Radiochemistry Expert Committee (REC)
Meeting Summary

July 27, 2016

1. Roll Call and Minutes:

Bob Shannon, Chair, called the meeting to order at 1pm Eastern on May 25, 2016 by teleconference. Attendance is recorded in Attachment A – there were 9 members present. Associate Members: Jim Chambers, Carl Kircher, Brian Miller, Terry Romanko and Bill Rogers (DOE/ETTP – Oak Ridge).

The May 25, 2016 minutes were distributed by email for review on June 6, 2016. No comments were received. They are considered approved and will be posted on the TNI website.

There was no meeting in June.

2. DOE Review of 2016 Module 6

Bill Rogers attended the meeting. The new Standard was compared to the DOE/DOD Standard.

Bob noted that the main goal of the new Standard was to make everything clearer. There was a lot of rewording done.

Bill commented that everything they reviewed appeared reasonable and the only new thing they are looking at is the quench crosstalk calibration of liquid scintillation detectors, which they had not seen before. This will require some thought on their part on how to implement it. He commented that it does not look like there is any exclusion.

Bob noted that this is an example for when a method requires it. The calculations are the same as they are for proportional counting. People should already be familiar with it.

Bill commented that the new Standard was a dramatic improvement in terms of clarification.

3. Subcommittee Updates

Assessor Training

Carolyn has not had a chance to make progress on this item. She expects to have a report next month.

Assessor Checklist

Larry, Vas and Marty have moved forward with the checklist. Updated copies were distributed to the committee on 7-26-16. The committee worked through these two checklists and a copy of the updates discussed below can be found in Attachment D (Note: The numbers line up with the version sent 7-26-16. The new version in Attachment D has been renumbered.)

Comments:

Checklist from 5/20/16:

Tom Semkow reviewed the checklist through Item #88 and provided written comments to Larry.

#49 – Larry asked about removing the note. He would prefer to delete the note to reduce bulk in the checklist.

Marty noted that a lot of people using the checklists are not as technically competent and the information should be left in for them.

Ilona noted that other TNI checklists do include notes, so she suggested that this should be noted in the checklist instructions since it is inconsistent with other checklists provided by TNI.

Richard and Nile prefer to leave the note in too.

The majority of the committee would like to leave it in, so it will be left in.

#50 –
Note left in to be consistent.

Marty commented that there are other notes that were taken out, so the subcommittee will go back and see if there are other notes that need to be included.

#52 – Reference will be removed. Not needed in checklist.

#53 – Will be left in.

#60 –
Larry proposes rewording to: Are sample results being calculated without batch specific matrix blank subtraction?

The note in the standard was not restated verbatim in the checklist. There was a slight re-wording. Marty asked if it should be verbatim.

Richard asked whether the second sentence dealing with uncertainty and the subtracted value should be included too.
Larry agreed the whole note should be there.

#61 – Leave note.

There should be an introductory page to the Checklist to explain that the checklist is not a replacement for the Standard. Ilona also noted that it should be clear that we are paraphrasing. Use the term "Clarification" instead of "Note" when it is a clarification that was not included in the Standard.

#69: It is not a note. It is just part of the Standard and will be left in.

#78:

This should be reworded as a question or it should be deleted.

Ilona suggested greying out any parts of the checklist where there really is no question. The section is only for information. You could also combine the information with the actual question relevant to the information.

#78 could be combined with #80.

The committee looked at different scenarios to see if this could be reworded into a question. Needs active language.

Larry agreed with Richard's suggestion of "where applicable, is a duplicate prepared by using a second aliquot through the entire procedure …". Something like this should be added to #78.

Bob asked about the second sentence – how would this result in a finding? Others agreed it would not.

The third sentence – "only " was on in the original. It changes the sense of it. Marty thinks "only" needs to be removed and other's agreed.

Carolyn does not think the second and third sentence add anything. Others agreed and the last two sentences will be removed. The first will be reworded into a question.

#82 – Suggestion that second sentence could be removed. It is universal. There was agreement.

#84 –
Tom explained his concerns. He suggested deleting the second question. It cannot be cause because tracer and carrier are not available.

The first question should be rephrased to avoid questioning the negative. This would avoid the second sentence/question.

Carolyn asked if the checklist is being set-up to look for a "Yes" response to each question. Larry and Marty did not think they did this.

Larry thinks the third question should be stricken. Everyone agreed.

Carolyn suggested changing "nor" to "or" in the first sentence.

Checklist from 6/15/16:

There was text added in from the May meeting. Larry asked people to look closely at 1-19 since there is red text that has been added and needs review. These changes were meant to address the insufficient detail noted during the last meeting.

Larry emphasized that review is really needed by committee members on the entire checklist.

Larry will take Bob's marked up version of the 5/20 checklist and add them to the 6/15 checklist. He will send out the new version for review in the next few days (Attachment D).

Bob asked if it would help to do some of these reviews by email by splitting it into specific sections to be reviewed each time. Bob will coordinate these reviews in smaller chunks to hopefully encourage more people to participate in the review.

Laboratory Training

A target has not been set for this information.

Small Laboratory Handbook

Dave sent Bob the version of the Small Lab Handbook he is working on. Bob will send out a copy to make sure everyone has one.

Dave came on the call at 2:17. He needs comments on the handbook before the next meeting. He is checking with the Quality Systems Expert Committee on format, but at this point he is asking for comments on content. He also needs more examples.

5. New Business

It was asked whether the Standard is final. The answer is "Yes". Marty had a few complaints from a lab. Ilona noted that the complaints may be helpful for developing the lab training. There was agreement.

6. Action Items

A summary of action items can be found in Attachment B.

7. Next Meeting and Close

Next months meeting will be scheduled by email. Bob may not be able to meet the regular meeting time.

A summary of action items and backburner/reminder items can be found in Attachment B and C.

The meeting was adjourned 2:24 pm Eastern. (Motion: Marty Second: Kieth Unanimously approved.)

Attachment A
Participants
Radiochemistry Expert Committee

Members	Affiliation		Contact Information	
			Phone	Email
Bob Shannon (Chair) **Present**	QRS, LLC Grand Marais, MN	Other	218-387-1100	BobShannon@boreal.org
Tom Semkow (Vice Chair) **Present**	Wadsworth Center, NY State DOH Albany, NY	AB	518-474-6071	thomas.semkow@health.ny.gov
Sreenivas (Vas) Komanduri **Absent**	State of NJ Department of Environmental Protection Trenton, NJ	AB	609-984-0855	Sreenivas.Komanduri@dep.state.nj.us
Marty Johnson **Present**	US Army Aviation and Missile Command Nuclear Counting Redstone Arsenal, AL	Lab	865-712-0275	Mjohnson@tSC-tn.com
Dave Fauth **Present**	Consultant Aiken, SC	Other	803-649-5268	dj1fauth@bellsouth.net
Carolyn Wong **Present**	Lawrence Livermore National Laboratory Livermore, CA	Lab	925-422-0398	CTWRACE@gmail.com
Keith McCroan **Present**	US EPA ORIA NAREL, Montgomery AL	Lab	334-270-3418	mccroan.keith@epa.gov
Nile Ludtke **Present**	Dade-Moeller and Associates Oak Ridge, TN	Other	865-481-6050	nile.luedtke@moellerinc.com
Larry Penfold **Present**	Test America Laboratories, Inc; Arvada, CO	Lab	303-736-0119	larry.penfold@testamericainc.com
Richard Sheibley **Present**	Sheibley Consulting, LLC	Other (Former AB)	651-485-1875	RHSHEIB111@yahoo.com
Ron Houck **Absent**	PA DEP/Bureau of Laboratories	AB	717-346-8210	rhouck@pa.gov
Ilona Taunton (Program Administrator) **Present**	The NELAC Institute	n/a	828-712-9242	Ilona.taunton@nelac-institute.org

Attachment B

Action Items – REC

	Action Item	Who	Target Completion	Completed
63	Send note to QS to ask them to consider making all references to "days" more clear by stating "calendar" days.	Bob	7/13/15	
68	Send common lab assessment findings to Dave for his use in preparing the chapter for the Small Lab Handbook.	All	10/20/15 Ongoing	
70	Send a request to get "Lesson Learned" ideas from committee and associate members.	Dave	11/17/15	
71	Follow-up with Ken and Shawn regarding PT Standard Issue.	Bob	11/17/15	
75	Prepare copy of Standard annotated with summary document language.	Carolyn	6/15/16	
76	Send Handbook to committee for review by the next meeting.	Bob All	8/24/16	
77	Combine changes to checklists and send out new update.	Larry	8/3/16	
78	Send Checklist Review requests in smaller chunks to make it easier and quicker to review.	Bob	Ongoing	

Attachment C – Back Burner / Reminders

	Item	Meeting Reference	Comments
1	Update charter in October 2016	n/a	
2	Issue of noting modifications to methods.	1/16/13	
4	Look at need to reference year for any standard references– which version is being referenced. Is this necessary?	5/22/13	
5	Form subcommittee of experts in MS and other atom counting techniques to see that these techniques are adequately addressed in the radiochemistry module.	9/24/14	

Guidance To Users Of This Checklist

- This checklist is a tool auxiliary to the TNI Standard. It is comprised of questions used to assess compliance with the 2015 TNI Standard, Volume 1, Module 6. The language in the checklist sometimes paraphrase the language in the Standard. If there are any apparent conflicts between checklist and the Standard, the original language in the Standard is primary.

- Where a "Clarification" is added to the checklist, this is added to help explain the item of inquiry, but it is not intended to change the meaning of the Standard.

- Where a "Note" is added to the checklist, it is a note taken directly from the Standard, and in accordance with TNI convention does not change the meaning or intent of the Standard.

- Where a declarative statement is added to the checklist without being identified as a "Clarification" or as a "Note," the language is taken verbatim from the Standard.

Assessment Checklist for Radiochemistry 7/27/2016 Draft

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Methods Reviewed – *complete as appropriate*

Gross Alpha/Gross Beta	***Strontium-89-90***	***Americium***
☐ 900.0, ☐ water	☐ 905.0, ☐ water	☐ Am-01-RC, ☐ solid
☐ 7110B, ☐ water	☐ Sr-03, ☐ water, ☐ solid, ☐ air	☐ Am-04-RC, ☐ water, ☐ air
☐ 9310, ☐ water, ☐ solid*, ☐ air*	☐ Sr-04, ☐ water	
		Plutonium Isotopes
Total Radium	**Tritium**	☐ Pu-01-RC, ☐ air
☐ 903.0, ☐ water	☐ 906.0, ☐ water	☐ Pu-02-RC, ☐ solid
☐ 903.1, ☐ water	☐ H-02, ☐ water	☐ Pu-03-RC, ☐ solid
☐ 9315, ☐ water, ☐ solid*, ☐ air*	☐ 7500-3H B, ☐ water	
	☐ Sr-02, ☐ water	**Uranium**
Radium-226	☐ 300 3H-04, ☐ water	☐ 908.0, ☐ water
☐ 903.2, ☐ water		☐ 908.1, ☐ water
☐ Ra-04, ☐ water	**Carbon-14**	☐ 7500-U B ☐ water
☐ 7500-Ra B, ☐ water	☐ C-01, ☐ water	☐ 7500-U C ☐ water
☐ 7500-Ra C, ☐ water		☐ U-02, ☐ water, ☐ solid, ☐ air
☐ EMSL-19, ☐ water, ☐ solid, ☐ air	**Cesium-134/137**	☐ U-04, ☐ water, ☐ solid, ☐ air
	☐ 901.0, ☐ water	
Radium-228		**Gamma Emitters**
☐ 904.0, ☐ water	**Iodine-131**	☐ 901.1, ☐ water
☐ Ra-05, ☐ water	☐ 7500-I B, ☐ water	☐ 902.0, ☐ water
☐ 7500-Ra D, ☐ water	☐ 7500-I C, ☐ water	☐ Ga-01-R, ☐ water, ☐ solid, ☐ air
☐ 9315 , ☐ water, ☐ solid, ☐ air		
☐ 9320, ☐ water, ☐ solid		
Analytes: _____Lab SOP # _____	**Analytes: _____Lab SOP # - _____**	**Analytes: _____Lab SOP # _____**

Notes: Solids can include soils, sediments, sludges, vegetation, and other bulk materials
* EPA 9310 and/or 9315 modified to include solids and/or air

[The methods and matrices above are examples. Accreditation bodies and assessors should edit to list methods/matrices in their program.]

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Item No.	Line of Inquiry		Status			Observations/Comments
			Y	N	n/a	
Method Validation						
1	V1M6, 1.5.1 a)	Does the laboratory, - Validate all methods, prior to their acceptance and institution, for which data will be reported? - Validate all methods across the range of physical and chemical parameters (e.g., density, Test Source composition, and analytical configurations) and activities that will be encountered in samples? - Where applicable, activity range includes zero activity (e.g., a method blank) in the validation?				
2	V1M6, 1.5.1 b), 1.5.2 through 1.5.5	Does the laboratory, - Validate method(s) in each quality system matrix? - Demonstrate method detection capability (DL for drinking water, MDA of other applications)? - Does the validation include evaluation of the following: - Precision - Bias - Measurement Uncertainty, and - Selectivity				
3	V1M6, 1.5.1 c)	For each method for which documented data are not otherwise available, does the laboratory perform validation to demonstrate that the above requirements are met?				
4	V1M6, 1.5.1 d)	Has the laboratory recorded the quality system matrix used in initial method validation studies?				
5	V1M6, 1.5.1 e)	Do the laboratory's method validations comply with the requirements at V1M2 5.4.5.1 through V1M2 5.4.5.3?				
6	V1M6, 1.5.1 f)	Has the laboratory documented the method validation procedure used and the results obtained? Does the documentation include a statement on the suitability of the method for the intended use?				
7	V1M6, 1.5.1 g)	Does the laboratory analyze, wherever available, externally-produced quality control samples from a nationally or internationally recognized source provider to determine its ability to produce acceptable data?				
8	V1M6, 1.5.2	Has the laboratory established detection capability for each method/matrix combination? Has the laboratory documented the procedure used to determine the detection capability? Does the laboratory documentation of detection capability identify the software used for calculations?				

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9	V1M6, 1.5.2.1 a) - c)	Does the laboratory's MDA include all sample processing steps? Is the laboratory's initial detection capability determined in a quality system matrix free of target analytes and interferences at levels that would impact results? Does the laboratory document detection capability each time there is a change in the test method or instrumentation that affects the analytical detection capability?				
10	V1M6, 1.5.2.2	If performing drinking water analysis for SDWA compliance, does the laboratory's detection capability conform to requirements in 40 CFR 141.25 c)?				
11	V1M6, 1.5.2.3 a)	Does the laboratory's method validation documentation include an evaluation of precision and bias for each analyte of interest, characterized across the range of activities that brackets the activities applicable in samples, including zero activity?				
12	V1M6, 1.5.2.3 b) - c)	Does the laboratory's method validation include all sample preparation steps in each relevant quality system matrix? Is the 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?				
13	V1M6, 1.5.2.3 d)	Where there are no established criteria for precision and bias, has the laboratory documented acceptance criteria based on intended use of the data, applicable regulations, or guidelines in MARLAP or the EPA FEM Document # 2006-01?				
14	V1M6, 1.5.4 a) - c)	Is the laboratory reporting results with a an estimate of Total Uncertainty consistent with the GUM and MARLAP, with exceptions for drinking water compliance testing? Do laboratory reports clearly specify the type of uncertainty reported, including the level of confidence? Are the results of precision obtained from the method validation process compared to the uncertainty estimates as a check on the validity of the uncertainty estimates?				Note: Counting uncertainty for drinking water. Total uncertainty for other applications.
15	V1M6, 1.5.5	Does method validation documentation include a qualitative statement describing the means of evaluating selectivity during method validation?				

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Item No.		Line of Inquiry	Status			Observations/Comments
			Y	N	n/a	
		Demonstration of Capability (DOC)				
16	V1M6, 1.6.1	Is an initial DOC conducted by individuals prior to performing any method without constant/close supervision, any time there is a significant change in instrument type, or any time that a method has not been performed by the analyst in a twelve (12) month period?				
17	V1M6, 1.6.2.1	Is documentation maintained for each initial DOC consistent with the minimum elements specified in Section 1.6.2.1 a) – g) ?				
18	V1M6, 1.6.3.1	Does the laboratory have a documented procedure describing ongoing DOC demonstrating that the analyst(s) has been able to routinely meet QC requirements in the last twelve (12) month period?				
19	V1M6, 1.6.3.2	Does the on-going demonstration include one of the following: a) Acceptable performance of blank(s) and sample(s) that have known accepted values, single blind to the analyst; another initial DOC; b) at least four (4) consecutive blank samples and four (4) consecutive spiked samples (e.g., batch LCS) with acceptable levels of precision and accuracy; c) a documented process of analyst review using QC samples. d) if a) through d) are not technically feasible, then analysis of real-world samples with results within predefined acceptance criteria (defined by the laboratory or method)?				
		Technical Requirements				
20	V1M6 1.7.1	Does the lab's process ensure meeting appropriate regulatory or contractual specifications and support decision making?				
21	V1M6 1.7.1	Does the instrument QC program meet the requirements of method regulation, contract and or the TNI Standard? When regulation/contract and or the method does not address instrument quality control program, does the laboratory incorporate MARLAP or other consensus standard guidelines?				

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Item No.	Line of Inquiry		Status			Observations/Comments
			Y	N	n/a	
Technical Requirements (continued)						
22	V1M6, 1.7.1.1 a)	Does the laboratory maintain the instrumentation required for each method it performs or seeking accreditation? When multiple instruments (or detectors) are involved for a common method, are the results across the instruments comparable? Does the laboratory establish the configuration and operating parameters for each measurement system (or instrument)?				
23	V1M6 1.7.1.1 b)	Does the laboratory document specific deviations for the system configuration or operational parameters when such modifications are required or necessary for a specific method(s)? Does the laboratory document the rationale for such changes?				
24	V1M6 1.7.1.1. c)	Does the laboratory periodically verify user-maintainable values for operational parameters to ensure their consistency with values recorded at the time of initial calibration and to ensure the continued integrity of the system configuration? If the system parameters have changed, does the laboratory perform corrective actions to determine and ameliorate any potential impact of the changes to the system configuration or operating parameters?				
25	V1M6, 1.7.1.2 a) i) – iii)	Does the laboratory perform radiation measurement systems calibration prior to initial use and when any of the following conditions occur and are these criteria documented in a procedure: • following replacement of a key detector element (e.g., a photomultiplier tube, silicon barrier detector, gas proportional detector chamber, germanium crystal, etc.)? • after a repair when subsequent performance checks indicate a change in performance? • after modification of system parameters that affect instrument response?				

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Item No.	Line of Inquiry		Status			Observations/Comments
			Y	N	n/a	
Technical Requirements (continued)						
26	V1M6, 1.7.1.2 a) iv) – vi)	Does the laboratory perform radiation measurement systems calibration prior to initial use and when any of the following conditions occur and are these criteria documented in a procedure: • 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? • when indicated by corrective actions? • when calibration is due according to a predetermined frequency?				
27	V1M6 1.7.1.2 b)	Does the laboratory perform multi-point calibrations, required, to correlate parameters (other than activity) such as the following cases? • channel-energy calibration of alpha or gamma spectrometers • energy-efficiency calibration of gamma spectrometers • mass-efficiency (mass-attenuation) calibration of gas-flow proportional • or x-ray detectors • quench-efficiency calibration of liquid scintillation detectors • mass-crosstalk calibration of gas-flow proportional; and • quench-crosstalk calibration of liquid scintillation detectors.				
28	V1M6 1.7.1.2 c)	Do instrument calibrations make use of reference standards based on physical measurements as defined in Section 1.7.2.6.c)? Do calibration standards have the same general physical characteristics (i.e., geometry, density, composition, nuclear decay properties, etc.) that match as closely as possible those of the samples to which the calibration will be applied [except as noted in Section 1.7.1.2 d)].				

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Item No.	Line of Inquiry		Status			Observations/Comments
			Y	N	n/a	
Technical Requirements (continued)						
29	V1M6 1.7.1.2 d) i) - iii	In cases where the laboratory uses empirical techniques (e.g., gamma transmission) and/or computational techniques (e.g., Monte Carlo or efficiency modeling techniques), • Has the laboratory performed documented validation of the correction method or model by physical measurement of reference standards as defined in Section 1.7.2.6.c)?) • Does the validation span the entire range of physical characteristics observed in samples to which the correction shall be applied (i.e., geometry, density, etc.) ? • Does the applied correction consistently minimize measurement bias across the range of physical characteristics? • Does the laboratory estimate and validate the uncertainty associated with the correction (see Section 1.5.4) and included it in the uncertainty reported with each associated sample result.				Note: Since Monte Carlo modeling techniques are relatively recent, the lab should have thorough documentation. The modeling techniques not applicable for drinking water analysis.
30	V1M6 1.7.1.2 e) i) – iv)	i) Does the laboratory establish and document in written procedures and in records the following details of initial instrument calibrations: 1. the type of calibrations to be performed? 2. the number of calibration points required? 3. a description of the calibration standards required? 4. the preparation of the calibration standards? 5. the counting of the calibration standards? 6. 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)? 7. all calculations? ii) Does the laboratory establish criteria, appropriate to the calibration technique, for the acceptance of an initial instrument calibration in written procedures? iii) If the initial instrument calibration results are outside established acceptance criteria, does the laboratory perform corrective actions? iv) Does the laboratory retain sufficient raw data records to permit reconstruction of the initial instrument calibration.				

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Item No.		Line of Inquiry	Status			Observations/Comments
			Y	N	n/a	
Technical Requirements (continued)						
31	V1M6 1.7.1.2 f)	Does the laboratory quantitate sample results only from the initial instrument calibrations unless otherwise allowed by regulation, method, or contract?				
32	V1M6, 1.7.1.3 a)	Are initial instrument calibrations verified with a source or lot independent of the reference standard used for the initial calibration using either: • a second set of calibration measurements compared to the first, or • quantifying a set of prepared standards using the initial calibration?				
33	V1M6, 1.7.1.3 b) & c)	Does the laboratory have a procedure stating the maximum uncertainty for calibration verification, and was that criterion met? Does the laboratory have a procedure with acceptance criteria for calibration verification, and were those criteria met? Does the laboratory perform corrective action if the criteria for calibration verification are not met?				
34	V1M6, 1.7.1.4 a) ii) & iii)	Is the same check source used for ongoing performance checks as the one used in the preparation of tolerance or control charts? Are performance check sources prepared, handled, sealed and/or encapsulated to prevent damage, loss of activity and contamination?				
35	V1M6, 1.7.1.4 a) iv)	Do the performance check sources provide adequate counting statistics for a relatively short count time, with count duration and check source activity sufficient to provide adequate counting statistics over the life of the source?				
36	V1M6, 1.7.1.4 a) v)	Where significant, is radioactive decay of the check source taken into account when evaluating count-rate sensitive parameters such as efficiency?				

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Item No.	Line of Inquiry		Status Y	Status N	Status n/a	Observations/Comments
Technical Requirements (continued)						
37	V1M6, 1.7.1.4 a) vi) & vii)	Does the laboratory monitor instrument performance checks using control or tolerance charts? Do laboratory procedures specify corrective actions to be taken when performance check acceptance criteria are not met, and does the laboratory take corrective actions in accordance with those procedures?				
38	V1M6, 1.7.1.4 b) & c)	Are performance checks conducted consistent with the minimum required frequency?				
		For gamma spectrometry systems, are detector efficiency, energy calibration, and peak resolution checked: - Semiconductor detector: twice weekly on non-consecutive days, or on day of use if the detector is not used continuously - Scintillation detector (e.g., sodium iodide): each day of use				
		For alpha spectrometry systems: - Energy calibration checked weekly				
		- Detector efficiency checked monthly				
		For gas-proportional and semiconductor alpha/beta detectors: - Alpha and beta efficiency checked each day of use				
		For liquid scintillation detectors: - Calibration at frequency recommended by the manufacturer - Efficiency with unquenched ^{3}H and ^{14}C standards: each day of use				
		For solid-state scintillation detectors (e.g. zinc sulfide): - Efficiency checked each day of use Exceptions to minimum performance check frequencies for individual Test Sources allowing periods longer than the required interval include the following: i) To allow completion of the count as long as instrument performance checks performed at the beginning and end of the measurement period meet all acceptance criteria. ii) To allow for completion of a Preparation Batch or Radiation Measurement Batch measured on an instrument with an automated sample changer, as long as the period between checks does not exceed seven (7) calendar days and checks are done at the beginning and end of the measurement in question and meet all acceptance criteria.				
Item	**Line of Inquiry**		**Status**			**Observations/Comments**

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No.			Y	N	n/a	
Technical Requirements (continued)						
39	V1M6, 1.7.1.4 d)	When detector systems are powered off between performance checks, are performance checks counted prior to the next Test Source measurement?				
40	V1M6, 1.7.1.5 d)	Does the laboratory have procedures for performing and evaluating subtraction background measurements that include the following: - Frequency and length of measurements? - Count times ≥ longest associated sample counting time - Use of control or tolerance charts and acceptance criteria? - Corrective action taken when acceptance criteria are not met?				
41	V1M6, 1.7.1.5 a)	Are subtraction background measurements performed and evaluated separately for each detector and appropriate to the method? Are subtraction background measurements being collected before and after any counting chamber changes are made (i.e., cleaning, liner replacement, or instrument modification)?				
42	V1M6, 1.7.1.5 c)	Are subtraction background measurements conducted consistent with the minimum required frequency, as specified for any of the three following alternatives: i) Paired measurements performed before and after each batch of Test Source measurements (a batch could be as small as a single sample); ii) Measurements performed at a fixed minimum frequency depending on the detector technology: • Gamma spectrometry: **Monthly** • Alpha spectrometry: **Monthly** • Gas-proportional and semiconductor alpha/beta detectors: **Quarterly** • Liquid scintillation detectors. o Individual quenched background: **Once per Preparation Batch**. o Quenched background curve: **Per laboratory procedures** • Solid-state scintillation detectors (e.g., zinc sulfide) for non-spectrometric measurements: **Each day of use** iii) Composite measurements using combined background measurements collected in a manner resulting in a representative determination with a combined counting time at least as long as the longest associated Test Source count time.				
Item	**Line of Inquiry**		**Status**			**Observations/Comments**

Audit ID: _____ **Laboratory:** _____ **Assessor:** _____ **Date:** _____

No.			Y	N	n/a	
Technical Requirements (continued)						
43	V1M6, 1.7.1.5 a)	Is the duration of the subtraction background measurement sufficient to quantify contamination that may affect routine sample measurements?				
44	V1M6, 1.7.1.5	Are the counting rates from the "subtraction background measurements" being subtracted from the total measured counting rates in Test Sources?				
45	V1M6, 1.7.1.6 a) – d)	Does the laboratory have a written procedure for performing short-term background checks that includes the following? iv) Establishes control or tolerance charts and acceptance criteria to monitor for significant changes; v) Corrective actions and/or qualification of reported results when short-term background counts exceed established limits; vi) Short-term unquenched background counts performed each day of use for liquid scintillation detectors. vii) Frequency and length of checks, with possible following exceptions: a. An uninterrupted count of an individual Test Source may be longer than the required interval between background counts if successful short-term backgrounds are performed prior to and after counting the Test Source. b. An uninterrupted count of a group of Test Sources may also be longer than the required interval between background counts to allow for completion of the batch (Preparation or RMB) if the period between checks does not exceed seven (7) calendar days and successful checks are performed prior to and at the end of the measurement period. Note: The frequency of subtraction background measurements may be increased from the above requirements when there is a low tolerance for unacceptable data due to failure of a subtraction background measurement.				
46	V1M6, 1.7.1.7	Does the laboratory have written procedures for corrective actions when radiation detectors have been contaminated, as determined by the subtraction background measurements, short-term background checks, or method blanks?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	

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Quality Control for Radiochemistry – General Requirements						
47	V1M6, 1.7.2.1 a)	Does the laboratory follow a documented QC program that monitors and assesses the performance of the laboratory's analytical systems? Does the laboratory, at a minimum, incorporate the QA program imposed by regulation, method(s) and this Standard? Does the laboratory follow the imposed regulations when the regulations are more stringent than this Standard? (see Module 2, Section 5.9.3.c). If it is not apparent which requirement is more stringent, does the laboratory follow the requirements of the regulation or the mandated method? Does the laboratory establish requirements in its quality system based on the guidelines of MARLAP Manual or other similar consensus standard organizations when there are no established guidelines?				
48	V1M6 1.7.2.1 b)	Does the laboratory process batch and sample-specific quality controls to provide empirical evidence that demonstrates that the analytical system is in control? Does the laboratory use the results for these controls to assess the data quality of sample results produced by the analytical system?				
49	V1M6 1.7.2.1 c)	Does the laboratory employ either a sample Preparation Batch or a RMB to determine the grouping of samples and assignment of batch QC?				
50	V1M6 1.7.2.1 c) i)	Does the laboratory initiate a Preparation Batch for samples that involves physical or chemical processing which affects the outcome of the test? Does the laboratory prepare the QC samples together with the associated preparation batch using the same process, personnel, and lot(s) of reagents?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	

Audit ID: _____ **Laboratory:** _____ **Assessor:** _____ **Date:** _____

Quality Control for Radiochemistry – General Requirements (continued)						
51	V1M6 1.7.2.1 c) ii)	Does the laboratory initiate an RMB in lieu of preparation batch where sample processing does not involve physical or chemical processing of the samples? (e.g., non-destructive gamma spectrometry, alpha/beta counting of air filters, or swipes on gas proportional detectors). Are the samples and associated QC in the RMB similar in physical and chemical parameters, and analytical configurations? (e.g., analytes, geometry, calibration, and background correction).				
52	V1M6 1.7.2.1 c) iii)	Does the laboratory keep open the RMB for adding samples for a period not exceeding 14 calendar days from the start of the first sample counting or until twenty (20) environmental samples have been counted, whichever occurs first?				
53	V1M6 1.7.2.1 c) iv)	Does the laboratory combine only such 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 (see Section 1.5)? Does the laboratory documented procedures for RMB that include how method validation is performed, and how corrections are applied to physical calibration? (e.g., for efficiency, density, cascade summing, and background)				
54	V1M6 1.7.2.1 d)	Does the laboratory's QC program document the frequency required for quality controls?				
55	V1M6 1.7.2.1 e)	Does the laboratory process all batch QC samples together with and under the same conditions as the associated samples, and use the same processes and procedures for preparation, analysis, data reduction and reporting of results? *Note:* Although samples in a Preparation Batch must 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 quality controls indicate that the systems are in control.				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	

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Quality Control for Radiochemistry – General Requirements (continued)						
56	V1M6 1.7.2.1 f)	Does the laboratory not use systematically or preferentially specific detectors, equipment or glassware for the analysis of QC samples? 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.				
57	V1M6 1.7.2.1 g)	Does the laboratory's 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?				
58	V1M6 1.7.2.1 h)	Does the laboratory assess the results of the QC samples against acceptance criteria documented in the QC program? Does the laboratory develop acceptance criteria consistent with guidelines in MARLAP or other consensus standards, or other criteria such as statistical control charts developed by the laboratory where there are no established criteria in regulations, the method, or contract?				
59	V1M6 1.7.2.1 i)	Does the laboratory track and trend the results of batch QC samples using statistical or tolerance control charts?				
60	V1M6 1.7.2.1 j)	Does the laboratory investigate the cause when results do not meet acceptance criteria and take corrective actions to eliminate the source or minimize the magnitude of the problem? Does the laboratory consider samples associated with a failed QC parameter as suspect and shall, wherever possible, reprocess such samples? Does the laboratory report results with appropriate data qualifiers when reprocessing is not possible? Does the laboratory note the occurrence of a failed QC sample and any associated actions in the laboratory report?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	

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Item No.		Line of Inquiry	Status Y	N	n/a	Observations/Comments
Quality Control – Negative Control						
61	V1M6 1.7.2.2 a)	Does the laboratory employ a minimum of one Method Blank (MB) per Preparation Batch or Radiation Measurement Batch?				
62	V1M6 1.7.2.2 b)	Are MBs prepared using a quality system matrix that is sufficiently analyte-free (to the extent possible), and using an aliquot of the matrix similar to that of routine samples? If sample aliquot sizes vary, do method blank acceptance criteria compensate for those differences?				
63	V1M6 1.7.2.2 c)	Does the laboratory have procedures in place to determine if MB results are significantly different than zero or impacts sample analytical results (e.g., MB > sample-specific MDA)?				
64	V1M6 1.7.2.2 d)	Is corrective action taken when a method blank (MB) result is significantly different than zero and associated sample results are < 5 * MB?				
65	V1M6 1.7.2.2 e)	Are method blank results monitored for long term trends, absolute bias, possible contamination or interferences that may affect sample results?				
66	V1M6 1.7.2.2 f)	Are sample results being calculated without batch-specific MB subtraction? Note: Average historical activity of MBs may be subtracted when systematic bias has been demonstrated. The laboratory shall account for the uncertainty of the subtracted value in its estimate of uncertainty for the final result.				
Item No.		**Line of Inquiry**	**Status Y**	**N**	**n/a**	**Observations/Comments**
Quality Control – Positive Control						
67	V1M6 1.7.2.3 a)	Does the laboratory employ a minimum of one Laboratory Control Sample (LCS) per Preparation Batch or Radiation Measurement Batch (RMB)? For RMBs, a calibration verification standard may be used in place of an LCS.				
Item No.		**Line of Inquiry**	**Status Y**	**N**	**n/a**	**Observations/Comments**
Quality Control – Positive Control (continued)						

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68	V1M6 1.7.2.3 b)	Are LCSs prepared using a quality system matrix that is sufficiently analyte-free (to the extent possible), and using an aliquot of the matrix similar to that of routine samples? If sample aliquot sizes vary, do method blank acceptance criteria compensate for those differences?				
69	V1M6 1.7.2.3 d)	Are LCSs spiked at a level such that the uncertainty of the LCS result is < 1/3 * acceptance criteria?				
70	V1M6 1.7.2.3 e)	Do the standards used to prepare LCSs conform to the requirements for reference standard provided in Section 1.7.2.6 c?				
71	V1M6 1.7.2.3 e) i-iii	Do LCSs include all of the radionuclide(s) being determined with the following allowed exceptions: viii) Gross alpha radionuclide(s) used to calibrate the detector ix) Alpha spectrometry radionuclide(s) with similar chemical characteristics x) Gamma-ray spectrometric radionuclides with similar gamma energies or radionuclides representing at least the low and high ends of the energy range used for analysis.				
72	V1M6 1.7.2.3 f)	Are LCSs in each batch evaluated using a statistical technique that allows comparison to the lab's established acceptance criteria?				
73	V1M6 1.7.2.3 g)	Where more than one analyte is spiked in the LCS, is each analyte evaluated against acceptance criteria?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Quality Control – Sample Specific QC Measures						

Audit ID: _____ **Laboratory:** _____ **Assessor:** _____ **Date:** _____

74	1.7.2.4	Does the laboratory document procedures for determining the effect of sample matrix on analytical results? Does the documented procedures relate to the analyses of specific QC samples? Are the QC samples 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.				
75	1.7.2.4	Does the laboratory have procedures for, - tracking, - managing, - handling sample-specific QC criteria, - spiking radionuclides at appropriate activities, - calculating recoveries, - determining variability (e.g., relative percent difference and/or z-score), - evaluating results and - reporting results based on the performance of the QC samples?				
76	1.7.2.4 a) i	Is the MS recovery an indication of matrix effects on the accuracy of sample results by using the selected method? Are the MS results reported to data users (customers) so that the customers evaluate the impact on their batch(s) samples? MSs are not typically employed (or required) 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.				
77	1.7.2.4 a) ii	Is the frequency for MS analysis specified by the method, or a regulation? Or, is it determined as part of the contract review process?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Quality Control – Sample Specific QC Measures (continued)						

Audit ID: _____ **Laboratory:** _____ **Assessor:** _____ **Date:** _____

78	1.7.2.4 a) iii	Are the radionuclides to be spiked for MS specified in the mandated method, or a regulation? or Are they determined as part of the contract review process? At minimum, are they consistent with those specified for the LCS in Sections 1.7.2.3.e and 1.7.2.3.f of this Standard? (Module 6)				
79	1.7.2.4 a) iv	Is the aliquot used for MS similar to that of routine samples analyzed in the Preparation Batch? If the sample size in the Preparation Batch varies (e.g., due to restriction on the activity or mass residue that may be processed), does the laboratory apply appropriate corrections to compensate for differing aliquots when applying the acceptance criteria for MS?				
80	1.7.2.4 a) v	Is the lack of sufficient volume to perform an MS noted in the laboratory report when appropriate?				
81	1.7.2.4 a) vi	Is the activity of the MS analyte(s) greater than five (5) times the MDA?				
82	1.7.2.4 a) vii	Are the acceptance criteria for MS recoveries as established or specified in the method, regulation or contract? Where there are no mandatory acceptance criteria established in the method, regulation or contract, does the laboratory develop acceptance criteria based on industry practices and guidelines, or consistent with the guidelines of MARLAP[3] or other consensus standards? Are the criteria documented or referenced in the laboratory's quality manual?				
83	1.7.2.4 a) viii	Is the standard used to prepare the MS meet the requirements for reference standard provided in Section 1.7.2.6.c., when possible? Is the final prepared MS acceptable even though not traceable to a national standards organization?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Quality Control – Sample Specific QC Measures (continued)						

Audit ID: _____ **Laboratory:** _____ **Assessor:** _____ **Date:** _____

84	1.7.2.4a) 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.).				
85	1.7.2.4b) i & v	Where applicable, is a matrix duplicate (MD) or matrix spike duplicate (MSD) prepared using a second aliquot of the same sample take through the entire analytical procedure. 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 or MSD.				
86	1.7.2.4 b) ii	Are the acceptance criteria for duplicates as established or specified by the method, regulation or contract? Where there are no mandatory acceptance criteria established in the method, regulation or contract, does the laboratory develop the acceptance criteria based on industry practices and guidelines, such as - control charting developed by the laboratory, or - consistent with the guidelines of MARLAP[3] or other consensus standards? Are the criteria documented or referenced in the laboratory's quality manual?				
87	1.7.2.4 b) iii	At a minimum, does the laboratory analyze one MD per Preparation Batch or RMB (radiation measurement batch)? For RMBs, does the MD consist of a second measurement of the sample -on the same detector if only one detector is available, or -on a different detector if more than one detector available?				

Item No.	Line of Inquiry	Status			Observations/Comments
		Y	N	n/a	
Quality Control – Sample Specific QC Measures (continued)					
88	1.7.2.4 b) iv	When samples have low-levels of activity (less than approximately three (3) times the MDA) does the laboratory, at its discretion, analyze MS/MSD to determine reproducibility within a Preparation Batch in place of a MD?.				
		Based on specific project or program requirements or when there is insufficient sample available, does the laboratory choose to analyze a LCS				

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89	1.7.2.4 b) v	in duplicate in place of a MD?				
90	1.7.2.4 c) i	For methods that employ a radioactive Tracer or a stable Carrier as a chemical yield monitor in the analysis, does the laboratory calculate and report the chemical yield for each sample? Is the chemical yield one of the quality control measures to be used to assess the associated sample result acceptance?				
91	1.7.2.4 c) ii	Is a Tracer or Carrier used that does not significantly interfere with the analyte(s) of interest or cause bias in its measurement? When a Tracer or Carrier is not available that is free of interference or bias with the analyte(s) of interest, is the interference or bias caused quantified and appropriate correction applied to the sample results?				
92	1.7.2.4 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?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Quality Control – Sample Specific QC Measures (continued)						
93	1.7.2.4 c) iv	Is the chemical yield assessed against acceptance criteria specified in the method, regulation, contract or laboratory SOP? Where there are no criteria, does the laboratory develop its criteria for data acceptance based on -guidelines established in the MARLAP[3] or -other criteria such control charting developed by the laboratory? Does the chemical yield assessment meet the required project or program MQOs (Section 1.3.1).				

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94	1.7.2.4 c) v	When the established chemical yield acceptance criteria are not met, does the laboratory follow the specified corrective action and contingencies? Is the occurrence of a failed chemical yield and the actions taken noted in the laboratory report?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Data Reduction						
95	1.7.2.5 a-c	Does the laboratory have SOPs documenting data reduction, detection capability (per Section 1.5.2), and measurement uncertainties (per Section 1.5.4)?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Reagent Quality, Water Quality, and Checks						
96	1.7.2.6 a)	Does the laboratory document the requirements for the reagents used in the laboratory? (At a minimum the reagents must be analytical reagent grade or better)				
97	1.7.2.6 b)	Is the quality of water sources monitored and documented and meet method specific requirements?				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Reagent Quality, Water Quality, and Checks (continued)						
98	1.7.2.6 c)	Does the QC Program establish and maintain provisions for radionuclide standards including the following requirements? i. Reference standards shall be obtained from a national metrology institute (NMI), e.g. NIST in the USA or NPL in Great Britain, or from suppliers of NMI reference standards. Alternatively, reference standards may be obtained from an ISO/IEC Guide 34[6] accredited reference material provider, or an ANSI N42.22[7]				

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		reference material manufacturer. ii. Reference standards shall be accompanied with a certificate of calibration that meets the requirements of either ISO Guide 31[1], or ANSI N42.22[7], Section 8, Certificates and shall 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. iii. Standards prepared or derived from externally-obtained reference materials shall be verified against an independent standard obtained from a second manufacturer prior to use for analysis of samples. The use of a standard from a second lot obtained from the same manufacturer is acceptable for use as a second source standard. Discrepancies between observed and expected values shall be investigated and appropriate measures taken that document the validity of standards prior to use. iv. The laboratory shall account for radioactive decay/ingrowth whenever decay/ingrowth has occurred between the Activity Reference Date and use that could impact use of the results.				

Item No.	Line of Inquiry	Status			Observations/Comments
		Y	N	n/a	
	Reagent Quality, Water Quality, and Checks (continued)				
98	1.7.2.6c				

(continued)

v. 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, the laboratory shall obtain from the provider the minimum information described in Section 1.7.2.6.c.ii.

[1] ISO Guide 31:2000, *Reference materials - Contents of certificates and labels*; International Organization for Standardization, 2000. Available from: http://www.iso.org/.

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		The laboratory shall independently verify the activity of such standards prior to use and document the verification. vi. If the laboratory's verification indicates a significant deviation from the original information from the provider, the standard should not be used unless the discrepancy can be resolved. If the standard is used for analysis of sample unknowns, the source and any other known limitations of the standard shall be disclosed in the final report.				
Item No.	**Line of Inquiry**		**Status**			**Observations/Comments**
			Y	**N**	**n/a**	
Constant and Consistent Test Conditions						
99	1.7.2.7					

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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 only when the target analyte is present in the sample selected for duplication in the batch.