IAEA-RML-2019-01 PROFICIENCY TEST FOR DETERMINATION OF RADIONUCLIDES IN SEA WATER

PRELIMINARY REPORT
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IAEA-RML-2019-01 PROFICIENCY TEST FOR DETERMINATION OF RADIONUCLIDES IN SEA WATER

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FOREWORD

The Radiometrics Laboratory of the IAEA Environment Laboratories has been providing quality support products and services for the last 60 years. These include the organization of proficiency tests and laboratory comparisons, and the production of certified reference materials, including a wide range of marine sample matrices and radionuclide levels.

As part of these activities, a Proficiency Test (PT) was organized at the request of the Nuclear Regulation Authority (NRA) of Japan to test the performance of participating laboratories in an analysis of radionuclides in a sea water sample. This exercise was initiated to support laboratories in sea water analyses of ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and an undisclosed γ emitter in sea water that may be released into the marine environment in accidental situations or through routine operations at nuclear facilities. Previous proficiency tests exercises are described in IAEA Analytical Quality in Nuclear Applications Series Nos 40–43, 51 and 58.

The IAEA wishes to thank all the participants and laboratories who took part in this proficiency test. The IAEA is also grateful to the Government of the Principality of Monaco for its support. We thank our IAEA colleagues C. Galdino and M. Pham for the technical assistance.

The IAEA officers responsible for this publication are P. Ivanov, I. Osvath, Paul Mc Ginnity and F. Descroix-Comanducci of the IAEA Environment Laboratories.

CONTENTS

1. INTRODUCTION

1.1. BACKGROUND

The IAEA Environment Laboratories (IAEA-EL) in Monaco and Seibersdorf regularly organize proficiency tests (PT) for radionuclides in environmental samples to support laboratories in IAEA Member States.

1.2. OBJECTIVES

This proficiency test was initiated to support laboratories in sea water analyses of ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs and ^{137}Cs and an undisclosed γ emitter in seawater that may be released into the marine environment in accidental situations or through routine operations at nuclear facilities. The results of this exercise allowed the participating laboratories to evaluate their performance in the analysis of these radionuclides for this sample type.

1.3. SCOPE

This publication describes the organization and the results of a proficiency test organized in cooperation with the Nuclear Regulation Authority (NRA) in Japan. A total of 96 laboratories from 51 countries participated in this exercise during the period July – December 2019. This included 28 laboratories from Japan and 68 laboratories from other IAEA Member States. The full list of participants is given Appendix III. Results of similar earlier exercises are described in IAEA Analytical Quality in Nuclear Applications Series Nos 40–43, 51 and 58 [1–6] and in Refs [7] and [8].

1.4. STRUCTURE

This publication contains a description of material offered and the reporting requirements (Section 2), the performance criteria (Section 3), the results of the exercise and discussion (Section 4), an appendix presenting the performance evaluation sorted by radionuclide (Appendix I), an appendix presenting the performance evaluation sorted by participant (Appendix II) and a list of participants (Appendix III).

2. MATERIAL AND METHODS

2.1. MATERIAL DISTRIBUTION AND REPORTING REQUIREMENTS

A sample containing 5 L of filtered Mediterranean Sea water spiked by the IAEA with the radionuclides ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and one undisclosed γ emitter was distributed to the participants, with the massic activities only known to the IAEA. The undisclosed γ emitter added to the sample was ^{155}Eu. The massic activities were traceable to a standard provided by the Czech Metrology Institute ČMI. The combined massic activities of ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and ^{155}Eu in the exercise samples were lower than the natural activity level of ^{40}K in sea water (which is approximately 12 Bq kg^{-1}). The ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and ^{155}Eu massic activities for the samples were approximately 5.00, 2.94, 0.20, 0.17, 1.52 and 1.08 Bq kg^{-1}, respectively. The sample also contained a non-active Cs-carrier and Eu-carrier, both at 1 mg kg^{-1}, in order to stabilize the solution and to minimize adsorption of Cs and Eu to the container walls. No Sr was added to the sample as non-active Sr present naturally in sea water will act as a carrier for ^{90}Sr.

The participants were required to report to the IAEA the ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and the undisclosed γ emitter massic activities (in Bq kg^{-1}) of the proficiency test sample combined with the associated uncertainties (also in Bq kg^{-1}). Additionally, the participants were asked to submit the following:

– A short description of the analytical method used for the sample analysis. The Information Sheet sent to the participants suggested for ^{3}H distillation followed by liquid scintillation counting. For ^{90}Sr, precipitation from sea water as mixed Ca/Sr oxalate or carbonate follow by a standard ^{90}Sr procedure (e.g. a radiochemical procedure such as precipitation with fuming nitric acid, liquid-liquid extraction or extraction chromatography followed by a measurement technique such as gas-flow proportional counting or liquid scintillation counting). For ^{134}Cs and ^{137}Cs,

three methods were suggested: (i) direct gamma spectrometry, (ii) adsorption on AMP (ammonium molybdophosphate, $(NH_4)_3PO_4Mo_{12}O_{36}$) and subsequent gamma spectrometry or (iii) adsorption on copper hexacyanoferrate ($Cu_2[Fe(CN)_6]$) and subsequent gamma spectrometry;

- Type of calibration and software used for gamma ray spectrometry;
- Nuclear data used;
- An uncertainty budget for the measurement results.

The reference date for reporting massic activities was set at 1 July 2019. At this date, the ranges for the traceable massic activities in the proficiency test exercise samples sent to the participants were 4.954–5.076 Bq kg^{-1} ^{3}H, 2.913–2.984 Bq kg^{-1} ^{89}Sr, 0.199–0.204 Bq kg^{-1} ^{90}Sr, 0.163–0.167 Bq kg^{-1} ^{134}Cs, 1.505–1.542 Bq kg^{-1} ^{137}Cs and 1.053–1.079 Bq kg^{-1} ^{155}Eu, respectively (see Table 1).

TABLE 1. IAEA ASSIGNED VALUES

Sample	^{3}H massic activity (Bq kg^{-1})	^{89}Sr massic activity (Bq kg^{-1})	^{90}Sr massic activity (Bq kg^{-1})	^{134}Cs massic activity (Bq kg^{-1})	^{137}Cs massic activity (Bq kg^{-1})	^{155}Eu massic activity (Bq kg^{-1})
001	5.025 ± 0.099	2.954 ± 0.055	0.2021 ± 0.0026	0.1656 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
002	5.005 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
003	5.012 ± 0.099	2.947 ± 0.055	0.2016 ± 0.0026	0.1652 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
004	5.018 ± 0.099	2.950 ± 0.055	0.2019 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.067 ± 0.020
005	5.001 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
006	5.000 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
007	5.015 ± 0.099	2.948 ± 0.055	0.2017 ± 0.0026	0.1652 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
008	5.001 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
009	5.013 ± 0.099	2.947 ± 0.055	0.2017 ± 0.0026	0.1652 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
010	4.991 ± 0.099	2.934 ± 0.055	0.2008 ± 0.0026	0.1644 ± 0.0018	1.516 ± 0.021	1.061 ± 0.020
011	4.990 ± 0.099	2.933 ± 0.055	0.2007 ± 0.0026	0.1644 ± 0.0018	1.516 ± 0.021	1.061 ± 0.020
012	5.005 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
013	5.004 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
014	5.006 ± 0.099	2.943 ± 0.055	0.2014 ± 0.0026	0.1650± 0.0019	1.521 ± 0.021	1.064 ± 0.020
015	5.008 ± 0.099	2.944 ± 0.055	0.2015 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.065 ± 0.020
016	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
017	5.002 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
018	5.007 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
019	4.998 ± 0.099	2.938 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
020	5.012 ± 0.099	2.947 ± 0.055	0.2016 ± 0.0026	0.1652 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
021	4.997 ± 0.099	2.938 ± 0.055	0.2010 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
022	5.004 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
023	4.993 ± 0.099	2.935 ± 0.055	0.2009 ± 0.0026	0.1645 ± 0.0018	1.517 ± 0.021	1.061 ± 0.020
024	5.017 ± 0.099	2.949 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.066 ± 0.020
025	4.982 ± 0.099	2.929 ± 0.055	0.2004 ± 0.0026	0.1641 ± 0.0018	1.513 ± 0.021	1.059 ± 0.020
026	4.994 ± 0.099	2.936 ± 0.055	0.2009 ± 0.0026	0.1646 ± 0.0018	1.517 ± 0.021	1.062 ± 0.020
027	5.008 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
028	4.999 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.063 ± 0.020
030	5.009 ± 0.099	2.945 ± 0.055	0.2015 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.065 ± 0.020

031	4.994 ± 0.099	2.936 ± 0.055	0.2009 ± 0.0026	0.1646 ± 0.0018	1.517 ± 0.021	1.062 ± 0.020
032	4.999 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
033	5.020 ± 0.099	2.951 ± 0.055	0.2019 ± 0.0026	0.1654 ± 0.0019	1.525 ± 0.021	1.067 ± 0.020
034	5.012 ± 0.099	2.947 ± 0.055	0.2016 ± 0.0026	0.1652 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
035	5.015 ± 0.099	2.948 ± 0.055	0.2017 ± 0.0026	0.1652 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
036	5.022 ± 0.099	2.953 ± 0.055	0.2020 ± 0.0026	0.1655 ± 0.0019	1.525 ± 0.021	1.068 ± 0.020
037	5.010 ± 0.099	2.945 ± 0.055	0.2015 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
038	5.019 ± 0.099	2.950 ± 0.055	0.2019 ± 0.0026	0.1654 ± 0.0019	1.524 ± 0.021	1.067 ± 0.020
039	5.003 ± 0.099	2.941 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.063 ± 0.020
040	5.009 ± 0.099	2.944 ± 0.055	0.2015 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.065 ± 0.020
041	4.999 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.063 ± 0.020
042	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
043	4.988 ± 0.099	2.932 ± 0.055	0.2006 ± 0.0026	0.1644 ± 0.0018	1.515 ± 0.021	1.060 ± 0.020
044	5.007 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
045	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
046	5.001 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
047	5.016 ± 0.099	2.949 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.066 ± 0.020
048	4.999 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.063 ± 0.020
049	4.985 ± 0.099	2.931 ± 0.055	0.2005 ± 0.0026	0.1643 ± 0.0018	1.514 ± 0.021	1.060 ± 0.020
050	5.007 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
051	4.997 ± 0.099	2.937 ± 0.055	0.2010 ± 0.0026	0.1646 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
052	4.990 ± 0.099	2.933 ± 0.055	0.2007 ± 0.0026	0.1644 ± 0.0018	1.515 ± 0.021	1.061 ± 0.020
053	5.004 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
054	4.986 ± 0.099	2.931 ± 0.055	0.2006 ± 0.0026	0.1643 ± 0.0018	1.514 ± 0.021	1.060 ± 0.020
055	4.985 ± 0.099	2.931 ± 0.055	0.2005 ± 0.0026	0.1643 ± 0.0018	1.514 ± 0.021	1.060 ± 0.020
056	4.981 ± 0.099	2.928 ± 0.054	0.2004 ± 0.0026	0.1641 ± 0.0018	1.513 ± 0.021	1.059 ± 0.020
057	4.984 ± 0.099	2.930 ± 0.054	0.2005 ± 0.0026	0.1642 ± 0.0018	1.514 ± 0.021	1.059 ± 0.020
058	5.004 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
059	5.035 ± 0.100	2.960 ± 0.055	0.2025 ± 0.0026	0.1659 ± 0.0019	1.529 ± 0.021	1.070 ± 0.020
060	5.042 ± 0.100	2.964 ± 0.055	0.2028 ± 0.0026	0.1661 ± 0.0019	1.531 ± 0.021	1.072 ± 0.020
061	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
062	4.955 ± 0.098	2.913 ± 0.054	0.1993 ± 0.0026	0.1633 ± 0.0018	1.505 ± 0.021	1.053 ± 0.020
063	5.005 ± 0.099	2.942 ± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
065	4.973 ± 0.098	2.923 ± 0.054	0.2000 ± 0.0026	0.1639 ± 0.0018	1.510 ± 0.021	1.057 ± 0.020
066	5.030 ± 0.100	2.957 ± 0.055	0.2023 ± 0.0026	0.1657 ± 0.0019	1.528 ± 0.021	1.069 ± 0.020
067	5.013 ± 0.099	2.947 ± 0.055	0.2017 ± 0.0026	0.1652 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
068	5.005 ± 0.099	2.942± 0.055	0.2013 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
069	4.966 ± 0.098	2.919 ± 0.054	0.1997 ± 0.0026	0.1636 ± 0.0018	1.508 ± 0.021	1.055 ± 0.020
070	5.015 ± 0.099	2.948 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
071	4.999 ± 0.099	2.939 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.063 ± 0.020
072	5.017 ± 0.099	2.950 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.067 ± 0.020
073	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020

075	4.998 ± 0.099	2.938 ± 0.055	0.2010 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
076	5.021 ± 0.099	2.952 ± 0.055	0.2020 ± 0.0026	0.1654 ± 0.0019	1.525 ± 0.021	1.067 ± 0.020
077	4.972 ± 0.098	2.923 ± 0.054	0.2000 ± 0.0026	0.1638 ± 0.0018	1.510 ± 0.021	1.057 ± 0.020
078	5.024 ± 0.099	2.953 ± 0.055	0.2021 ± 0.0026	0.1655 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
079	5.006 ± 0.099	2.943 ± 0.055	0.2014 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020
080	5.001 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
081	4.974 ± 0.099	2.924 ± 0.054	0.2001 ± 0.0026	0.1639 ± 0.0018	1.511 ± 0.021	1.057 ± 0.020
082	5.028 ± 0.099	2.956 ± 0.055	0.2023 ± 0.0026	0.1657 ± 0.0019	1.527 ± 0.021	1.069 ± 0.020
083	5.020 ± 0.099	2.951 ± 0.055	0.2019 ± 0.0026	0.1654 ± 0.0019	1.525 ± 0.021	1.067 ± 0.020
084	4.996 ± 0.099	2.937 ± 0.055	0.2010 ± 0.0026	0.1646 ± 0.0019	1.517 ± 0.021	1.062 ± 0.020
085	4.997 ± 0.099	2.938 ± 0.055	0.2010 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
086	5.027 ± 0.099	2.955 ± 0.055	0.2022 ± 0.0026	0.1656 ± 0.0019	1.527 ± 0.021	1.068 ± 0.020
087	4.959 ± 0.099	2.915 ± 0.054	0.1995 ± 0.0026	0.1634 ± 0.0018	1.506 ± 0.021	1.054 ± 0.020
088	5.011 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
089	4.982 ± 0.099	2.929 ± 0.054	0.2004 ± 0.0026	0.1642 ± 0.0018	1.513 ± 0.021	1.059 ± 0.020
090	5.007 ± 0.099	2.943 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
091	5.024 ± 0.099	2.954 ± 0.055	0.2021 ± 0.0026	0.1655 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
092	5.024 ± 0.099	2.954 ± 0.055	0.2021 ± 0.0026	0.1655 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
093	5.025 ± 0.099	2.954 ± 0.055	0.2021 ± 0.0026	0.1656 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
094	4.991 ± 0.099	2.934 ± 0.055	0.2008 ± 0.0026	0.1644 ± 0.0018	1.516 ± 0.021	1.061 ± 0.020
095	5.021 ± 0.099	2.952 ± 0.055	0.2020 ± 0.0026	0.1655 ± 0.0019	1.525 ± 0.021	1.067 ± 0.020
096	5.017 ± 0.099	2.949 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.066 ± 0.020
097	5.017 ± 0.099	2.949 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.066 ± 0.020
098	4.954 ± 0.099	2.913 ± 0.054	0.1993 ± 0.0026	0.1632 ± 0.0018	1.505 ± 0.021	1.053 ± 0.020
099	5.001 ± 0.099	2.940 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
100	5.018 ± 0.099	2.950 ± 0.055	0.2019 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.067 ± 0.020
101	4.982 ± 0.099	2.929 ± 0.054	0.2004 ± 0.0026	0.1641 ± 0.0018	1.513 ± 0.021	1.059 ± 0.020
102	5.026 ± 0.100	2.955 ± 0.055	0.2022 ± 0.0026	0.1656 ± 0.0019	1.527 ± 0.021	1.068 ± 0.020
104	4.991 ± 0.099	2.934 ± 0.055	0.2008 ± 0.0026	0.1645 ± 0.0018	1.516 ± 0.021	1.061 ± 0.020
105	5.002 ± 0.099	2.941 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
106	4.998 ± 0.099	2.938 ± 0.055	0.2011 ± 0.0026	0.1647 ± 0.0019	1.518 ± 0.021	1.062 ± 0.020
107	4.992 ± 0.099	2.935 ± 0.055	0.2008 ± 0.0026	0.1645 ± 0.0018	1.516 ± 0.021	1.061 ± 0.020
108	5.017 ± 0.099	2.949 ± 0.055	0.2018 ± 0.0026	0.1653 ± 0.0019	1.524 ± 0.021	1.066 ± 0.020
109	5.024 ± 0.099	2.953 ± 0.055	0.2021 ± 0.0026	0.1655 ± 0.0019	1.526 ± 0.021	1.068 ± 0.020
110	5.007 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020
111	5.013 ± 0.099	2.947 ± 0.055	0.2016 ± 0.0026	0.1652 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
112	5.028 ± 0.100	2.956 ± 0.055	0.2023 ± 0.0026	0.1657 ± 0.0019	1.527 ± 0.021	1.069 ± 0.020
113	5.009 ± 0.099	2.945 ± 0.055	0.2015 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.065 ± 0.020
114	5.012 ± 0.099	2.947 ± 0.055	0.2016 ± 0.0026	0.1652 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
115	5.013 ± 0.099	2.947 ± 0.055	0.2017 ± 0.0026	0.1652 ± 0.0019	1.523 ± 0.021	1.066 ± 0.020
116	5.012 ± 0.099	2.946 ± 0.055	0.2016 ± 0.0026	0.1651 ± 0.0019	1.522 ± 0.021	1.065 ± 0.020
117	5.006 ± 0.099	2.943 ± 0.055	0.2014 ± 0.0026	0.1649 ± 0.0019	1.520 ± 0.021	1.064 ± 0.020

118	5.002 ± 0.099	2.941 ± 0.055	0.2012 ± 0.0026	0.1648 ± 0.0019	1.519 ± 0.021	1.063 ± 0.020
119	5.008 ± 0.099	2.944 ± 0.055	0.2015 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.065 ± 0.020
120	5.007 ± 0.099	2.944 ± 0.055	0.2014 ± 0.0026	0.1650 ± 0.0019	1.521 ± 0.021	1.064 ± 0.020

3. PERFORMANCE CRITERIA

The methodology adopted for this exercise is described in Ref. [7] and was slightly updated from the existing IAEA methodology [8]. (i.e., in this exercise a k value of 2.58 instead of 2.56 was used and a normalisation factor was introduced to the trueness equation; see Equation 5 below). The scoring system took into account the accuracy, precision and trueness of the reported data and included in the evaluation both the combined standard uncertainty of the IAEA value and the combined standard uncertainty reported by the participating laboratories. The IAEA values, which were used for the data evaluation, were the certified values of radionuclides at the reference date. A result must pass three tests to be assigned the status 'Accepted', otherwise it was assigned the status 'Warning' or 'Not accepted'.

3.1. ACCURACY

The first step in producing a score for a result $Value_{\text{Analyst}}$ was the estimation of the bias. The relative bias between the Analyst's value and the IAEA target value was calculated as follows and expressed as a percentage:

$$Bias_{\text{relative}} = \frac{Value_{\text{Analyst}} - Value_{\text{IAEA}}}{Value_{\text{IAEA}}} \times 100\% \quad (1)$$

The absolute value of the relative bias was compared to the Maximal Accepted Relative Bias (MARB). Participants' results were scored as 'Pass' for accuracy when:

$$|Bias_{\text{relative}}| \leq \text{MARB} \quad (2)$$

The MARB values used in this evaluation were 20% for ^{134}Cs and ^{137}Cs, 25% for ^{3}H and ^{90}Sr and 30% for ^{89}Sr and ^{155}Eu.

3.2. PRECISION AND TRUENESS

The precision *P* for each result was calculated according to the following equation:

$$P = \sqrt{\left(\frac{unc_{\text{IAEA}}}{Value_{\text{IAEA}}}\right)^2 + \left(\frac{unc_{\text{Analyst}}}{Value_{\text{Analyst}}}\right)^2} \times 100\% \quad (3)$$

The precision *P* was compared to the Limit of Accepted Precision (LAP). The participants' results were scored as 'Pass' for precision when:

$$P \leq \text{LAP} \quad (4)$$

The LAP values used in this evaluation were 20% for ^{134}Cs and ^{137}Cs, 25% for ^{3}H and ^{90}Sr and 30% for ^{89}Sr and ^{155}Eu.

The participants' results for trueness were scored as 'Pass' when:

$$|Bias_{\text{relative}}| \leq \frac{Value_{\text{Analyst}}}{Value_{\text{IAEA}}} 2.58\, P \quad (5)$$

3.3. FINAL EVALUATION

For the final evaluation, all three scores were combined (see Table 2). The result was considered as 'Accepted' if it passed all three tests. If the accuracy test was failed, the result was considered as 'Not accepted'. If the accuracy test was passed but one of the other two tests was failed, the result was assigned the 'Warning' status. The 'Warning' status will reflect cases in which the reported result was close enough to the assigned property value, but its associated uncertainty was deemed to be either too small or too large.

TABLE 2. PERFORMANCE EVALUATION CRITERIA

Accuracy	Precision	Trueness	Final evaluation
Pass	Pass	Pass	Accepted
Pass	Fail	Pass	Warning
Pass	Pass	Fail	Warning
Fail	Pass/Fail	Pass/Fail	Not accepted

These evaluation criteria can also be illustrated by plotting the relative bias against the relative uncertainty of the participants' result (see Figure 1). In the illustrated case, a relative uncertainty of 1% for the IAEA value is assumed with MARB and LAP limits of 20%.

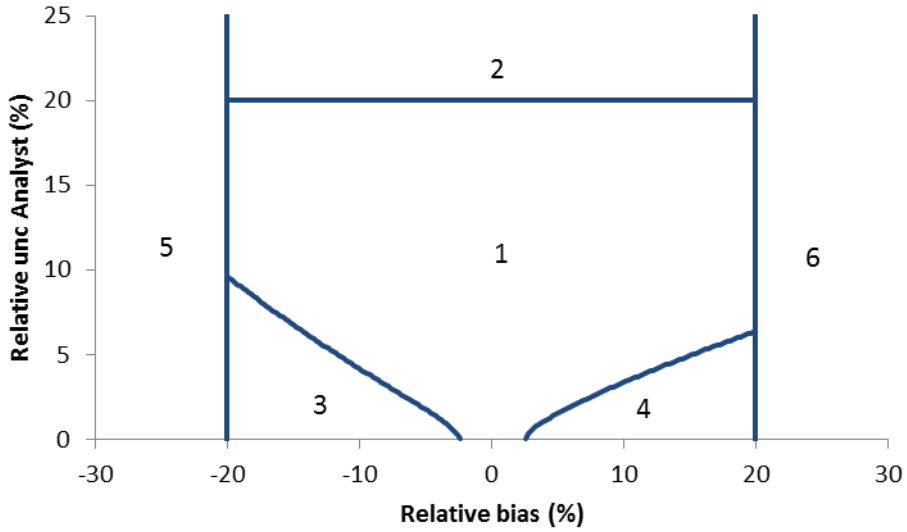

FIG. 1. Visualization of performance evaluation criteria.

The plot consists of six zones (Zone 1 'Accepted'; Zones 2, 3 and 4 'Warning'; Zones 5 and 6 'Not accepted'), whose areas are defined by the three tests used above to evaluate the data. The areas of Zones 1, 3 and 4 are finite, while the areas of Zones 2, 5 and 6 are infinite. A result located in Zone 1 passes all three tests (evaluation 'Accepted'). A result located in Zone 2 fails only the precision test as its associated uncertainty is deemed to be too large (evaluation: 'Warning'). A result located in Zones 3 and 4 fails only the trueness test as its associated uncertainty is deemed to be too small (evaluation: 'Warning'). A result located in Zones 5 and 6 fails (at least) the accuracy test as its relative bias is larger than the MARB (evaluation: 'Not accepted').

3.4. COMPARISON OF PARTICIPANTS' VALUES WITH THE IAEA VALUES

The means and the uncertainties for the combined participants' results were calculated according to a method developed by Cox (i.e. the weighted mean of the largest consistent subset containing *p* results) [9] and subsequently compared with the IAEA values. The mean of the combined participants' results, $Value_{\text{Combined}}$, was tested against the IAEA value, $Value_{\text{IAEA}}$, using this equation:

$$t = \frac{Value_{\text{Combined}} - Value_{\text{IAEA}}}{\sqrt{(unc_{\text{Combined}})^2 + (unc_{\text{IAEA}})^2}} \quad (6)$$

The effective degrees of freedom v_{eff} were determined with the Welch-Satterthwaite equation. The effective degrees of freedom v_{eff} were rounded and the critical value t_{crit} for this value was identified.

The criterion for passing the *t* test was:

$$|t| < t_{\text{crit}} \quad (7)$$

If the absolute value of *t* was greater than the critical value t_{crit}, this indicates there was a significant difference between the combined participants' results and the IAEA value.

4. RESULTS AND DISCUSSION

In total 299 measurement results were reported by 96 laboratories from 51 countries for ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and ^{155}Eu. The evaluation of these results showed that 70% of all reported results were 'Accepted', while 19% of the individual measurement results were 'Not accepted' with the remaining 11% having the 'Warning' status. The performance evaluation for ^{3}H, ^{89}Sr, ^{90}Sr, ^{134}Cs, ^{137}Cs and ^{155}Eu is summarized in Table 3.

TABLE 3. SUMMARY EVALUATION OF THE RADIONUCLIDES REPORTED

Radionuclide	Number of submitted results	Accepted	Warning	Not accepted
^{3}H	49	36	6	7
^{89}Sr	15	9	2	4
^{90}Sr	35	22	2	11
^{134}Cs	83	56	11	16
^{137}Cs	91	76	7	8
^{155}Eu	26	9	5	12

For all radionuclides, no significant bias of the combined participants' results was observed (see Table 4).

TABLE 4. COMPARISON OF THE COMBINED PARTICIPANTS' RESULTS WITH THE IAEA VALUE

Nuclide	Combined participants' result (Bq kg^{-1})	IAEA value (Bq kg^{-1})	Size of the LCS* (%)	*t*-value	Critical *t*-value	Bias (%)
^{3}H	5.050 ± 0.326	5.005 ± 0.099	38 (78%)	1.36	2.01	1.3
^{89}Sr	2.800 ±0.233	2.942 ± 0.055	3 (20%)	-1.78	2.03	-13.9
^{90}Sr	0.202 ± 0.015	0.201 ± 0.003	25 (71%)	-0.65	2.01	-1.4
^{134}Cs	0.160 ± 0.013	0.165 ± 0.002	73 (88%)	-0.46	1.99	-5.6
^{137}Cs	1.518 ± 0.064	1.520 ± 0.021	73 (80%)	0.96	1.99	1.8

*Size of the LCS (largest consistent subset) denotes the percentage of the returned results contributing to combined participants' results

For ^{3}H, ^{89}Sr, ^{90}Sr and ^{137}Cs approximately half of the participants' results demonstrated a negative bias (45%, 53%, 51% and 52% of the results, respectively), while for ^{134}Cs 54 out of 83 participants' results (65% of the results) showed a negative bias. In the previous proficiency test exercises ^{134}Cs has also been challenging to quantify mainly due to coincidence summing being problematic for ^{134}Cs as it leads to signal loss and hence underestimation of the activity levels for this radionuclide. It is evident from the results that some participants haven't made a sufficient correction for coincidence summing. Further details on the summary data evaluation sorted by sample number are given in Table 5.

TABLE 5. SUMMARY EVALUATION

Sample number	^{3}H	^{89}Sr	^{90}Sr	^{134}Cs	^{137}Cs
S19N003					NA
S19N004	A	A	A	NA	A
S19N005	W	W	A	A	A
S19N006	NA	A	A	A	A
S19N007				NA	NA
S19N008	NA		A	W	A
S19N009	W		NA	NA	A
S19N010				A	A
S19N011	NA			NA	A
S19N012				NA	A
S19N013				A	A
S19N014	A			A	A
S19N015	A			A	A
S19N016	A			A	A
S19N017				A	A
S19N018	A			W	NA
S19N019	A	NA	NA	A	A
S19N020					NA
S19N023				A	A
S19N024				NA	A
S19N025	A		A	A	A
S19N026				NA	A
S19N027	A			A	A
S19N028				W	A
S19N030			NA	A	A
S19N031	A		W	A	A
S19N032				A	A
S19N033	W		W		A
S19N034	A		A	A	A
S19N035				W	W
S19N036	A	NA	NA	A	A
S19N037				NA	NA
S19N038	A	NA	A	NA	A
S19N039	A	NA	A	W	W
S19N041	A		NA	A	A
S19N042					A
S19N043	A			A	A
S19N044				A	A

TABLE 5. SUMMARY EVALUATION (cont.)

Lab code	^{3}H	^{89}Sr	^{90}Sr	^{134}Cs	^{137}Cs
S19N045				A	A
S19N046	A				
S19N047				NA	A
S19N048				W	A
S19N049	NA		NA	A	W
S19N050				A	A
S19N051			A		
S19N052					
S19N053	A		NA	A	A
S19N054	A		A	A	A
S19N055	A	A	A	A	A
S19N056	A			A	A
S19N057	A	A	A	A	A
S19N058				A	A
S19N059				A	A
S19N060	A		A	A	A
S19N061				A	A
S19N062	W	NA	A	A	A
S19N065	A	A	NA	A	A
S19N066	NA			W	A
S19N067			A	A	A
S19N068				A	A
S19N069				NA	A
S19N070	A	A	NA	A	A
S19N071	A			A	A
S19N072				A	A
S19N073	A		A	A	A
S19N075				A	A
S19N076	A	A	A	A	A
S19N077					A
S19N078				A	A
S19N079			NA	NA	W
S19N080	A				
S19N082	A	A	A		
S19N083	A	W	A	W	A
S19N085	A			A	A
S19N086				W	W
S19N088				NA	W

S19N089	NA			A	W
S19N090	W	A	NA	NA	NA
S19N094				A	A
S19N096				NA	A
S19N097					NA
S19N098	A			A	A
S19N099	W		A	A	A
S19N101	A			A	A
S19N105	A		A	A	A
S19N107	NA				A
S19N108	A		A	A	A
S19N110				A	A
S19N111	A			A	A
S19N112				W	A
S19N113				NA	A
S19N115				A	A
S19N116					
S19N117					A
S19N118				A	A
S19N119				NA	A

A indicates 'Accepted', W indicates 'Warning' and NA indicates 'Not accepted'

The performance evaluation sorted by radionuclide and the bias plots are presented in Appendix I (see Tables 6–10 and Figures 2–6). In the bias plots, the 'Accepted' results are represented by dark blue points. 'Warning' and 'Not accepted' results are represented by the yellow and red points, respectively. The error bars represent the standard uncertainties of the bias (with a coverage factor of $k = 1$). The dotted lines represent a relative bias of ± 20% (Maximum Accepted Bias for ^{134}Cs and ^{137}Cs), ± 25% (Maximum Accepted Bias for ^{3}H and ^{90}Sr) or ± 25% (Maximum Accepted Bias for ^{89}Sr). The performance evaluation sorted by laboratory code is presented in Appendix II. All laboratories reported their values with standard uncertainties ($k = 1$). However, a large spread in the submitted uncertainties was observed with relative uncertainties (at $k = 1$) ranging from 0.8% to 30.3% for ^{3}H, from 1.7% to 28.5% for ^{89}Sr, from 2.2% to 36.5% for ^{90}Sr, from 3.2% to 92.2% for ^{134}Cs and from 0.4% to 47.2% for ^{137}Cs. However, most reported relative uncertainties were in the range of 5% – 15% (^{3}H and ^{89}Sr), 5% – 10% (^{90}Sr) and 3% – 10% (^{134}Cs and ^{137}Cs).

For ^{3}H, practically all participants performed a distillation of the sea water samples, followed by liquid scintillation counting (LSC). Nine participants (samples S19N014, S19N053, S19N065, S19N071, S19N076, S19N080, S19N082, S19N098 and S19N105) performed electrolytic enrichment after distillation (and obtained very good results with small uncertainties of less than 8% at $k = 1$). The direct measurements after distillation yielded slightly larger uncertainties generally between 5% and 25%.

For ^{90}Sr, the large majority of participants used gas-flow proportional counting (GPC) of chemically separated ^{90}Y as the analysis technique, except nine participants (samples S19N004, S19N006, S19N019, S19N036, S19N049, S19N055, S19N067, S19N070 and S19N079) who used LSC/Cherenkov counting. Chemical separation techniques used included precipitations of Sr-oxalate, Sr-phosphate or Sr-carbonate, barium chromate precipitations, iron hydroxide precipitation, nitric acid precipitations, cation-exchange chromatography, Sr-extraction chromatography and direct liquid-liquid extraction of ^{90}Y with HDEHP (di-(2-ethylhexyl)phosphoric acid). No significant difference between the performances of the chemical separation techniques is apparent.

For ^{89}Sr analysis, the chemical separation techniques used included precipitations of Sr-oxalate, Sr-phosphate or Sr-carbonate, barium chromate precipitations, iron hydroxide precipitation, nitric acid precipitations, cation-exchange chromatography, Sr-extraction chromatography. Approximately half of the submitted results were obtained with beta-counters and the other half by liquid scintillation counting. No significant difference in the performance between the two techniques is apparent.

For ^{134}Cs and ^{137}Cs, most participants have measured the sea water samples directly with gamma spectrometry, while the remaining laboratories either used a pre-concentration technique (e.g. adsorption on ammonium molybdophosphate (AMP), MnO_2 or Ni/Cu cyanoferrate) to separate the caesium radionuclides from the sea water matrix followed by gamma spectrometry (samples S19N009, S19N023, S19N027, S19N038, S19N039, S19N043, S19N045, S19N049, S19N057, S19N060, S19N061, S19N070, S19N076, S19N078, S19N086, S19N088, S19N090, S19N099, S19N105 and S19N110), evaporation of the sample followed by gamma spectrometry (samples S19N013, S19N014, S19N015, S19N034, S19N056, S19N089) or used a combination of techniques. No significant difference in the performance between the techniques is apparent.

APPENDIX I. PERFORMANCE EVALUATION TABLES SORTED BY RADIONUCLIDE

TABLE 6. EVALUATION RESULTS FOR ^{3}H

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N003	–	–	5.012	0.099	–	–	–	–	–	Not reported
S19N004	5.300	0.500	5.018	0.099	5.6	9.6	Pass	Pass	Pass	Accepted
S19N005	5.480	0.124	5.001	0.099	9.6	3.0	Pass	Pass	Fail	Warning
S19N006	6.352	0.492	5.000	0.099	27.0	8.0	Fail	Pass	Fail	Not accepted
S19N007	–	–	5.015	0.099	–	–	–	–	–	Not reported
S19N008	3.230	0.326	5.001	0.099	-35.4	10.3	Fail	Pass	Fail	Not accepted
S19N009	5.322	0.043	5.013	0.099	6.2	2.1	Pass	Pass	Fail	Warning
S19N010	–	–	4.991	0.099	–	–	–	–	–	Not reported
S19N011	7.240	1.040	4.990	0.099	4	5.0	Fail	Pass	Pass	Not accepted
S19N012	–	–	5.005	0.099	–	–	–	–	–	Not reported
S19N013	–	–	5.004	0.06	–	–	–	–	–	Not reported
S19N014	5.230	0.284	5.006	0.099	4.5	5.8	Pass	Pass	Pass	Accepted
S19N015	4.220	0.730	5.008	0.099	-15.7	17.4	Pass	Pass	Pass	Accepted
S19N016	5.600	0.570	5.011	0.099	11.8	10.4	Pass	Pass	Pass	Accepted
S19N017	–	–	5.002	0.099	–	–	–	–	–	Not reported
S19N018	5.501	0.772	5.007	0.099	9.9	14.2	Pass	Pass	Pass	Accepted
S19N019	6.113	0.612	4.998	0.099	22.3	10.2	–	–	–	Not reported
S19N020	–	–	5.012	0.099	–	–	–	–	–	Not reported

TABLE 6. EVALUATION RESULTS FOR ^{3}H (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N023	–	–	4.993	0.099	–	–	–	–	–	Not reported
S19N024	–	–	5.017	0.099	–	–	–	–	–	Not reported
S19N025	6.169	0.527	4.982	0.099	23.8	8.8	Pass	Pass	Pass	Accepted
S19N026	–	–	4.994	0.099	–	–	–	–	–	Not reported
S19N027	4.503	0.525	5.008	0.099	-10.1	11.8	Pass	Pass	Pass	Accepted
S19N028	–	–	4.999	0.099	–	–	–	–	–	Not reported
S19N030	–	–	5.009	0.099	–	–	–	–	–	Not reported
S19N031	5.620	0.270	4.994	0.099	12.5	5.2	Pass	Pass	Pass	Accepted
S19N032	–	–	4.999	0.099	–	–	–	–	–	Not reported
S19N033	4.000	1.333	5.020	0.099	-20.3	33.4	Pass	Fail	Pass	Warning
S19N034	4.920	0.451	5.012	0.099	-1.8	9.4	Pass	Pass	Pass	Accepted
S19N035	–	–	5.015	0.099	–	–	–	–	–	Not reported
S19N036	4.050	0.480	5.022	0.099	-19.4	12.0	Pass	Pass	Pass	Accepted
S19N037	–	–	5.010	0.099	–	–	–	–	–	Not reported
S19N038	5.050	0.100	5.019	0.099	6	3.7	Pass	Pass	Pass	Accepted
S19N039	4.930	0.130	5.003	0.099	-1.5	3.3	Pass	Pass	Pass	Accepted
S19N041	4.710	0.460	4.999	0.099	-5.8	10	Pass	Pass	Pass	Accepted
S19N042	–	–	5.011	0.099	–	–	–	–	–	Not reported
S19N043	5.530	0.283	4.998	0.099	10.9	5.5	Pass	Pass	Pass	Accept

TABLE 6. EVALUATION RESULTS FOR ^{3}H (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N044	–	–	5.007	0.099	–	–	–	–	–	Not reported
S19N045	–	–	5.011	0.099	–	–	–	–	–	Not reported
S19N046	4.980	0.350	5.001	0.099	-0.4	7.3	Pass	Pass	Pass	Accepted
S19N047	–	–	5.016	0.099	–	–	–	–	–	Not reported
S19N048	–	–	4.999	0.099	–	–	–	–	–	Not reported
S19N049	0.013	0.002	4.985	0.099	-99.7	11.7	Fail	Pass	Fail	Not accepted
S19N050	–	–	5.007	0.099	–	–	–	–	–	Not reported
S19N051	–	–	4.997	0.099	–	–	–	–	–	Not reported
S19N052	–	–	4.990	0.099	–	–	–	–	–	Not reported
S19N053	5.380	0.530	5.004	0.099	7.5	10.0	Pass	Pass	Pass	Accepted
S19N054	5.360	0.400	4.986	0.099	7.5	7.7	Pass	Pass	Pass	Accepted
S19N055	4.770	0.670	4.985	0.099	-4.3	14.2	Pass	Pass	Pass	Accepted
S19N056	4.200	0.500	4.981	0.099	-15.7	12.1	Pass	Pass	Pass	Accepted
S19N057	5.000	0.270	4.984	0.099	0.3	5.8	Pass	Pass	Pass	Accepted
S19N058	–	–	5.004	0.099	–	–	–	–	–	Not reported
S19N059	–	–	5.035	0.100	–	–	–	–	–	Not reported
S19N060	4.910	0.370	5.042	0.100	-2.6	7.8	Pass	Pass	Pass	Accepted
S19N061	–	–	5.011	0.099	–	–	–	–	–	Not reported

TABLE 6. EVALUATION RESULTS FOR ^{3}H (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N062	5.724	0.157	4.955	0.098	15.5	3.4	Pass	Pass	Fail	Warning
S19N065	4.650	0.180	4.973	0.098	-6.5	4.3	Pass	Pass	Pass	Accepted
S19N066	8.100	0.900	5.030	0.100	61	11.3	Fail	Pass	Fail	Not accepted
S19N067	–	–	5.013	0.099	–	–	–	–	–	Not reported
S19N068	–	–	5.005	0.099	–	–	–	–	–	Not reported
S19N069	–	–	4.966	0.098	–	–	–	–	–	Not reported
S19N070	4.300	0.800	5.015	0.099	-14.3	18.7	Pass	Pass	Pass	Accepted
S19N071	5.140	0.260	4.999	0.099	2.8	5.4	Pass	Pass	Pass	Accepted
S19N072	–	–	5.017	0.099	–	–	–	–	–	Not reported
S19N073	5.007	0.290	5.011	0.099	-0.1	6.1	Pass	Pass	Pass	Accepted
S19N075	–	–	4.998	0.099	–	–	–	–	–	Not reported
S19N076	5.410	0.180	5.021	0.099	7.7	3.9	Pass	Pass	Pass	Accepted
S19N077	–	–	4.972	0.098	–	–	–	–	–	Not reported
S19N078	–	–	5.024	0.099	–	–	–	–	–	Not reported
S19N079	–	–	5.006	0.099	–	–	–	–	–	Not reported
S19N080	5.130	0.110	5.001	0.099	2.6	2.9	Pass	Pass	Pass	Accepted
S19N082	4.900	0.300	5.028	0.100	-2.6	6.4	Pass	Pass	Pass	Accepted
S19N083	5.050	0.207	5.020	0.099	0.6	4.5	Pass	Pass	Pass	Accepted
S19N085	7.740	1.056	4.997	0.099	-5.1	22.4	Pass	Pass	Pass	Accepted

TABLE 6. EVALUATION RESULTS FOR ^{3}H (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N086	–	–	5.027	0.100	–	–	–	–	–	Not reported
S19N088	–	–	5.011	0.099	–	–	–	–	–	Not reported
S19N089	3.140	0.105	4.982	0.099	-37.0	3.9	Fail	Pass	Fail	Not accepted
S19N090	5.450	0.122	5.007	0.099	8.9	3.0	Pass	Pass	Fail	Warning
S19N094	–	–	4.991	0.099	–	–	–	–	–	Not reported
S19N096	–	–	5.017	0.098	–	–	–	–	–	Not reported
S19N097	–	–	5.017	0.099	–	–	–	–	–	Not reported
S19N098	4.881	0.201	4.954	0.098	-1.5	4.6	Pass	Pass	Pass	Accepted
S19N099	4.638	0.104	5.001	0.099	-7.3	3.0	Pass	Pass	Fail	Warning
S19N101	5.064	0.141	4.982	0.099	1.7	3.4	Pass	Pass	Pass	Accepted
S19N105	5.200	0.260	5.002	0.099	4.0	5.4	Pass	Pass	Pass	Accepted
S19N107	16.500	2.080	4.992	0.099	230.5	12.8	Fail	Pass	Fail	Not accepted
S19N108	5.456	0.307	5.017	0.099	8.8	6.0	Pass	Pass	Pass	Accepted
S19N110	–	–	5.007	0.099	–	–	–	–	–	Not reported
S19N111	4.925	0.406	5.013	0.099	-1.7	8.5	Pass	Pass	Pass	Accepted
S19N112	–	–	5.028	0.100	–	–	–	–	–	Not reported
S19N113	–	–	5.009	0.099	–	–	–	–	–	Not reported
S19N115	–	–	5.013	0.099	–	–	–	–	–	Not reported
S19N116	–	–	5.012	0.099	–	–	–	–	–	Not reported

TABLE 6. EVALUATION RESULTS FOR ^{3}H (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N117	–	–	5.006	0.099	–	–	–	–	–	Not reported
S19N118	–	–	5.002	0.099	–	–	–	–	–	Not reported
S19N119	–	–	5.008	0.099	–	–	–	–	–	Not reported

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N003	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N004	3.378	0.901	2.950	0.055	14.5	26.7	Pass	Pass	Pass	Accepted
S19N005	3.550	0.062	2.940	0.055	20.8	2.6	Pass	Pass	Fail	Warning
S19N006	3.201	0.557	2.939	0.055	8.9	17.5	Pass	Pass	Pass	Accepted
S19N007	–	–	2.948	0.055	–	–	–	–	–	Not reported
S19N008	–	–	2.940	0.055	–	–	–	–	–	Not reported
S19N009	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N010	–	–	2.934	0.055	–	–	–	–	–	Not reported
S19N011	–	–	2.933	0.055	–	–	–	–	–	Not reported
S19N012	–	–	2.942	0.055	–	–	–	–	–	Not reported
S19N013	–	–	2.942	0.055	–	–	–	–	–	Not reported
S19N014	–	–	2.943	0.055	–	–	–	–	–	Not reported
S19N015	–	–	2.944	0.055	–	–	–	–	–	Not reported
S19N016	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N017	–	–	2.940	0.055	–	–	–	–	–	Not reported
S19N018	–	–	2.944	0.055	–	–	–	–	–	Not reported
S19N019	14.772	4.210	2.938	0.055	402.7	28.6	Fail	Pass	Fail	Not accepted
S19N020	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N023	–	–	2.935	0.055	–	–	–	–	–	Not reported

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N024	–	–	2.949	0.055	–	–	–	–	–	Not reported
S19N025	–	–	2.929	0.055	–	–	–	–	–	Not reported
S19N026	–	–	2.936	0.055	–	–	–	–	–	Not reported
S19N027	–	–	2.944	0.055	–	–	–	–	–	Not reported
S19N028	–	–	2.939	0.055	–	–	–	–	–	Not reported
S19N030	–	–	2.945	0.055	–	–	–	–	–	Not reported
S19N031	–	–	2.936	0.055	–	–	–	–	–	Not reported
S19N032	–	–	2.939	0.055	–	–	–	–	–	Not reported
S19N033	–	–	2.951	0.055	–	–	–	–	–	Not reported
S19N034	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N035	–	–	2.948	0.055	–	–	–	–	–	Not reported
S19N036	0.830	0.090	2.953	0.055	-71.9	11	Fail	Pass	Fail	Not accepted
S19N037	–	–	2.945	0.055	–	–	–	–	–	Not reported
S19N038	1.840	0.043	2.950	0.055	-37.6	3.0	Fail	Pass	Fail	Not accepted
S19N039	–	–	2.941	0.055	–	–	–	–	–	Not reported
S19N041	–	–	2.939	0.055	–	–	–	–	–	Not reported
S19N042	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N043	–	–	2.932	0.055	–	–	–	–	–	Not reported
S19N044	–	–	2.944	0.055	–	–	–	–	–	Not reported

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N045	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N046	–	–	2.940	0.055	–	–	–	–	–	Not reported
S19N047	–	–	2.949	0.055	–	–	–	–	–	Not reported
S19N048	–	–	2.939	0.055	–	–	–	–	–	Not reported
S19N049	–	–	2.931	0.055	–	–	–	–	–	Not reported
S19N050	–	–	2.944	0.055	–	–	–	–	–	Not reported
S19N051	–	–	2.937	0.055	–	–	–	–	–	Not reported
S19N052	–	–	2.933	0.055	–	–	–	–	–	Not reported
S19N053	–	–	2.942	0.055	–	–	–	–	–	Not reported
S19N054	–	–	2.931	0.055	–	–	–	–	–	Not reported
S19N055	2.590	0.270	2.931	0.055	-11.6	10.6	Pass	Pass	Pass	Accepted
S19N056	–	–	2.928	0.054	–	–	–	–	–	Not reported
S19N057	2.780	0.190	2.930	0.054	-5.1	7.1	Pass	Pass	Pass	Accepted
S19N058	–	–	2.942	0.055	–	–	–	–	–	Not reported
S19N059	–	–	2.960	0.055	–	–	–	–	–	Not reported
S19N060	–	–	2.964	0.055	–	–	–	–	–	Not reported
S19N061	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N062	–	–	2.913	0.054	–	–	–	–	–	Not reported
S19N065	3.740	0.350	2.923	0.054	27.9	9.5	Pass	Pass	Pass	Accepted

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N066	–	–	2.957	0.055	–	–	–	–	–	Not reported
S19N067	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N068	–	–	2.942	0.055	–	–	–	–	–	Not reported
S19N069	–	–	2.919	0.055	–	–	–	–	–	Not reported
S19N070	2.100	0.500	2.948	0.055	-28.8	23.9	Pass	Pass	Pass	Accepted
S19N071	–	–	2.939	0.055	–	–	–	–	–	Not reported
S19N072	–	–	2.950	0.055	–	–	–	–	–	Not reported
S19N073	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N075	–	–	2.938	0.055	–	–	–	–	–	Not reported
S19N076	3.050	0.233	2.952	0.055	3.3	7.9	Pass	Pass	Pass	Accepted
S19N077	–	–	2.923	0.054	–	–	–	–	–	Not reported
S19N078	–	–	2.953	0.055	–	–	–	–	–	Not reported
S19N079	–	–	2.943	0.055	–	–	–	–	–	Not reported
S19N080	–	–	2.940	0.055	–	–	–	–	–	Not reported
S19N082	2.800	0.200	2.956	0.055	-5.3	7.4	Pass	Pass	Pass	Accepted
S19N083	2.400	0.110	2.951	0.055	-18.7	4.9	Pass	Pass	Fail	Warning
S19N085	–	–	2.938	0.055	–	–	–	–	–	Not reported

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N086	–	–	2.955	0.055	–	–	–	–	–	Not reported
S19N088	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N089	–	–	2.929	0.054	–	–	–	–	–	Not reported
S19N090	2.496	0.314	2.943	0.055	-15.2	12.7	Pass	Pass	Pass	Accepted
S19N094	–	–	2.934	0.055	–	–	–	–	–	Not reported
S19N096	–	–	2.949	0.055	–	–	–	–	–	Not reported
S19N097	–	–	2.949	0.055	–	–	–	–	–	Not reported
S19N098	–	–	2.913	0.054	–	–	–	–	–	Not reported
S19N099	–	–	2.940	0.055	–	–	–	–	–	Not reported
S19N101	–	–	2.929	0.054	–	–	–	–	–	Not reported
S19N105	–	–	2.941	0.055	–	–	–	–	–	Not reported
S19N107	–	–	2.935	0.055	–	–	–	–	–	Not reported
S19N108	–	–	2.949	0.055	–	–	–	–	–	Not reported
S19N110	–	–	2.944	0.055	–	–	–	–	–	Not reported
S19N111	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N112	–	–	2.956	0.055	–	–	–	–	–	Not reported
S19N113	–	–	2.945	0.055	–	–	–	–	–	Not reported

TABLE 7. EVALUATION RESULTS FOR ^{89}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N115	–	–	2.947	0.055	–	–	–	–	–	Not reported
S19N116	–	–	2.946	0.055	–	–	–	–	–	Not reported
S19N117	–	–	2.943	0.055	–	–	–	–	–	Not reported
S19N118	–	–	2.941	0.055	–	–	–	–	–	Not reported
S19N119	–	–	2.944	0.055	–	–	–	–	–	Not reported

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N003	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N004	0.210	0.030	0.202	0.003	4.0	14.1	Pass	Pass	Pass	Accepted
S19N005	0.160	0.028	0.201	0.003	-20.5	17.5	Pass	Pass	Pass	Accepted
S19N006	0.199	0.035	0.201	0.003	-1.3	17.4	Pass	Pass	Pass	Accepted
S19N007	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N008	0.240	0.015	0.201	0.003	19.2	6.4	Pass	Pass	Pass	Accepted
S19N009	0.066	0.007	0.202	0.003	-67.3	10.1	Fail	Pass	Fail	Not accepted
S19N010	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N011	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N012	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N013	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N014	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N015	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N016	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N017	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N018	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N019	0.262	0.096	0.201	0.003	30.3	36.6	Fail	Fail	Pass	Not accepted
S19N020	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N023	–	–	0.201	0.003	–	–	–	–	–	Not reported

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N024	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N025	0.202	0.011	0.200	0.003	1.0	5.8	Pass	Pass	Pass	Accepted
S19N026	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N027	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N028	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N030	0.120	0.015	0.201	0.003	-40.6	12.6	Fail	Pass	Fail	Not accepted
S19N031	0.224	0.005	0.201	0.003	11.5	2.6	Pass	Pass	Pass	Accepted
S19N032	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N033	0.183	0.005	0.202	0.003	-9.4	3.0	Pass	Pass	Fail	Warning
S19N034	0.189	0.009	0.202	0.003	-6.3	5.1	Pass	Pass	Pass	Accepted
S19N035	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N036	0.270	0.030	0.202	0.003	33.6	11.2	Fail	Pass	Pass	Not accepted
S19N037	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N038	0.207	0.046	0.202	0.003	2.5	22.3	Pass	Pass	Pass	Accepted
S19N039	0.214	0.011	0.201	0.003	6.3	5.3	Pass	Pass	Pass	Accepted
S19N041	0.420	0.042	0.201	0.003	108.8	10.1	Fail	Pass	Fail	Not accepted
S19N042	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N043	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N044	–	–	0.201	0.003	–	–	–	–	–	Not reported

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N045	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N046	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N047	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N048	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N049	0.095	0.006	0.201	0.003	-52.5	6.7	Fail	Pass	Fail	Not accepted
S19N050	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N051	0.190	0.013	0.201	0.003	-5.5	7.0	Pass	Pass	Pass	Accepted
S19N052	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N053	0.508	0.050	0.201	0.003	152.4	10.0	Fail	Pass	Fail	Not accepted
S19N054	0.180	0.012	0.201	0.003	-10.2	6.8	Pass	Pass	Pass	Accepted
S19N055	0.230	0.030	0.201	0.003	14.7	13.1	Pass	Pass	Pass	Accpeted
S19N056	–	–	0.200	0.003	–	–	–	–	–	Not reported
S19N057	0.196	0.015	0.200	0.003	-2.2	7.8	Pass	Pass	Pass	Accepted
S19N058	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N059	–	–	0.203	0.003	–	–	–	–	–	Not reported
S19N060	0.224	0.020	0.203	0.003	10.4	9.0	Pass	Pass	Pass	Accepted
S19N061	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N062	0.183	0.012	0.199	0.003	-8.2	6.4	Pass	Pass	Pass	Accepted
S19N065	0.148	0.023	0.200	0.003	-26.3	15.6	Fail	Pass	Pass	Not accepted

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N066	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N067	0.170	0.020	0.202	0.003	-15.7	11.8	Pass	Pass	Pass	Accepted
S19N068	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N069	–	–	0.200	0.003	–	–	–	–	–	Not reported
S19N070	0.120	0.040	0.202	0.003	-40.5	33.4	Fail	Fail	Pass	Not accepted
S19N071	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N072	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N073	0.205	0.013	0.202	0.003	1.7	6.6	Pass	Pass	Pass	Accepted
S19N075	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N076	0.216	0.017	0.202	0.003	7.0	8.1	Pass	Pass	Pass	Accepted
S19N077	–	–	0.200	0.003	–	–	–	–	–	Not reported
S19N078	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N079	3.400	0.500	0.201	0.003	1588.5	14.8	Fail	Pass	Fail	Not accepted
S19N080	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N082	0.200	0.020	0.202	0.003	-1.1	10.1	Pass	Pass	Pass	Accepted
S19N083	0.210	0.008	0.202	0.003	4.0	3.9	Pass	Pass	Pass	Accepted
S19N085	–	–	0.201	0.003	–	–	–	–	–	Not reported

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N086	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N088	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N089	–	–	0.200	0.003	–	–	–	–	–	Not reported
S19N090	0.148	0.013	0.201	0.003	-26.5	8.7	Fail	Pass	Fail	Not accepted
S19N094	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N096	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N097	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N098	–	–	0.199	0.003	–	–	–	–	–	Not reported
S19N099	0.213	0.015	0.201	0.003	5.9	7.1	Pass	Pass	Pass	Accepted
S19N101	–	–	0.200	0.003	–	–	–	–	–	Not reported
S19N105	0.203	0.012	0.201	0.003	0.9	6.0	Pass	Pass	Pass	Accepted
S19N107	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N108	0.190	0.011	0.202	0.003	-6.0	6.0	Pass	Pass	Pass	Accepted
S19N110	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N111	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N112	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N113	–	–	0.201	0.003	–	–	–	–	–	Not reported

TABLE 8. EVALUATION RESULTS FOR ^{90}Sr (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N115	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N116	–	–	0.202	0.003	–	–	–	–	–	Not reported
S19N117	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N118	–	–	0.201	0.003	–	–	–	–	–	Not reported
S19N119	–	–	0.201	0.003	–	–	–	–	–	Not reported

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N003	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N004	0.132	0.012	0.165	0.002	-20.2	9.2	Pass	Pass	Pass	Accepted
S19N005	0.145	0.013	0.165	0.002	-12.0	8.8	Pass	Pass	Pass	Accepted
S19N006	0.182	0.017	0.165	0.002	10.5	9.4	Pass	Pass	Pass	Accepted
S19N007	0.257	0.048	0.165	0.002	55.7	18.7	Fail	Pass	Pass	Not accepted
S19N008	0.135	0.028	0.165	0.002	-18.0	20.7	Pass	Fail	Pass	Warning
S19N009	0.103	0.011	0.165	0.002	-37.6	10.7	Fail	Pass	Fail	Not accepted
S19N010	0.163	0.018	0.164	0.002	-0.6	11.3	Pass	Pass	Pass	Accepted
S19N011	0.200	0.020	0.164	0.002	21.6	10.1	Fail	Pass	Pass	Not accepted
S19N012	0.130	0.013	0.165	0.002	-21.2	10.1	Fail	Pass	Fail	Not accepted
S19N013	0.155	0.017	0.165	0.002	-6.2	11.2	Pass	Pass	Pass	Accpeted
S19N014	0.162	0.009	0.165	0.002	-1.8	5.7	Pass	Pass	Pass	Accepted
S19N015	0.180	0.012	0.165	0.002	9.1	6.8	Pass	Pass	Pass	Accepted
S19N016	0.191	0.032	0.165	0.002	15.9	16.9	Pass	Pass	Pass	Accepted
S19N017	0.155	0.010	0.165	0.002	-5.9	6.5	Pass	Pass	Pass	Accepted
S19N018	0.157	0.040	0.165	0.002	-4.8	25.5	Pass	Fail	Pass	Warning
S19N019	0.170	0.019	0.165	0.002	3.2	11.2	Pass	Pass	Pass	Accepted
S19N020	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N023	0.154	0.013	0.165	0.002	-6.4	8.6	Pass	Pass	Pass	Accepted

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N024	0.120	0.030	0.165	0.002	-27.4	25.0	Fail	Fail	Pass	Not Accepted
S19N025	0.163	0.011	0.164	0.002	-0.7	7.0	Pass	Pass	Pass	Accepted
S19N026	0.241	0.017	0.165	0.002	46.3	7.1	Fail	Pass	Fail	Not accepted
S19N027	0.163	0.016	0.165	0.002	-1.2	9.9	Pass	Pass	Pass	Accepted
S19N028	0.149	0.031	0.165	0.002	-9.5	20.8	Pass	Fail	Pass	Warning
S19N030	0.174	0.020	0.165	0.002	5.1	11.4	Pass	Pass	Pass	Accepted
S19N031	0.153	0.008	0.165	0.002	-7.0	5.3	Pass	Pass	Pass	Accepted
S19N032	0.170	0.030	0.165	0.002	3.2	17.7	Pass	Pass	Pass	Accepted
S19N033	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N034	0.147	0.011	0.165	0.002	-11.0	7.6	Pass	Pass	Pass	Accepted
S19N035	0.170	0.070	0.165	0.002	3.0	40.9	Pass	Fail	Pass	Warning
S19N036	0.180	0.020	0.165	0.002	8.8	11.2	Pass	Pass	Pass	Accepted
S19N037	0.081	0.075	0.165	0.002	-50.7	92.2	Fail	Fail	Pass	Not accepted
S19N038	0.131	0.011	0.165	0.002	-20.8	8.2	Fail	Pass	Fail	Not accepted
S19N039	0.139	0.007	0.165	0.002	-15.7	5.1	Pass	Pass	Fail	Warning
S19N041	0.143	0.009	0.165	0.002	-13.2	6.4	Pass	Pass	Pass	Accepted
S19N042	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N043	0.152	0.008	0.164	0.002	-7.3	5.1	Pass	Pass	Pass	Accepted
S19N044	0.150	0.012	0.165	0.002	-4.8	2.7	Pass	Pass	Pass	Accepted

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N045	0.164	0.010	0.165	0.002	-0.7	6.2	Pass	Pass	Pass	Accepted
S19N046	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N047	0.230	0.008	0.165	0.002	39.4	3.6	Fail	Pass	Fail	Not accepted
S19N048	0.163	0.038	0.165	0.002	-1.0	23.3	Pass	Fail	Pass	Warning
S19N049	0.136	0.012	0.164	0.002	-17.1	8.9	Pass	Pass	Pass	Accepted
S19N050	0.179	0.012	0.165	0.002	8.5	6.8	Pass	Pass	Pass	Accepted
S19N051	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N052	–	–	0.164	0.002	–	–	–	–	–	Not reported
S19N053	0.176	0.012	0.165	0.002	6.7	6.9	Pass	Pass	Pass	Accepted
S19N054	0.168	0.015	0.164	0.002	2.3	9.0	Pass	Pass	Pass	Accepted
S19N055	0.140	0.010	0.164	0.002	-14.8	7.2	Pass	Pass	Pass	Accepted
S19N056	0.168	0.017	0.164	0.002	2.4	10.2	Pass	Pass	Pass	Accepted
S19N057	0.160	0.009	0.164	0.002	-2.6	5.7	Pass	Pass	Pass	Accepted
S19N058	0.170	0.20	0.165	0.002	3.1	11.8	Pass	Pass	Pass	Accepted
S19N059	0.178	0.019	0.166	0.002	7.2	10.7	Pass	Pass	Pass	Accepted
S19N060	0.160	0.011	0.166	0.002	-3.7	6.8	Pass	Pass	Pass	Accepted
S19N061	0.158	0.005	0.165	0.002	-4.3	3.4	Pass	Pass	Pass	Accepted
S19N062	0.168	0.023	0.163	0.002	2.9	13.7	Pass	Pass	Pass	Accepted
S19N065	0.152	0.026	0.164	0.002	-7.2	17.1	Pass	Pass	Pass	Accepted

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N066	0.142	0.005	0.166	0.002	-14.3	3.7	Pass	Pass	Fail	Warning
S19N067	0.150	0.010	0.165	0.002	-9.2	6.8	Pass	Pass	Pass	Accepted
S19N068	0.142	0.014	0.165	0.002	-13.7	10.2	Pass	Pass	Pass	Accepted
S19N069	0.200	0.060	0.164	0.002	22.2	30.0	Fail	Fail	Pass	Not accepted
S19N070	0.160	0.030	0.165	0.002	-3.2	18.8	Pass	Pass	Pass	Accepted
S19N071	0.150	0.010	0.165	0.002	-8.9	6.8	Pass	Pass	Pass	Accepted
S19N072	0.152	0.019	0.165	0.002	-8.1	12.9	Pass	Pass	Pass	Accepted
S19N073	0.155	0.017	0.165	0.002	-6.1	11.1	Pass	Pass	Pass	Accepted
S19N075	0.177	0.020	0.165	0.002	7.5	11.4	Pass	Pass	Pass	Accepted
S19N076	0.168	0.013	0.165	0.002	1.7	8.0	Pass	Pass	Pass	Accepted
S19N077	–	–	0.164	0.002	–	–	–	–	–	Not reported
S19N078	0.155	0.005	0.166	0.002	-6.1	3.5	Pass	Pass	Pass	Accepted
S19N079	0.210	0.030	0.165	0.002	27.3	14.3	Fail	Pass	Pass	Not accepted
S19N080	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N082	–	–	0.166	0.002	–	–	–	–	–	Not reported
S19N083	0.142	0.008	0.165	0.002	-14.1	6.0	Pass	Pass	Fail	Warning
S19N085	0.169	0.015	0.165	0.002	2.6	8.7	Pass	Pass	Pass	Accepted
S19N086	0.133	0.040	0.166	0.002	-19.7	30.1	Pass	Fail	Pass	Warning

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N088	0.210	0.004	0.165	0.002	27.1	2.1	Fail	Pass	Fail	Not accepted
S19N089	0.168	0.010	0.164	0.002	2.3	6.2	Pass	Pass	Pass	Accepted
S19N090	0.199	0.007	0.165	0.002	20.6	3.8	Fail	Pass	Fail	Not accepted
S19N094	0.155	0.015	0.164	0.002	-5.6	10.0	Pass	Pass	Pass	Accepted
S19N096	0.271	0.029	0.165	0.002	64.2	10.7	Fail	Pass	Fail	Not accepted
S19N097	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N098	0.154	0.009	0.163	0.002	-5.5	6.2	Pass	Pass	Pass	Accepted
S19N099	0.153	0.009	0.165	0.002	-7.3	5.9	Pass	Pass	Pass	Accepted
S19N101	0.158	0.018	0.164	0.002	-3.7	11.4	Pass	Pass	Pass	Accepted
S19N105	0.156	0.011	0.165	0.002	-5.4	7.1	Pass	Pass	Pass	Accepted
S19N107	–	–	0.164	0.002	–	–	–	–	–	Not reported
S19N108	0.173	0.013	0.165	0.002	4.4	7.6	Pass	Pass	Pass	Accepted
S19N110	0.166	0.009	0.165	0.002	0.9	5.8	Pass	Pass	Pass	Accepted
S19N111	0.160	0.010	0.165	0.002	-3.1	6.4	Pass	Pass	Pass	Accepted
S19N112	0.134	0.011	0.166	0.002	-18.9	8.3	Pass	Pass	Fail	Warning
S19N113	0.204	0.044	0.165	0.002	23.6	21.6	Fail	Fail	Pass	Not accepted
S19N115	0.157	0.020	0.165	0.002	-5.0	12.8	Pass	Pass	Pass	Accepted
S19N116	0.133	0.023	0.165	0.002	-19.6	17.7	Pass	Pass	Pass	Accepted

TABLE 9. EVALUATION RESULTS FOR ^{134}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N117	–	–	0.165	0.002	–	–	–	–	–	Not reported
S19N118	0.160	0.007	0.165	0.002	-2.9	4.5	Pass	Pass	Pass	Accepted
S19N119	0.106	0.032	0.165	0.002	-35.8	29.9	Fail	Fail	Pass	Not accepted

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N003	0.897	0.033	1.522	0.021	-41.1	3.9	Fail	Pass	Fail	Not accepted
S19N004	1.520	0.105	1.524	0.021	-0.3	7.0	Pass	Pass	Pass	Accepted
S19N005	1.520	0.046	1.519	0.021	0.1	3.3	Pass	Pass	Pass	Accepted
S19N006	1.489	0.064	1.519	0.021	-2.0	4.5	Pass	Pass	Pass	Accepted
S19N007	1.109	0.070	1.523	0.021	-27.2	6.5	Fail	Pass	Fail	Not accepted
S19N008	1.356	0.234	1.519	0.021	-10.7	17.3	Pass	Pass	Pass	Accepted
S19N009	1.606	0.062	1.523	0.021	5.5	4.1	Pass	Pass	Pass	Accepted
S19N010	1.560	0.058	1.516	0.021	2.9	4.0	Pass	Pass	Pass	Accepted
S19N011	1.500	0.040	1.516	0.021	-1.0	3.0	Pass	Pass	Pass	Accepted
S19N012	1.500	0.094	1.520	0.021	-1.3	6.4	Pass	Pass	Pass	Accepted
S19N013	1.562	0.059	1.520	0.021	2.8	4.0	Pass	Pass	Pass	Accepted
S19N014	1.522	0.051	1.521	0.021	0.1	3.6	Pass	Pass	Pass	Accepted
S19N015	1.656	0.090	1.521	0.021	8.9	5.6	Pass	Pass	Pass	Accepted
S19N016	1.396	0.109	1.522	0.021	-8.3	7.9	Pass	Pass	Pass	Accepted
S19N017	1.510	0.090	1.519	0.021	-0.6	6.1	Pass	Pass	Pass	Accepted
S19N018	2.170	0.029	1.521	0.021	42.7	1.9	Fail	Pass	Fail	Not accepted
S19N019	1.470	0.090	1.518	0.021	-3.2	6.3	Pass	Pass	Pass	Accepted
S19N020	0.800	0.200	1.522	0.021	-47.5	25.0	Fail	Fail	Fail	Not accepted
S19N023	1.499	0.037	1.517	0.021	-1.2	2.8	Pass	Pass	Pass	Accepted

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N024	1.580	0.120	1.524	0.021	3.7	7.7	Pass	Pass	Pass	Accepted
S19N025	1.543	0.045	1.513	0.021	2.0	3.2	Pass	Pass	Pass	Accepted
S19N026	1.635	0.058	1.517	0.021	7.8	3.8	Pass	Pass	Pass	Accepted
S19N027	1.560	0.130	1.521	0.021	2.6	8.4	Pass	Pass	Pass	Accepted
S19N028	1.407	0.078	1.518	0.021	-7.3	5.7	Pass	Pass	Pass	Accepted
S19N030	1.565	0.171	1.521	0.021	2.9	11.0	Pass	Pass	Pass	Accepted
S19N031	1.530	0.038	1.517	0.021	-0.9	2.8	Pass	Pass	Pass	Accepted
S19N032	1.730	0.140	1.518	0.021	14.0	8.2	Pass	Pass	Pass	Accepted
S19N033	1.592	0.136	1.525	0.021	4.4	8.6	Pass	Pass	Pass	Accepted
S19N034	1.544	0.086	1.522	0.021	1.4	5.7	Pass	Pass	Pass	Accepted
S19N035	1.231	0.311	1.523	0.021	-19.2	25.3	Pass	Fail	Pass	Warning
S19N036	1.600	0.200	1.525	0.021	4.9	12.6	Pass	Pass	Pass	Accepted
S19N037	0.261	0.123	1.522	0.021	-82.9	47.3	Fail	Fail	Fail	Not accepted
S19N038	1.372	0.101	1.524	0.021	-10.0	7.5	Pass	Pass	Pass	Accepted
S19N039	1.360	0.015	1.520	0.021	-10.5	1.8	Pass	Pass	Fail	Warning
S19N041	1.350	0.099	1.518	0.021	-11.1	7.5	Pass	Pass	Pass	Accepted
S19N042	1.348	0.138	1.522	0.021	-11.4	10.3	Pass	Pass	Pass	Accepted
S19N043	1.480	0.064	1.515	0.021	-2.3	4.5	Pass	Pass	Pass	Accepted
S19N044	1.448	0.034	1.521	0.021	-4.8	2.7	Pass	Pass	Pass	Accepted

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N045	1.595	0.068	1.522	0.021	4.8	4.4	Pass	Pass	Pass	Accepted
S19N046	–	–	1.519	0.021	–	–	–	–	–	Not reported
S19N047	1.523	0.014	1.524	0.021	0.0	1.6	Pass	Pass	Pass	Accepted
S19N048	1.546	0.059	1.518	0.021	1.8	4.0	Pass	Pass	Pass	Accepted
S19N049	1.682	0.035	1.514	0.021	11.1	2.5	Pass	Pass	Fail	Warning
S19N050	1.530	0.080	1.521	0.021	0.6	5.4	Pass	Pass	Pass	Accepted
S19N051	–	–	1.518	0.021	–	–	–	–	–	Not reported
S19N052	–	–	1.515	0.021	–	–	–	–	–	Not reported
S19N053	1.476	0.098	1.520	0.021	-2.9	6.8	Pass	Pass	Pass	Accepted
S19N054	1.400	0.071	1.514	0.021	-7.5	5.3	Pass	Pass	Pass	Accepted
S19N055	1.660	0.100	1.514	0.021	9.6	6.2	Pass	Pass	Pass	Accepted
S19N056	1.600	0.090	1.513	0.021	5.8	5.8	Pass	Pass	Pass	Accepted
S19N057	1.500	0.080	1.514	0.021	-0.9	5.5	Pass	Pass	Pass	Accepted
S19N058	1.500	0.110	1.520	0.021	-1.3	7.5	Pass	Pass	Pass	Accepted
S19N059	1.529	0.097	1.529	0.021	0.0	6.5	Pass	Pass	Pass	Accepted
S19N060	1.540	0.089	1.531	0.021	0.6	5.9	Pass	Pass	Pass	Accepted
S19N061	1.544	0.013	1.522	0.021	1.5	1.6	Pass	Pass	Pass	Accepted
S19N062	1.416	0.032	1.505	0.021	-5.9	2.6	Pass	Pass	Pass	Accepted
S19N065	1.470	0.010	1.510	0.021	-2.7	1.5	Pass	Pass	Pass	Accepted

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N066	1.510	0.030	1.528	0.021	-1.2	2.4	Pass	Pass	Pass	Accepted
S19N067	1.400	0.070	1.523	0.021	-8.1	5.2	Pass	Pass	Pass	Accepted
S19N068	1.565	0.034	1.520	0.021	3.0	2.6	Pass	Pass	Pass	Accepted
S19N069	1.490	0.070	1.508	0.021	-1.2	4.9	Pass	Pass	Pass	Accepted
S19N070	1.400	0.200	1.523	0.021	-8.1	14.4	Pass	Pass	Pass	Accepted
S19N071	0.450	0.060	1.518	0.021	-4.5	4.4	Pass	Pass	Pass	Accepted
S19N072	1.495	0.037	1.524	0.021	-1.9	2.8	Pass	Pass	Pass	Accepted
S19N073	1.410	0.054	1.522	0.021	-7.4	4.1	Pass	Pass	Pass	Accepted
S19N075	1.516	0.104	1.518	0.021	-0.1	7.0	Pass	Pass	Pass	Accepted
S19N076	1.504	0.059	1.525	0.021	-1.4	4.2	Pass	Pass	Pass	Accepted
S19N077	1.380	0.116	1.510	0.021	-8.6	8.5	Pass	Pass	Pass	Accepted
S19N078	1.582	0.049	1.526	0.021	3.7	3.4	Pass	Pass	Pass	Accepted
S19N079	1.770	0.070	1.520	0.021	16.4	4.2	Pass	Pass	Fail	Warning
S19N080	–	–	1.519	0.021	–	–	–	–	–	Not reported
S19N082	–	–	1.527	0.021	–	–	–	–	–	Not reported
S19N083	1.560	0.049	1.525	0.021	2.3	3.4	Pass	Pass	Pass	Accepted
S19N085	1.522	0.030	1.518	0.021	0.3	2.4	Pass	Pass	Pass	Accepted
S19N086	1.588	0.430	1.527	0.021	4.0	27.1	Pass	Fail	Pass	Warning

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N088	1.686	0.008	1.522	0.021	10.7	1.4	Pass	Pass	Fail	Warning
S19N089	1.700	0.051	1.513	0.021	12.3	3.3	Pass	Pass	Fail	Warning
S19N090	2.080	0.019	1.521	0.021	36.8	1.6	Fail	Pass	Fail	Not accepted
S19N094	1.518	0.022	1.516	0.021	0.1	2.0	Pass	Pass	Pass	Accepted
S19N096	1.683	0.095	1.524	0.021	10.4	5.8	Pass	Pass	Pass	Accepted
S19N097	7.100	0.600	1.524	0.021	366.0	8.6	Fail	Pass	Fail	Not accepted
S19N098	1.484	0.049	1.505	0.021	-1.4	3.6	Pass	Pass	Pass	Accepted
S19N099	1.466	0.019	1.519	0.021	-3.5	1.9	Pass	Pass	Pass	Accepted
S19N101	1.470	0.040	1.513	0.021	-2.8	3.0	Pass	Pass	Pass	Accepted
S19N105	1.490	0.051	1.519	0.021	-1.9	3.7	Pass	Pass	Pass	Accepted
S19N107	1.410	0.046	1.516	0.021	-7.0	3.5	Pass	Pass	Pass	Accepted
S19N108	1.540	0.064	1.524	0.021	1.1	4.4	Pass	Pass	Pass	Accepted
S19N110	1.671	0.085	1.521	0.021	9.9	5.3	Pass	Pass	Pass	Accepted
S19N111	1.470	0.010	1.522	0.021	-3.4	1.5	Pass	Pass	Pass	Accepted
S19N112	1.628	0.042	1.527	0.021	6.6	2.9	Pass	Pass	Pass	Accepted
S19N113	1.659	0.054	1.521	0.021	9.0	3.5	Pass	Pass	Pass	Accepted
S19N115	1.429	0.033	1.523	0.021	-6.1	2.7	Pass	Pass	Pass	Accepted
S19N116	2.827	0.255	1.522	0.021	85.7	9.1	Fail	Pass	Fail	Not accepted

TABLE 10. EVALUATION RESULTS FOR ^{137}Cs (cont.)

Sample number	Lab value (Bq kg^{-1})	Lab uncert. (Bq kg^{-1})	IAEA value (Bq kg^{-1})	IAEA uncert. (Bq kg^{-1})	Relative bias (%)	P (%)	Accuracy	Precision	Trueness	Final score
S19N117	1.457	0.110	1.520	0.021	-4.2	7.7	Pass	Pass	Pass	Accepted
S19N118	1.550	0.050	1.519	0.021	2.0	3.5	Pass	Pass	Pass	Accepted
S19N119	1.433	0.079	1.521	0.021	-5.8	5.7	Pass	Pass	Pass	Accepted

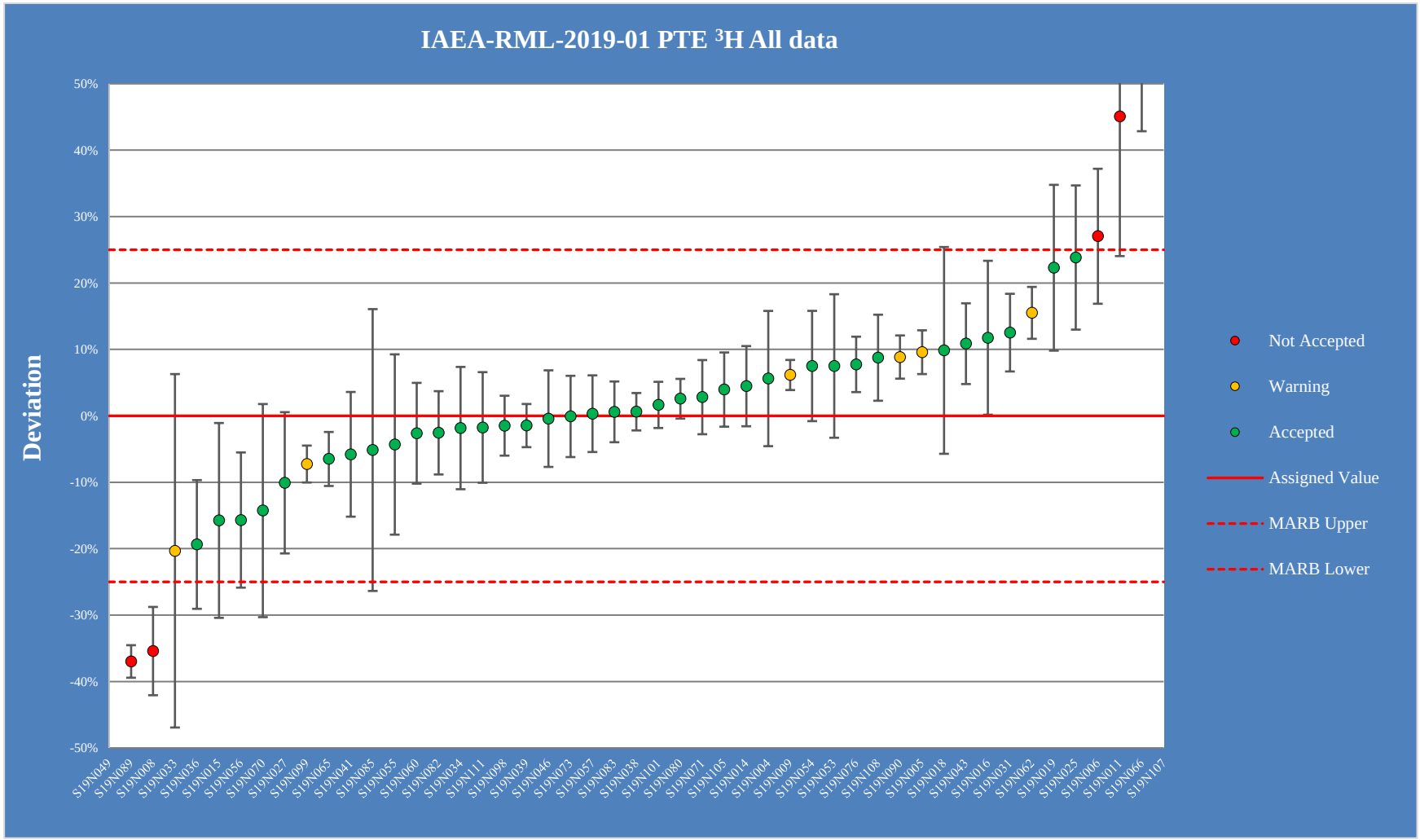
IAEA-RML-2019-01 PTE 3H All data
Deviation
50%
40%
30%
20%
10%
0%
-10%
-20%
-30%
-40%
-50%
S19N049
S19N089
S19N008
S19N033
S19N036
S19N015
S19N056
S19N070
S19N027
S19N099
S19N065
S19N041
S19N085
S19N055
S19N060
S19N082
S19N034
S19N111
S19N098
S19N039
S19N046
S19N073
S19N057
S19N083
S19N038
S19N101
S19N080
S19N071
S19N105
S19N014
S19N004
S19N009
S19N054
S19N053
S19N076
S19N108
S19N090
S19N005
S19N018
S19N043
S19N016
S19N031
S19N062
S19N019
S19N025
S19N006
S19N011
S19N066
S19N107
Not Accepted
Warning
Accepted
Assigned Value
MARB Upper
MARB Lower

FIG. 2. H-3 bias.

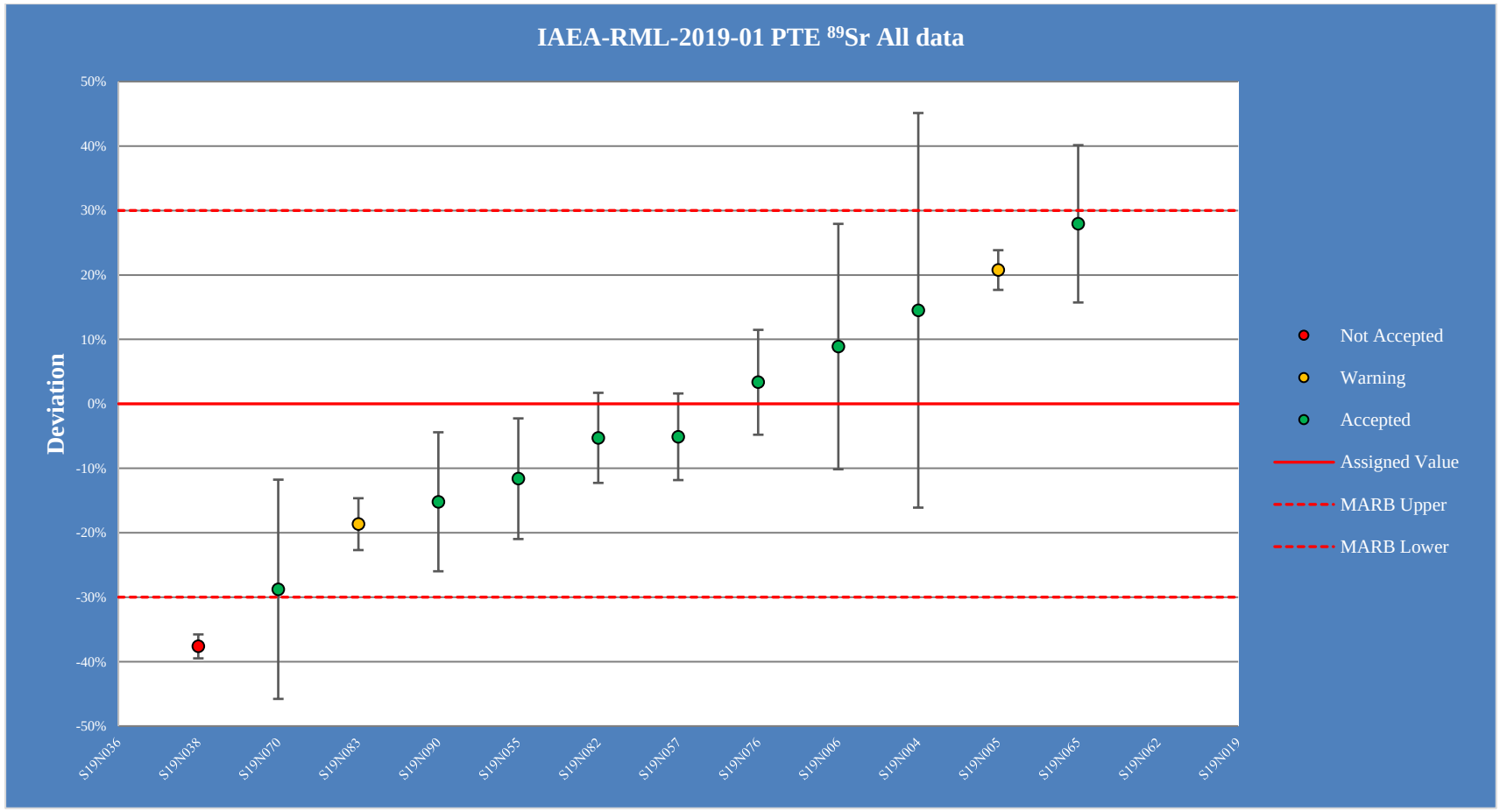

FIG. 3. Sr-89 bias.

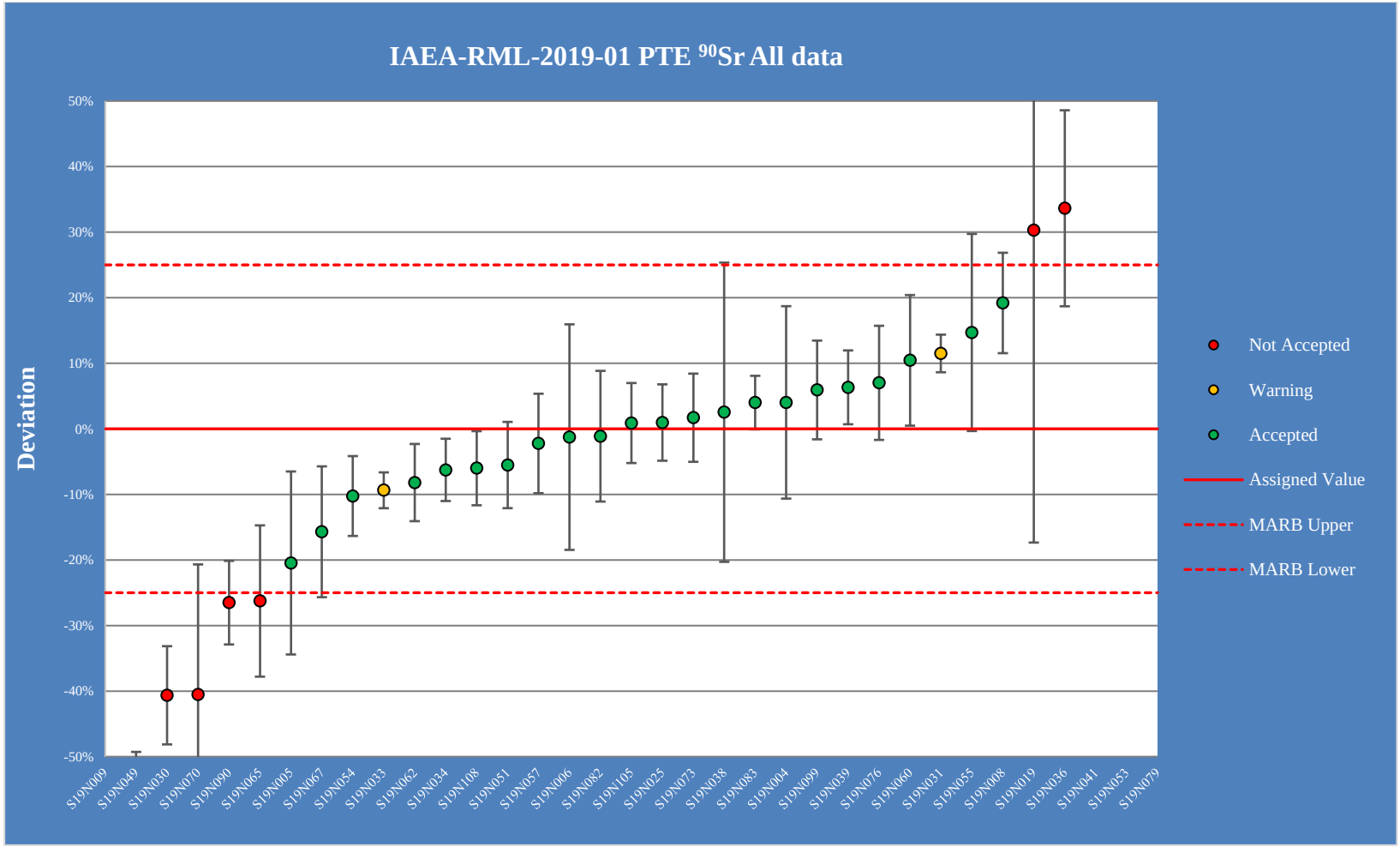

FIG. 4. Sr-90 bias.

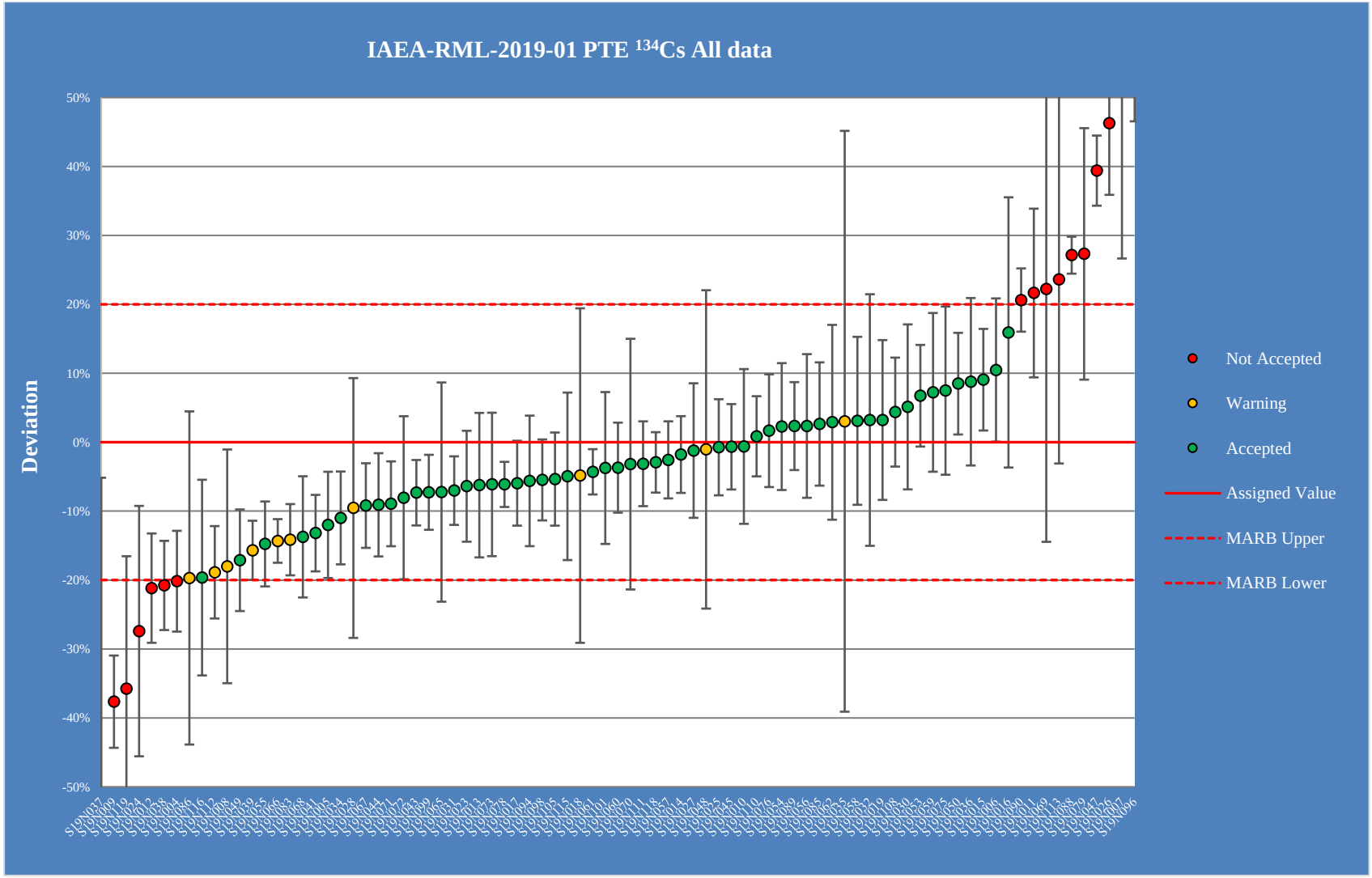

FIG. 5. Cs-134 bias.

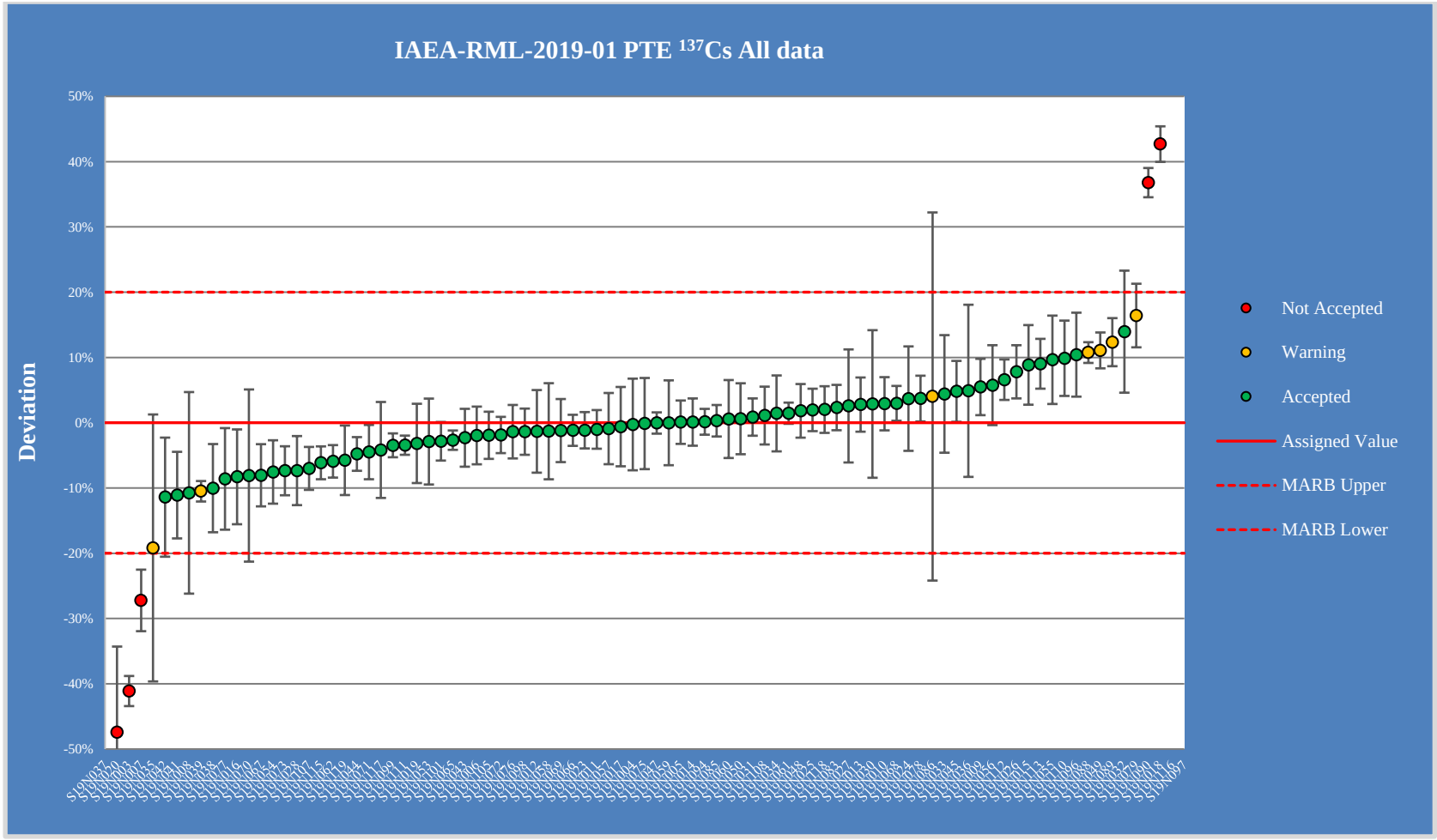

FIG. 6. Cs-137 bias.

APPENDIX II. PERFORMANCE EVALUATION TABLES SORTED BY SAMPLE NUMBER

TABLE 11. SAMPLE NUMBER S19N003

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.012	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.947	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.522	0.021	0.897	0.033	-41.1%	3.9%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 12. SAMPLE NUMBER S19N004

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.018	0.099	5.300	0.500	5.6%	9.6%	Pass	Pass	Pass	Accepted
^{89}Sr	2.950	0.055	3.378	0.901	14.5%	26.7%	Pass	Pass	Pass	Accepted
^{90}Sr	0.202	0.003	0.210	0.030	4.0%	14.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.132	0.012	-20.2%	9.2%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.524	0.021	1.520	0.105	-0.3%	7.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	0.400	0.045	-62.5%	11.4%	Fail	Pass	Fail	Not accepted

TABLE 13. SAMPLE NUMBER S19N005

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	5.480	0.124	9.6%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.940	0.055	3.550	0.062	20.8%	2.6%	Pass	Pass	Fail	Warning
^{90}Sr	0.201	0.003	0.160	0.028	-20.5%	17.5%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.145	0.013	-12.0%	8.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.520	0.046	0.1%	3.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 14. SAMPLE NUMBER S19N006

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.000	0.099	6.352	0.492	27.0%	8.0%	Fail	Pass	Fail	Not accepted
^{89}Sr	2.939	0.055	3.201	0.557	8.9%	17.5%	Pass	Pass	Pass	Accepted
^{90}Sr	0.201	0.003	0.199	0.035	-1.3%	17.4%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.182	0.017	10.5%	9.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.489	0.064	-2.0%	4.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	0.821	0.054	-22.8%	6.8%	Pass	Pass	Fail	Warning

TABLE 15. SAMPLE NUMBER S19N007

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.015	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.948	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.257	0.048	55.7%	18.7%	Fail	Pass	Pass	Not accepted
^{137}Cs	1.523	0.021	1.109	0.070	-27.2%	6.5%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.066	0.020	–	–	–	–	–	–	–	Not reported

TABLE 16. SAMPLE NUMBER S19N008

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	3.230	0.326	-35.4%	10.3%	Fail	Pass	Fail	Not accepted
^{89}Sr	2.940	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.240	0.015	19.2%	6.4%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.135	0.028	-18.0%	20.7%	Pass	Fail	Pass	Warning
^{137}Cs	1.519	0.021	1.356	0.234	-10.7%	17.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	–	–	–	–	-	Not reported

TABLE 17. SAMPLE NUMBER S19N009

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.013	0.099	5.322	0.043	6.2%	2.1%	Pass	Pass	Fail	Warning
^{89}Sr	2.947	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	0.066	0.007	-67.3%	10.1%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.103	0.011	-37.6%	10.7%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.523	0.021	1.606	0.062	5.5%	4.1%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	–	–	–	–	–	–	–	Not reported

TABLE 18. SAMPLE NUMBER S19N010

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.991	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.934	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.164	0.002	0.163	0.018	-0.6%	11.3%	Pass	Pass	Pass	Accepted
^{137}Cs	1.516	0.021	1.560	0.058	2.9%	4.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	0.236	0.043	-77.7%	18.2%	Fail	Pass	Fail	Not accepted

TABLE 19. SAMPLE NUMBER S19N011

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.990	0.099	7.240	1.040	45.1%	14.5%	Fail	Pass	Pass	Not accepted
^{89}Sr	2.933	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.164	0.002	0.200	0.020	21.6%	10.1%	Fail	Pass	Pass	Not accepted
^{137}Cs	1.516	0.021	1.500	0.040	-1.0%	3.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	–	–	–	–	–	–	–	Not reported

TABLE 20. SAMPLE NUMBER S19N012

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.005	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.942	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.130	0.013	-21.2%	10.1%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.520	0.021	1.500	0.094	-1.3%	6.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	–	–	–	–	–	Not reported

TABLE 21. SAMPLE NUMBER S19N013

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.004	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.942	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.155	0.017	-6.2%	11.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.520	0.021	1.562	0.059	2.8%	4.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	–	–	–	–	–	Not reported

TABLE 22. SAMPLE NUMBER S19N014

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.006	0.099	5.230	0.284	4.5%	5.8%	Pass	Pass	Pass	Accepted
^{89}Sr	2.943	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.162	0.009	-1.8%	5.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.522	0.051	0.1%	3.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	1.300	0.067	22.2%	5.5%	Pass	Pass	Fail	Warrning

TABLE 23. SAMPLE NUMBER S19N015

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.008	0.099	4.220	0.730	-15.7%	17.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.944	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.180	0.012	9.1%	6.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.656	0.090	8.9%	5.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	0.163	0.015	-84.7%	9.4%	Fail	Pass	Fail	Not accepted

TABLE 24. SAMPLE NUMBER S19N016

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	5.600	0.570	11.8%	10.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.946	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.191	0.032	15.9%	16.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.396	0.109	-8.3%	7.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 25. SAMPLE NUMBER S19N017

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.002	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.940	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.155	0.010	-5.9%	6.5%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.510	0.090	-0.6%	6.1%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	0.986	0.048	-7.3%	5.2%	Pass	Pass	Pass	Accepted

TABLE 26. SAMPLE NUMBER S19N018

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.007	0.099	5.501	0.772	9.9%	14.2%	Pass	Pass	Pass	Accepted
^{89}Sr	2.944	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.157	0.040	-4.8%	25.5%	Pass	Fail	Pass	Warning
^{137}Cs	1.521	0.021	2.170	0.029	42.7%	1.9%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.064	0.020	–	–	–	–	–	–	–	Not reported

TABLE 27. SAMPLE NUMBER S19N019

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.998	0.099	6.113	0.612	22.3%	10.2%	Pass	Pass	Pass	Accepted
^{89}Sr	2.938	0.055	14.772	4.210	402.7%	28.6%	Fail	Pass	Fail	Not accepted
^{90}Sr	0.201	0.003	0.262	0.096	30.3%	36.6%	Fail	Fail	Pass	Not accepted
^{134}Cs	0.165	0.002	0.170	0.019	3.2%	11.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.470	0.090	-3.2%	6.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	0.860	0.065	-19.1%	7.8%	Pass	Pass	Fail	Warning

TABLE 28. SAMPLE NUMBER S19N020

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.012	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.947	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.522	0.021	0.800	0.200	-47.5%	25.0%	Fail	Fail	Fail	Not accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 29. SAMPLE NUMBER S19N023

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.993	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.935	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.154	0.013	-6.4%	8.6%	Pass	Pass	Pass	Accepted
^{137}Cs	1.517	0.021	1.499	0.037	-1.2%	2.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	–	–	–	–	–	–	–	Not reported

TABLE 30. SAMPLE NUMBER S19N024

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.949	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.120	0.030	-27.4%	25.0%	Fail	Fail	Pass	Not accepted
^{137}Cs	1.524	0.021	1.580	0.120	3.7%	7.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	–	–	–	–	–	–	–	Not reported

TABLE 31. SAMPLE NUMBER S19N025

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	6.169	0.527	23.8%	8.8%	Pass	Pass	Pass	Accepted
^{89}Sr	2.929	0.054	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.200	0.003	0.202	0.011	1.0%	5.8%	Pass	Pass	Pass	Accepted
^{134}Cs	0.164	0.002	0.163	0.011	-0.7%	7.0%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.543	0.045	2.0%	3.2%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	0.900	0.043	-15.0%	5.1%	Pass	Pass	Fail	Warrning

TABLE 32. SAMPLE NUMBER S19N026

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.994	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.936	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.241	0.017	46.3%	7.1%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.517	0.021	1.635	0.058	7.8%	3.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	1.782	0.149	67.8%	8.6%	Fail	Pass	Fail	Not accepted

TABLE 33. SAMPLE NUMBER S19N027

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.008	0.099	4.503	0.525	-10.1%	11.8%	Pass	Pass	Pass	Accepted
^{89}Sr	2.944	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.163	0.016	-1.2%	9.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.560	0.130	2.6%	8.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	1.100	0.160	3.3%	14.7%	Pass	Pass	Pass	Accepted

TABLE 34. SAMPLE NUMBER S19N028

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.999	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.939	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.149	0.031	-9.5%	20.8%	Pass	Fail	Pass	Warrning
^{137}Cs	1.518	0.021	1.407	0.078	-7.3%	5.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 35. SAMPLE NUMBER S19N030

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.009	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.945	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.120	0.015	-40.6%	12.6%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.174	0.020	5.1%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.565	0.171	2.9%	11.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	0.540	0.072	-49.3%	13.5%	Fail	Pass	Fail	Not accepted

TABLE 36. SAMPLE NUMBER S19N031

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.994	0.099	5.620	0.270	12.5%	5.2%	Pass	Pass	Pass	Accepted
^{89}Sr	2.936	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.224	0.005	11.5%	2.6%	Pass	Pass	Fail	Warning
^{134}Cs	0.165	0.002	0.153	0.008	-7.0%	5.3%	Pass	Pass	Pass	Accepted
^{137}Cs	1.517	0.021	1.530	0.038	0.9%	2.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	–	–	–	–	–	–	–	Not reported

TABLE 37. SAMPLE NUMBER S19N032

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.999	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.939	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.170	0.030	3.2%	17.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.730	0.140	14.0%	8.2%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	–	–	–	–	–	–	–	Not reported

TABLE 38. SAMPLE NUMBER S19N033

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.020	0.099	4.000	1.333	-20.3%	33.4%	Pass	Fail	Pass	Warning
^{89}Sr	2.951	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	0.183	0.005	-9.4%	3.0%	Pass	Pass	Fail	Warning
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.525	0.021	1.592	0.136	4.4%	8.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	1.084	0.151	1.6%	14.1%	Pass	Pass	Pass	Accepted

TABLE 39. SAMPLE NUMBER S19N034

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.012	0.099	4.920	0.451	-1.8%	9.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.947	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	0.189	0.009	-6.3%	5.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.147	0.011	-11.0%	7.6%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.544	0.086	1.4%	5.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 40. SAMPLE NUMBER S19N035

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.015	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.948	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.170	0.070	3.0%	40.9%	Pass	Fail	Pass	Warning
^{137}Cs	1.523	0.021	1.231	0.311	-19.2%	25.3%	Pass	Fail	Pass	Warning
^{155}Eu	1.066	0.020	–	–	–	–	–	–	–	Not reported

TABLE 41. SAMPLE NUMBER S19N036

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.022	0.099	4.050	0.480	-19.4%	12.0%	Pass	Pass	Pass	Accepted
^{89}Sr	2.953	0.055	0.830	0.090	-71.9%	11.0%	Fail	Pass	Fail	Not accepted
^{90}Sr	0.202	0.003	0.270	0.030	33.6%	11.2%	Fail	Pass	Pass	Not accepted
^{134}Cs	0.165	0.002	0.180	0.020	8.8%	11.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.525	0.021	1.600	0.200	4.9%	12.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.068	0.020	0.150	0.020	-85.9%	13.5%	Fail	Pass	Fail	Not accepted

TABLE 42. SAMPLE NUMBER S19N037

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.010	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.945	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.081	0.075	-50.7%	92.2%	Fail	Fail	Pass	Not accepted
^{137}Cs	1.522	0.021	0.261	0.123	-82.9%	47.3%	Fail	Fail	Fail	Not accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 43. SAMPLE NUMBER S19N038

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.019	0.099	5.050	0.100	0.6%	2.8%	Pass	Pass	Pass	Accepted
^{89}Sr	2.950	0.055	1.840	0.043	-37.6%	3.0%	Fail	Pass	Fail	Not accepted
^{90}Sr	0.202	0.003	0.207	0.046	2.5%	22.3%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.131	0.011	-20.8%	8.2%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.524	0.021	1.372	0.101	-10.0%	7.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	–	–	–	–	–	–	–	Not reported

TABLE 44. SAMPLE NUMBER S19N039

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.003	0.099	4.930	0.130	-1.5%	3.3%	Pass	Pass	Pass	Accepted
^{89}Sr	2.941	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.214	0.011	6.3%	5.3%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.139	0.007	-15.7%	5.1%	Pass	Pass	Fail	Warning
^{137}Cs	1.520	0.021	1.360	0.015	-10.5%	1.8%	Pass	Pass	Fail	Warning
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 45. SAMPLE NUMBER S19N041

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.999	0.099	4.710	0.460	-5.8%	10.0%	Pass	Pass	Pass	Accepted
^{89}Sr	2.939	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.420	0.042	108.8%	10.1%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.143	0.009	-13.2%	6.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.350	0.099	-11.1%	7.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 46. SAMPLE NUMBER S19N042

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.946	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.522	0.021	1.348	0.138	-11.4%	10.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 47. SAMPLE NUMBER S19N043

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.988	0.099	5.530	0.283	10.9%	5.5%	Pass	Pass	Pass	Accepted
^{89}Sr	2.932	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.164	0.002	0.152	0.008	-7.3%	5.1%	Pass	Pass	Pass	Accepted
^{137}Cs	1.515	0.021	1.480	0.064	-2.3%	4.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.060	0.020	0.289	0.016	-72.8%	5.8%	Fail	Pass	Fail	Not accepted

TABLE 48. SAMPLE NUMBER S19N044

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.007	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.944	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.150	0.012	-9.1%	8.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.448	0.034	-4.8%	2.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	–	–	–	–	–	Not reported

TABLE 49. SAMPLE NUMBER S19N045

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.946	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.164	0.010	-0.7%	6.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.595	0.068	4.8%	4.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	–	–	–	–	–	Not reported

TABLE 50. SAMPLE NUMBER S19N046

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	4.980	0.350	-0.4%	7.3%	Pass	Pass	Pass	Accepted
^{89}Sr	2.940	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.519	0.021	–	–	–	–	–	–	–	Not reported
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 51. SAMPLE NUMBER S19N047

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.016	0.099	–	–	–	–	–	–	–	Not Reported
^{89}Sr	2.949	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.202	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.230	0.008	39.4%	3.6%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.524	0.021	1.523	0.014	0.0%	1.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	–	–	–	–	–	–	–	Not reported

TABLE 52. SAMPLE NUMBER S19N048

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.999	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.939	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.163	0.038	-1.0%	23.3%	Pass	Fail	Pass	Warning
^{137}Cs	1.518	0.021	1.546	0.059	1.8%	4.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	–	–	–	–	–	Not reported

TABLE 53. SAMPLE NUMBER S19N049

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.985	0.099	0.013	0.002	-99.7%	11.7%	Fail	Pass	Fail	Not accepted
^{89}Sr	2.931	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.095	0.006	-52.5%	6.7%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.164	0.002	0.136	0.012	-17.1%	8.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.514	0.021	1.682	0.035	11.1%	2.5%	Pass	Pass	Fail	Warning
^{155}Eu	1.060	0.020	–	–	–	–	–	–	–	Not reported

TABLE 54 SAMPLE NUMBER S19N050

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.007	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.944	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	–	–	–	–	–	–	–	Not reported
^{134}Cs	0.165	0.002	0.179	0.012	8.5%	6.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.530	0.080	0.6%	5.4%	Pass	A	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	–	–	–	–	–	Not reported

TABLE 55. SAMPLE NUMBER S19N051

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.997	0.099	–	–	–	–	–	–	–	Not reported
^{89}Sr	2.937	0.055	–	–	–	–	–	–	–	Not reported
^{90}Sr	0.201	0.003	0.190	0.013	-5.5%	7.0%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	–	–	–	–	–	–	–	Not reported
^{137}Cs	1.518	0.021	–	–	–	–	–	–	–	Not reported
^{155}Eu	1.062	0.020	–	–	–	–	–	–	–	Not reported

TABLE 56. SAMPLE NUMBER S19N052

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.990	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.933	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.515	0.021	–	–	-	-	-	-	-	Not reported
^{155}Eu	1.061	0.020	–	–	-	-	-	-	-	Not reported

TABLE 57. SAMPLE NUMBER S19N053

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.004	0.099	5.380	0.530	7.5%	10.0%	Pass	Pass	Pass	Accepted
^{89}Sr	2.942	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.508	0.050	152.4%	10.0%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.176	0.012	6.7%	6.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.520	0.021	1.476	0.098	-2.9%	6.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 58. SAMPLE NUMBER S19N054

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.986	0.099	5.360	0.400	7.5%	7.7%	Pass	Pass	Pass	Accepted
^{89}Sr	2.931	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.180	0.012	-10.2%	6.8%	Pass	Pass	Pass	Accepted
^{134}Cs	0.164	0.002	0.168	0.015	2.3%	9.0%	Pass	Pass	Pass	Accepted
^{137}Cs	1.514	0.021	1.400	0.071	-7.5%	5.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.060	0.020	–	–	-	-	-	-	-	Not reported

TABLE 59. SAMPLE NUMBER S19N055

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.985	0.099	4.770	0.670	-4.3%	14.2%	Pass	Pass	Pass	Accepted
^{89}Sr	2.931	0.055	2.590	0.270	-11.6%	10.6%	Pass	Pass	Pass	Accepted
^{90}Sr	0.201	0.003	0.230	0.030	14.7%	13.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.164	0.002	0.140	0.010	-14.8%	7.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.514	0.021	1.660	0.100	9.6%	6.2%	Pass	Pass	Pass	Accepted
^{155}Eu	1.060	0.020	1.100	0.120	3.8%	11.1%	Pass	Pass	Pass	Accepted

TABLE 60. SAMPLE NUMBER S19N056

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.981	0.099	4.200	0.500	-15.7%	12.1%	Pass	Pass	Pass	Accepted
^{89}Sr	2.928	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.168	0.017	2.4%	10.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.600	0.090	5.8%	5.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 61. SAMPLE NUMBER S19N057

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.984	0.099	5.000	0.270	0.3%	5.8%	Pass	Pass	Pass	Accepted
^{89}Sr	2.930	0.054	2.780	0.190	-5.1%	7.1%	Pass	Pass	Pass	Accepted
^{90}Sr	0.200	0.003	0.196	0.015	-2.2%	7.8%	Pass	Pass	Pass	Accepted
^{134}Cs	0.164	0.002	0.160	0.009	-2.6%	5.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.514	0.021	1.500	0.080	-0.9%	5.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	0.570	0.034	-46.2%	6.3%	Fail	Pass	Fail	Not accepted

TABLE 62. SAMPLE NUMBER S19N058

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.004	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.942	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.170	0.020	3.1%	11.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.520	0.021	1.500	0.110	-1.3%	7.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	1.050	0.120	-1.3%	11.6%	Pass	Pass	Pass	Accepted

TABLE 63. SAMPLE NUMBER S19N059

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.035	0.100	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.960	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.203	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.166	0.002	0.178	0.019	7.2%	10.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.529	0.021	1.529	0.097	0.0%	6.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.070	0.020	0.934	0.068	-12.7%	7.5%	Pass	Pass	Pass	Accepted

TABLE 64. SAMPLE NUMBER S19N060

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.042	0.100	4.910	0.370	-2.6%	7.8%	A	A	A	Accepted
^{89}Sr	2.964	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.203	0.003	0.224	0.020	10.4%	9.0%	A	A	A	Accepted
^{134}Cs	0.166	0.002	0.160	0.011	-3.7%	6.8%	A	A	A	Accepted
^{137}Cs	1.531	0.021	1.540	0.089	0.6%	5.9%	A	A	A	Accepted
^{155}Eu	1.072	0.020	–	–	-	-	-	-	-	Not reported

TABLE 65. SAMPLE NUMBER S19N061

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.946	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.158	0.005	-4.3%	3.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.544	0.013	1.5%	1.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 66. SAMPLE NUMBER S19N062

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.955	0.098	5.724	0.157	15.5%	3.4%	Pass	Pass	Fail	Warning
^{89}Sr	2.913	0.054	6.320	0.186	116.9%	3.5%	N	Pass	Fail	Not accepted
^{90}Sr	0.199	0.003	0.183	0.012	-8.2%	6.4%	Pass	Pass	Pass	Accepted
^{134}Cs	0.163	0.002	0.168	0.023	2.9%	13.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.505	0.021	1.416	0.032	-5.9%	2.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.053	0.020	–	–	-	-	-	-	-	Not reported

TABLE 67. SAMPLE NUMBER S19N065

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.973	0.098	4.650	0.180	-6.5%	4.3%	Pass	Pass	Pass	Accepted
^{89}Sr	2.923	0.054	3.740	0.350	27.9%	9.5%	Pass	Pass	Pass	Accepted
^{90}Sr	0.200	0.003	0.148	0.023	-26.3%	15.6%	Fail	Pass	Pass	Not accepted
^{134}Cs	0.164	0.002	0.152	0.026	-7.2%	17.1%	Pass	Pass	Pass	Accepted
^{137}Cs	1.510	0.021	1.470	0.010	-2.7%	1.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.057	0.020	–	–	-	-	-	-	-	Not reported

TABLE 68. SAMPLE NUMBER S19N066

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.030	0.100	8.100	0.900	61.0%	11.3%	N	A	N	Not accepted
^{89}Sr	2.957	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.166	0.002	0.142	0.005	-14.3%	3.7%	A	A	N	Warning
^{137}Cs	1.528	0.021	1.510	0.030	-1.2%	2.4%	A	A	A	Accepted
^{155}Eu	1.069	0.020	–	–	-	-	-	-	-	Not reported

TABLE 69. SAMPLE NUMBER S19N067

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.013	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.947	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	0.170	0.020	-15.7%	11.8%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.150	0.010	-9.2%	6.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.523	0.021	1.400	0.070	-8.1%	5.2%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	0.510	0.040	-52.1%	8.1%	Fail	Pass	Fail	Not accepted

TABLE 70. SAMPLE NUMBER S19N068

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.005	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.942	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.142	0.014	-13.7%	10.2%	A	A	A	Accepted
^{137}Cs	1.520	0.021	1.565	0.034	3.0%	2.6%	A	A	A	Accepted
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 71. SAMPLE NUMBER S19N069

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.966	0.098	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.919	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.200	0.060	22.2%	30.0%	Fail	Fail	Pass	Not accepted
^{137}Cs	1.508	0.021	1.490	0.070	-1.2%	4.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.055	0.020	–	–	-	-	-	-	-	Not reported

TABLE 72. SAMPLE NUMBER S19N070

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.015	0.099	4.300	0.800	-14.3%	18.7%	Pass	Pass	Pass	Accepted
^{89}Sr	2.948	0.055	2.100	0.500	-28.8%	23.9%	Pass	Pass	Pass	Accepted
^{90}Sr	0.202	0.003	0.120	0.040	-40.5%	33.4%	N	N	Pass	Not accepted
^{134}Cs	0.165	0.002	0.160	0.030	-3.2%	18.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.523	0.021	1.400	0.200	-8.1%	14.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	1.000	0.200	-6.2%	20.1%	Pass	Pass	Pass	Accepted

TABLE 73. SAMPLE NUMBER S19N071

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.999	0.099	5.140	0.260	2.8%	5.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.939	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.150	0.010	-8.9%	6.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.450	0.060	-4.5%	4.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	1.220	0.070	14.8%	6.0%	Pass	Pass	Pass	Accepted

TABLE 74. SAMPLE NUMBER S19N072

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.950	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.152	0.019	-8.1%	12.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.524	0.021	1.495	0.037	-1.9%	2.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	–	–	-	-	-	-	-	Not reported

TABLE 75. SAMPLE NUMBER S19N073

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	5.007	0.290	-0.1%	6.1%	Pass	Pass	Pass	Accepted
^{89}Sr	2.946	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	0.205	0.013	1.7%	6.6%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.155	0.017	-6.1%	11.1%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.410	0.054	-7.4%	4.1%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 76. SAMPLE NUMBER S19N075

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.998	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.938	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.177	0.020	7.5%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.516	0.104	-0.1%	7.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	0.649	0.092	-38.9%	14.3%	Fail	Pass	Fail	Not accepted

TABLE 77. SAMPLE NUMBER S19N076

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.021	0.099	5.410	0.180	7.7%	3.9%	Pass	Pass	Pass	Accepted
^{89}Sr	2.952	0.055	3.050	0.233	3.3%	7.9%	Pass	Pass	Pass	Accepted
^{90}Sr	0.202	0.003	0.216	0.017	7.0%	8.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.168	0.013	1.7%	8.0%	Pass	Pass	Pass	Accepted
^{137}Cs	1.525	0.021	1.504	0.059	-1.4%	4.2%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	–	–	-	-	-	-	-	Not reported

TABLE 78. SAMPLE NUMBER S19N077

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.972	0.098	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.923	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.510	0.021	1.380	0.116	-8.6%	8.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.057	0.020	–	–	-	-	-	-	-	Not reported

TABLE 79. SAMPLE NUMBER S19N078

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.024	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.953	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.166	0.002	0.155	0.005	-6.1%	3.5%	A	A	A	Accepted
^{137}Cs	1.526	0.021	1.582	0.049	3.7%	3.4%	A	A	A	Accepted
^{155}Eu	1.068	0.020	–	–	-	-	-	-	-	Not reported

TABLE 80. SAMPLE NUMBER S19N079

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.006	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.943	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	3.400	0.500	1588.5%	14.8%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.210	0.030	27.3%	14.3%	Fail	Pass	Pass	Not accepted
^{137}Cs	1.520	0.021	1.770	0.070	16.4%	4.2%	Pass	Pass	Fail	Warning
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 81. SAMPLE NUMBER S19N080

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	5.130	0.110	2.6%	2.9%	Pass	Pass	Pass	Accepted
^{89}Sr	2.940	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.519	0.021	–	–	-	-	-	-	-	Not reported
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 82. SAMPLE NUMBER S19N082

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.028	0.100	4.900	0.300	-2.6%	6.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.956	0.055	2.800	0.200	-5.3%	7.4%	Pass	Pass	Pass	Accepted
^{90}Sr	0.202	0.003	0.200	0.020	-1.1%	10.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.166	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.527	0.021	–	–	-	-	-	-	-	Not reported
^{155}Eu	1.069	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N083

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.020	0.099	5.050	0.207	0.6%	4.5%	Pass	Pass	Pass	Accepted
^{89}Sr	2.951	0.055	2.400	0.110	-18.7%	4.9%	Pass	Pass	Fail	Warning
^{90}Sr	0.202	0.003	0.210	0.008	4.0%	3.9%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.142	0.008	-14.1%	6.0%	Pass	Pass	Fail	Warning
^{137}Cs	1.525	0.021	1.560	0.049	2.3%	3.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.067	0.020	0.928	0.048	-13.0%	5.5%	Pass	Pass	N	Warning

TABLE 84. SAMPLE NUMBER S19N085

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.997	0.099	4.740	1.056	-5.1%	22.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.938	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.169	0.015	2.6%	8.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.518	0.021	1.522	0.030	0.3%	2.4%	Pass	Pass	Pass	Accepted
^{155}Eu	1.062	0.020	0.341	0.051	-67.9%	15.0%	Fail	Pass	Fail	Not accepted

TABLE 83. SAMPLE NUMBER S19N086

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.027	0.100	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.955	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.166	0.002	0.133	0.040	-19.7%	30.1%	Pass	Fail	Pass	Warning
^{137}Cs	1.527	0.021	1.588	0.430	4.0%	27.1%	Pass	Fail	Pass	Warning
^{155}Eu	1.068	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N088

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.011	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.946	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.210	0.004	27.1%	2.1%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.522	0.021	1.686	0.008	10.7%	1.4%	Pass	Pass	Fail	Warning
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N089

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	3.140	0.105	-37.0%	3.9%	Fail	Pass	Fail	Not accepted
^{89}Sr	2.929	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.168	0.010	2.3%	6.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.700	0.051	12.3%	3.3%	Pass	Pass	Fail	Warning
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N090

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.007	0.099	5.450	0.122	8.9%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.943	0.055	2.496	0.314	-15.2%	12.7%	Pass	Pass	Pass	Accepted
^{90}Sr	0.201	0.003	0.148	0.013	-26.5%	8.7%	Fail	Pass	Fail	Not accepted
^{134}Cs	0.165	0.002	0.199	0.007	20.6%	3.8%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.521	0.021	2.080	0.019	36.8%	1.6%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N094

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.991	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.934	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.155	0.015	-5.6%	10.0%	Pass	Pass	Pass	Accepted
^{137}Cs	1.516	0.021	1.518	0.022	0.1%	2.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N096

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.949	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.271	0.029	64.2%	10.7%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.524	0.021	1.683	0.095	10.4%	5.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N094

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.991	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.934	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.155	0.015	-5.6%	10.0%	Pass	Pass	Pass	Accepted
^{137}Cs	1.516	0.021	1.518	0.022	0.1%	2.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N096

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.949	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.271	0.029	64.2%	10.7%	Fail	Pass	Fail	Not accepted
^{137}Cs	1.524	0.021	1.683	0.095	10.4%	5.8%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N097

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.949	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.524	0.021	7.100	0.600	366.0%	8.6%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.066	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N098

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.954	0.098	4.881	0.201	-1.5%	4.6%	Pass	Pass	Pass	Accepted
^{89}Sr	2.913	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.199	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.163	0.002	0.154	0.009	-5.5%	6.2%	Pass	Pass	Pass	Accepted
^{137}Cs	1.505	0.021	1.484	0.049	-1.4%	3.6%	Pass	Pass	Pass	Accepted
^{155}Eu	1.053	0.020	1.178	0.122	11.9%	10.5%	Pass	Pass	Pass	Accepted

TABLE 83. SAMPLE NUMBER S19N099

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	4.638	0.104	-7.3%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.940	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.213	0.015	5.9%	7.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.153	0.009	-7.3%	5.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.466	0.019	-3.5%	1.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N101

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	5.064	0.141	1.7%	3.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.929	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.158	0.018	-3.7%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.470	0.040	-2.8%	3.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N099

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	4.638	0.104	-7.3%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.940	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.213	0.015	5.9%	7.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.153	0.009	-7.3%	5.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.466	0.019	-3.5%	1.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N101

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	5.064	0.141	1.7%	3.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.929	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.158	0.018	-3.7%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.470	0.040	-2.8%	3.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N099

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	4.638	0.104	-7.3%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.940	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.213	0.015	5.9%	7.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.153	0.009	-7.3%	5.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.466	0.019	-3.5%	1.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N101

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	5.064	0.141	1.7%	3.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.929	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.158	0.018	-3.7%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.470	0.040	-2.8%	3.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N099

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.001	0.099	4.638	0.104	-7.3%	3.0%	Pass	Pass	Fail	Warning
^{89}Sr	2.940	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.213	0.015	5.9%	7.1%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.153	0.009	-7.3%	5.9%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.466	0.019	-3.5%	1.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N101

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.982	0.099	5.064	0.141	1.7%	3.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.929	0.054	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.200	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	0.158	0.018	-3.7%	11.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.513	0.021	1.470	0.040	-2.8%	3.0%	Pass	Pass	Pass	Accepted
^{155}Eu	1.059	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N105

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.002	0.099	5.200	0.260	4.0%	5.4%	Pass	Pass	Pass	Accepted
^{89}Sr	2.941	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	0.203	0.012	0.9%	6.0%	Pass	Pass	Pass	Accepted
^{134}Cs	0.165	0.002	0.156	0.011	-5.4%	7.1%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.490	0.051	-1.9%	3.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N107

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	4.992	0.099	16.500	2.080	230.5%	12.8%	Fail	Pass	Fail	Not accepted
^{89}Sr	2.935	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.164	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.516	0.021	1.410	0.046	-7.0%	3.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.061	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N108

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.017	0.099	5.456	0.307	8.8%	6.0%	A	A	A	Accepted
^{89}Sr	2.949	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	0.190	0.011	-6.0%	6.0%	A	A	A	Accepted
^{134}Cs	0.165	0.002	0.173	0.013	4.4%	7.6%	A	A	A	Accepted
^{137}Cs	1.524	0.021	1.540	0.064	1.1%	4.4%	A	A	A	Accepted
^{155}Eu	1.066	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N110

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.007	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.944	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.166	0.009	0.9%	5.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.521	0.021	1.671	0.085	9.9%	5.3%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N111

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.013	0.099	4.925	0.406	-1.7%	8.5%	Pass	Pass	Pass	Accepted
^{89}Sr	2.947	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.160	0.010	-3.1%	6.4%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	1.470	0.010	-3.4%	1.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N112

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.028	0.100	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.956	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.166	0.002	0.134	0.011	-18.9%	8.3%	Pass	Pass	Fail	Warning
^{137}Cs	1.527	0.021	1.628	0.042	6.6%	2.9%	Pass	Pass	Pass	Accepted
^{155}Eu	1.069	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N113

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.009	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.945	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.204	0.044	23.6%	21.6%	Fail	Fail	Pass	Not accepted
^{137}Cs	1.521	0.021	1.659	0.054	9.0%	3.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N115

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.013	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.947	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.157	0.020	-5.0%	12.8%	Pass	Pass	Pass	Accepted
^{137}Cs	1.523	0.021	1.429	0.033	-6.1%	2.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.066	0.020	0.544	0.031	-48.9%	6.0%	Fail	Pass	Fail	Not accepted

TABLE 83. SAMPLE NUMBER S19N116

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.012	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.946	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.202	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.133	0.023	-19.6%	17.7%	Pass	Pass	Pass	Accepted
^{137}Cs	1.522	0.021	2.827	0.255	85.7%	9.1%	Fail	Pass	Fail	Not accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N117

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.006	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.943	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	–	–	-	-	-	-	-	Not reported
^{137}Cs	1.520	0.021	1.457	0.110	-4.2%	7.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.064	0.020	–	–	-	-	-	-	-	Not reported

TABLE 83. SAMPLE NUMBER S19N118

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.002	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.941	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.160	0.007	-2.9%	4.5%	Pass	Pass	Pass	Accepted
^{137}Cs	1.519	0.021	1.550	0.050	2.0%	3.5%	Pass	Pass	Pass	Accepted
^{155}Eu	1.063	0.020	–	–	-	-	-	-	-	Not reported

TABLE 84. SAMPLE NUMBER S19N119

Radionuclide	Assigned Value	Assigned Uncertainty	Reported Value	Reported Uncertainty	Relative Bias	P test	Accuracy	Precision	Trueness	Final Score
^{3}H	5.008	0.099	–	–	-	-	-	-	-	Not reported
^{89}Sr	2.944	0.055	–	–	-	-	-	-	-	Not reported
^{90}Sr	0.201	0.003	–	–	-	-	-	-	-	Not reported
^{134}Cs	0.165	0.002	0.106	0.032	-35.8%	29.9%	Fail	Fail	Pass	Not accepted
^{137}Cs	1.521	0.021	1.433	0.079	-5.8%	5.7%	Pass	Pass	Pass	Accepted
^{155}Eu	1.065	0.020	–	–	-	-	-	-	-	Not reported

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