting time for blanks and test sources?		
M6: 8.3.3	Batch Quality Control (Method Blank, Laboratory Control Sample, Matrix Spike, Matrix Duplicate): In the absence of customer specified criteria, is the criteria outlined in Table B-18, Gas Flow Proportional Counting used?		
M6: 8.3.4	Tracer and/or Carrier When used for GPC analysis, does initial sample preparation include treatment to ensure that tracer/carrier and analyte will undergo similar reactions during processing?		
M6: 8.3.4	Do all tracers/carriers have the same chemistry as the isotopes of interest for the separations?		
M6: 8.3.5	Planchets		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.3.5.a	Are planchets thoroughly cleaned before use to ensure that there are no interfering residues or contamination?		
M6: 8.3.5.b	Are all planchets prepared not to exceed sample weights in excess of the calibrated ranges of established self-absorption curves?		
M6: 8.3.5.c	Are planchets exhibiting physical characteristics notably different from the self-absorption standards (e.g., evidence of corrosion) not counted unless remediation efforts such as additional sample preparation and remounting or flaming prove unsuccessful?		
M6: 8.3.6	Sample Analyses		
M6: 8.3.6.a	Is sample mass recorded and demonstrated to be stable prior to counting?		
M6: 8.3.6.b	Are any non-routine counting situations discussed in the case narrative?		
M6: 8.4	Liquid Scintillation Counting		
M6: 8.4	In the absence of customer specified criteria, is the criteria outlined in Table B-19, Liquid Scintillation Counter Analysis used?		
M6: 8.4.1	Tritium in Water Are water samples for tritium analysis and all associated QC samples distilled prior to analysis unless specified otherwise by the customer?		
M6: 8.4.1	Does the applicable preparation procedure specify the fraction to be collected?		
M6: 8.4.1	Is the same fraction collected for samples and all associated QC samples?		
M6: 8.4.2	Counting Vial Preparation		
M6: 8.4.2.a	Are samples counted in low potassium glass vials or high-density polyethylene vials?		
M6: 8.4.2.a	Are any other vials accepted for use by the customer?		
M6: 8.4.2.a	Are records of the acceptance criteria maintained?		
M6: 8.4.2.b	Are samples in polyethylene vials counted within a time period not to exceed the manufacturer's specification for the cocktail used in the analysis?		
M6: 8.4.2.b	Do analytical records contain sufficient information for this to be verified?		
M6: 8.4.2.c	Are vials prepared according to manufacturer's specification for the cocktail?		
M6: 8.4.2.d	Are the vials "dark adapted" for a minimum of 30 minutes or according to the cocktail manufacturer's specifications before counting?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
M6: 8.4.2.e	Are the prepared vials inspected to verify that the sample loaded properly in the cocktail and there is no visual evidence of phase separation before or after completion of the count?		
M6: 8.4.2.f	Is the sample volume to scintillation cocktail volume ratio consistent for all standards and samples?		
M6: 8.4.3	Calibration (Initial, Initial Verification, and Continuing Verification) Any component of the cocktail that affects the energy transfer process and has a significant effect on the analysis and is referred to as quench. The quench of a cocktail can be affected by: color; turbidity; molecules of high electron affinity; solvent; acidity; and dissolved gases. Calibrations are typically established using an efficiency-response/quench curve.		Clarifying Statement
M6: 8.4.3.a	Are calibration quench sets not stored in direct sunlight or under fluorescent lights?		
M6: 8.4.3.b	For analysis methods using quench curves to determine individual sample detection efficiency or background, are the quench curves generated at a frequency defined by the laboratory and described in the laboratory procedure?		
M6: 8.4.3.c	Is a calibration established for each radionuclide and liquid scintillation cocktail matrix?		
M6: 8.4.4	Detector Response		
M6: 8.4.4.a	Are calibration and window settings specific for a radionuclide/method application?		
M6: 8.4.5	Instrument Background		
M6: 8.4.5.a	Is the instrument background vial for all tritium matrices prepared with low-tritium or “dead” water unless the laboratory can demonstrate suitably small background or blank effects from other sources of water?		
M6: 8.4.5.b	Is the instrument background vial prepared with the same water to cocktail ratio as the samples are prepared?		
M6: 8.4.5.c	Is the type of water (dead water, DI water, etc.) used to prepare the instrument background vial identified in the procedure?		
M6: 8.4.5.d	Is the instrument background analyzed with each sample batch?		
M6: 8.4.5.d	Unless calculated from a running average of background counts or a background quench curve, is the most recent background count used to calculate sample activities and MDAs?		

DoD/DOE QSM 6.0 Clause	Requirement	Conformity C / NC / NA	Comments/Objective Evidence
	Note: This is not a performance check, rather a background subtraction sample in a configuration equivalent to that of associated samples in the batch. It is used to generate the background subtraction data for the batch (using the results associated directly with that batch, results of a rolling mean, or background quench curve).		
M6: 8.4.5.e	Is the effect of quench on background evaluated and corrected using a background quench curve if it is significant?		
M6: 8.4.6	Batch Quality Control (Method Blank, Laboratory Control Sample, Matrix Spike, Matrix Duplicate) In addition to the requirements in 7.1.5 b), d), if customer criteria are not specified, is the criteria outlined in Table B-19, Liquid Scintillation Counter Analysis used?		
M6: 8.4.6.a	Tracer and/or Carrier		
M6: 8.4.6.a.i	If a laboratory uses a tracer or carrier, is its use and implementation specified in the laboratory's procedure?		
M6: 8.4.6.a.ii	When used for isotope specific analysis by liquid scintillation counter analyses, does initial sample preparation include treatment to ensure that tracer/carrier and analyte will undergo similar reactions during processing?		
M6: 8.4.6.a.iii	Are all tracers used for liquid scintillation counter analysis tested by the laboratory for contribution in the regions of interest (ROI) of the analytes of interest?		
M6: 8.4.6.a.iii	If a significant contribution is found, is the method for correction documented and accepted by the customer prior to use?		
M6: 8.4.6.a.iii	Are records maintained?		
M6: 8.4.7	Spectrum Evaluation		
M6: 8.4.7.a	Are sample spectra reviewed and made available to the customer for each sample and QC sample?		
M6: 8.4.7.b	Are each sample and QC sample spectrum assessed for correctly chosen ROIs, acceptability of peak shape, and interferences due to non-target analytes or luminescence?		
M6: 8.4.8	Sample-Specific Conditions The following are additional conditions that require reanalysis for a particular sample and analyte, beginning with the preparation or recounting, as appropriate.		Clarifying Statement

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M6: 8.4.8.a	If the sample quench does not fall within the range of the quench curve, are the samples reanalyzed such that the sample quench is in the range of a quench curve?		
M6: 8.4.8.a	If this cannot be achieved, is it discussed in the case narrative?		
M6: 8.5	Radon Scintillation (Lucas Cell)		
M6: 8.5	Does the analyses by Lucas Cell incorporate EPA Method 903.1 (current version), Radium226 in Drinking Water Radon Emanation Technique, or ASTM D3454?		
M6: 8.5	When references are updated, is an implementation schedule determined by the laboratory?		
M6: 8.5	Are deviations from the method documented in the laboratory's procedure and accepted by the customer?		
M6: 8.5	In the absence of customer specified criteria, is the criteria outlined in Table B-20, Radon Scintillation shall used?		
M6: 8.5.1	Calibration (Initial, Initial Verification, and Continuing Verification)		
M6: 8.5.1.a	Are bubblers used for Radium-226 calibrations not used for sample analysis?		
M6: 8.5.1.b	Is Initial Calibration performed prior to use, following repair, loss of control, or upon incorporation of new or changed instrumentation?		
M6: 8.5.1.b.i	Is the operating voltage plateau for each detector established?		
M6: 8.5.1.b.ii	Are the manufacturer's specifications verified and is each selected operational voltage confirmed it is within the slope range of <2%/100V?		
M6: 8.5.1.b.iii	Is the Cell/Detector Efficiency established for each Cell/Detector pair by using a traceable Radium-226 calibration source that matches the test sample configuration (type, size, and position relative to the detector)?		
M6: 8.5.1.c	Continuing Calibration Verification		
M6: 8.5.1.c.i	Is a detector response check performed each day of use using an appropriate test source?		
M6: 8.5.1.c.i	Are the results of this detector response check within established laboratory-developed acceptance criteria?		
M6: 8.5.1.c.ii	Is each Cell/Detector pair efficiency verified at least annually?		
M6: 8.5.1.c.ii Supplemental Information: 03/11/2024	Is the continuing efficiency for each Cell/Detector pair within ± 25% of the initially determined efficiency?		

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M6: 8.5.1.d	Does any cell/detector pair removed from service require re-calibration prior to being returned to service?		
M6: 8.5.2	Background Counts		
M6: 8.5.2.a	Is each Cell cleaned/purged, evacuated, and counted on its paired detector prior to the next use?		
M6: 8.5.2.a	Are results of this background count within the laboratory-developed acceptance criteria that does not impact sample analyses?		
M6: 8.5.3	Batch Quality Control (Method Blank, Laboratory Control Sample, Matrix Spike, Matrix Duplicate)		
M6: 8.5.3.a	Method Blank		
M6: 8.5.3.a.i	Unless required by the program, are quality control checks not used to correct sample activities, but only to monitor contamination?		
M6: 8.5.3.a.ii	Is one method blank prepared per preparatory batch?		
M6: 8.5.3.a.iii	Are batch method blank samples rotated though cell/detector pairs to provide evidence of continuing process contamination control?		
M6: 8.5.3.a.iv	Is the count time for the method blanks equal to or longer than associated sample count times?		
M6: 8.5.3.a.v Supplemental Information: 03/11/2024	Is the acceptance criteria for the method blank $\|Z_{Blank}\| \leq 3$ or within laboratory-developed criteria of ± 3 standard deviations of the mean?		
M6: 8.5.3.b	Laboratory Control Sample		
M6: 8.5.3.b.i	Is one LCS prepared per preparatory batch?		
M6: 8.5.3.b.ii	Are batch LCS samples rotated though cell/detector pairs to provide evidence of continuing calibration?		
M6: 8.5.3.b.iii Supplemental Information: 03/11/2024	Does the LCS meet customer specified requirements, acceptance criteria of $\|Z_{LCS}\| \leq 3$, or laboratory-developed acceptance criteria of ± 3 standard deviations of the mean that are within 25% of the known LCS value?		
M6: 8.5.3.c	Matrix Spike Sample		
M6: 8.5.3.c.i	Is one MS prepared per preparatory batch?		
M6: 8.5.3.c.ii	Does the MS shall meet customer specified requirements, an acceptance criterion of $Z_{MS} \leq 3$ if the activity level of the sample is greater than 5 times the spiking level or be within 40-140% recovery?		
M6: 8.5.3.d	Duplicate		
M6: 8.5.3.d.i	Is one duplicate prepared per preparatory batch (one per 10 for drinking water sample groups)?		
M6: 8.5.3.d.ii	Does the duplicate meet customer specified requirements, acceptance criteria of $\|Z_{Dup}\| \leq 3$, a		

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	duplicate error ratio of < 3, or a relative percent difference of ≤25%?		
M6: 8.5.4	Carrier		
M6: 8.5.4.a	If carriers are used quantitatively, is the criteria in Table B20 of Appendix B followed?		