Software Requirements Specification for the Nondestructive Assay Data Review Expert System

S. D. Matthews
J. C. Determan
M. A. McQueen

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Idaho National Engineering and Environmental Laboratory
Bechtel BWXT Idaho, LLC
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Scott D. Matthews
John C. Determan
Miles A. McQueen

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Idaho National Engineering and Environmental Laboratory
Idaho Falls, Idaho 83415

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ABSTRACT

This software requirements specification is intended to delineate the requirements for developing and managing the Nondestructive Assay (NDA) Data Review Expert System. The NDA Data Review Expert System is necessary because the U. S. Department of Energy (DOE) requires a determination of the entrained transuranic (TRU) mass and associated parameters for defense generated containerized TRU waste. This software will provide an independent technical review (ITR) of the NDA analyses of the TRU wastes conducted both by the Stored Waste Examination Pilot Plant (SWEPP) Gamma Analysis Package (SGAP) and the SWEPP Assay System (SAS) [Passive Active Neutron (PAN) Assay System].
SUMMARY

This specification provides the functional requirements, the performance requirements, and the quality attributes for NDA Data Review Expert System.
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<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Am</td>
<td>Americum</td>
</tr>
<tr>
<td>DOE</td>
<td>U.S. Department of Energy</td>
</tr>
<tr>
<td>ETR</td>
<td>expert technical review</td>
</tr>
<tr>
<td>INEEL</td>
<td>Idaho National Engineering and Environmental Laboratory</td>
</tr>
<tr>
<td>IDC</td>
<td>Item Description Code</td>
</tr>
<tr>
<td>ITR</td>
<td>independent technical review</td>
</tr>
<tr>
<td>NDA</td>
<td>Nondestructive Assay</td>
</tr>
<tr>
<td>PAN</td>
<td>Passive Active Neutron</td>
</tr>
<tr>
<td>Pu</td>
<td>Plutonium</td>
</tr>
<tr>
<td>RSD</td>
<td>relative standard deviation</td>
</tr>
<tr>
<td>SAS</td>
<td>SWEPP Assay System</td>
</tr>
<tr>
<td>SGAP</td>
<td>SWEPP Gamma Analysis Package</td>
</tr>
<tr>
<td>SWEPP</td>
<td>Stored Waste Examination Pilot Plant</td>
</tr>
<tr>
<td>TRU</td>
<td>transuranic</td>
</tr>
<tr>
<td>U</td>
<td>uranium</td>
</tr>
</tbody>
</table>
Software Requirements Specification for the Nondestructive Assay Data Review Expert System

1. INTRODUCTION

1.1 Purpose

This software requirements specification is intended to delineate the requirements for developing and managing the Nondestructive Assay (NDA) Data Review Expert System. The NDA Data Review Expert System is necessary because the U. S. Department of Energy (DOE) requires a determination of the entrained transuranic (TRU) mass and associated parameters for defense generated containerized TRU waste. This software will provide an independent technical review (ITR) of the NDA analyses of the TRU wastes conducted both by the Stored Waste Examination Pilot Plant (SWEPP) Gamma Analysis Package (SGAP) and the SWEPP Assay System (SAS) [Passive Active Neutron (PAN) Assay System].

Software requirements are meant to be a detailed description of “what” the system will do (that is, specific functions or tasks the system will perform for the end user). How these functions are actually implemented within the system are covered in the design document, which are supplied by the software provider. Consequently, this requirements specification is intended as a design basis and a verification and validation basis for the NDA Data Review Expert System.

1.2 Scope

This document specifies the requirements for the NDA Data Review Expert System as installed at the Idaho National Engineering and Environmental Laboratory (INEEL) and was written to comply with the TRU Waste Program quality requirements for software documentation and configuration management. The NDA Data Review Expert System is intended to facilitate and expedite the ITR of the TRU analytical data conducted by cognizant NDA professionals. This NDA Data Review Expert System analyzes the analytical data produced by the SWEPP Gamma Analysis Package and the SWEPP Assay System to ensure that the calibration constants are valid, the electronics were performing as expected, the assays and associated calibration measurements were conducted within the proper time and that the data are internally consistent. Thus, with the NDA Data Review Expert System, a cognizant NDA professional can more effectively focus upon more complex NDA analyses since the expert system can eliminate the tedium of the more mundane analytical checks.

1.3 Overview

This Software Requirements Specification for the NDA Data Review Expert System provides a description of the system in Section 2 and a description of the functional, interface, performance and quality attribute requirements in Section 3.
2. GENERAL DESCRIPTION

2.1 Product Perspective

2.1.1 System Interfaces

None

2.1.2 User Interfaces

The user interface will have two primary requirements: (1) the capability for the user to define which assay batch is to be analyzed by the NDA Data Review Expert System; and (2) an opportunity to review the results of the analysis.

2.1.3 Hardware Interfaces

None

2.1.4 Software Interfaces

The NDA Data Review Expert System (NDA-DRXS) interfaces with the SAS, Version 3.2, to input an ASCII file containing the active and passive results from the waste drums. NDA-DRXS also interfaces with SGAP, the gamma analysis software and with CLIPS, Version 6.10, to provide the foundation for the expert system rules.

Figure 1 indicates the relationships among the objects associated with the expert system. Within each object, the data attributes and the methods or functionality of the object are also shown.

Figure 2 shows the expert system user interface that enables the analyst to access the SAS data and the SGAP gamma analysis data. This interface then collects the waste attribute data from ASCII files created by the SAS and the SGAP gamma analysis system and creates a database of the pertinent attributes to be analyzed by the expert system. The expert system analyzes these data against rules formulated by technical experts. Thus, the expert system emulates a human expert analyzing NDA data. First, the expert system analyzes the NDA data against rules applicable to all NDA data. The expert system also provides the capability to analyze the data specific to various waste types, such as, sludges or debris.
Figure 1. Software interfaces.
2.1.5 Software Function

The NDA Data Review Expert System is a rule-based program that uses a set of rules derived by cognizant NDA professionals to determine the actions to be taken. The rules are in the form of “IF pattern THEN action”. An “inference engine” matches the rule pattern specified by cognizant NDA professionals against a set of facts input from the NDA analyses written in ASCII text. If the rule pattern matches the NDA analysis “facts”, then the expert system performs the action specified by matching the rule. Actions typically involve adding, removing, or modifying facts known to the system, and these actions continue until no more rule patterns can be matched.

The rules are defined for the following review categories:

- check the validity of the batch results;
- check to determine if the results are within or outside the technical envelope;
- evaluate the correctness of the results;
- determine if a recalculation is needed;
- perform quality checks of the NDA results.

The expert system evaluates the NDA results against the above rule categories and then ascertains the following actions based upon the severity of the exception to the rules:

1. assay is rejected;
2. assay is deficient;
3. ETR review required;
4. additional ITR review required;
5. assay is acceptable.

2.1.6 Communications Interfaces

None

2.1.7 Memory Constraints

None

2.1.8 Operations

The expert system must have the capability to not only evaluate the PAN assay and the gamma spectroscopy assay results per the expert system rules but also the capability to re-evaluate the assay results because of perceived anomalies.

2.1.9 Site Adaptation Requirements

None
2.2 Product Functions

NDA waste characterization data generated for use in the National TRU Program must be of known and demonstrable quality. Each measurement is required to receive an independent technical review by a qualified expert. With hundreds of measures acquired on each drum, and hundreds of thousands of such drums in the national inventory, a large and costly data review/validation effort is mandated. For this reason, the authors have developed a generic expert system framework for review/validation of nondestructive waste assay data, known as NDA-DRXS. This system expresses the process of data review in a set of expert system rules, and is designed around an object-oriented framework that can be easily customized for application at sites with different NDA configurations and waste inventory properties.

NDA techniques are the most common and efficient means to determine the TRU material quantity. A common NDA system configuration is one that employs active and passive neutron counting techniques to estimate the mass of TRU nuclides in a waste container. This configuration also requires radionuclidic and isotopic composition data. The most common means of acquiring this data is through high-resolution gamma spectroscopy. Another common NDA system configuration is one that employs passive high-resolution gamma spectroscopy combined with sample gamma transmission measurements. Extensive data are collected from these devices, and so a lengthy data reduction process is necessitated. The NDA-DRXS system ensures that this data reduction process was performed correctly, and that the reduced data are consistent, believable, and representative of a valid set of measurements.

The functionality applicable to the expert system analysis for specific Item Description Code (IDC) types is described within the pertinent appendix. Figure 3 shows the process flow through the expert system.

Figure 2. Nondestructive assay data validation expert system work flow.
Figure 3. Flow of data in Nondestructive Assay Analysis and Expert System.
2.3 User Characteristics

The NDA Data Review Expert System users are typically personnel with physics experience and NDA knowledge. This user community also is familiar with the operation of and analysis of NDA software.

2.4 Constraints

The constraining documents are:

- PLN-182, Quality Program Plan for WIPP
- RWMC MCP-1803

2.5 Assumptions and Dependencies

3. SOFTWARE REQUIREMENTS

3.1 External Interfaces

3.1.1 User Interfaces

None

3.1.2 Hardware Interfaces

None

3.1.3 Software Interfaces

The Assay System Expert Data System accesses the following files created by the SAS, Version 3.2: (1) SWEPP Assay System data file; (2) matrix.lst

3.1.4 Communication Interfaces

None

3.2 Software Functional Requirements

The software functional requirements and associated data dictionary for the process inputs and outputs are partitioned according to the functionality applicable to the expert system rules. Appendices A and B contain the functional requirements and data dictionary, respectively.

3.3 Performance Requirements

If the expert system requires more than two seconds to produce an output, the expert system shall provide a dialog notifying the user that the system is validating the assay results per the expert system rules.

The expert system shall store the assay data with an anticipated annual growth of five Gbytes/year.

3.4 Logical Database Requirements

None

3.5 Design Constraints

NDA-DRXS has the following constraints:

- developed using Microsoft Visual C++, Version 5.0 or greater;
- will execute on a Windows NT, version 4.0 or greater;
- SAS input files will have been generated by SAS Version 3.1 or greater;
- Gamma scan data must have been generated by BGAV5 or greater
3.6 Standards Compliance

None

3.7 System Attributes

3.7.1 Usability

NDA-DRXS will use pull-down menus and related windows graphical user interface capabilities.

3.7.2 Training

A cognizant NDA professional will be able to execute the NDA Data Review Expert System and use the output for ITR with one hour of training.

3.7.3 Security

The system shall require a valid id and password on an authenticated Windows NT account before accessing any expert system data.

3.7.4 Data Integrity

The operational expert system output data shall be controlled in accordance with PLN-579, Program Plan for Certification of INEEL Contact-Handled Stored Transuranic Waste, Appendix B.
4. DEFINITIONS

ASCII. American Standard for Computer Information Interchange. ASCII data are written in understandable text.

CLIPS. C Language Integrated Production System.
5. REFERENCES


Appendix A

General Requirements
A.1 FUNCTIONALITY

This software complements the expertise of the nondestructive assay (NDA) personnel who monitor the results issued by the Stored Waste Examination Pilot Plant (SWEPP) Assay System (SAS). This expert system will perform the following data validation tests to:

1. ensure all sections of the SAS file are present, for example, non zero dates
2. ensure that background correction was done within 24 hours of assay
3. ensure that all neutron counts are non-zero and above the defined minimum, for example, no detector failures.
4. validate constant values, that is, operator error during assay can result in use of improper values.
5. ensure specific count and mass ratio values are within specified range with respect to defined minima and maxima.
6. validate presence and consistency of Pu assay results
7. validate presence and consistency of uranium (U) assay results
8. validate presence and consistency of americium (Am) assay results
9. check that gamma attenuation table is correct name
10. check gamma efficiency table is correct name
11. perform gamma fit error checks
12. check Pu mass ratios to ensure assayed values within historical ± 50% interval
13. check transuranic (TRU) activity concentration and active pulse counts
14. check that both assays in replicate or duplicate analysis are consistent and that all updated values are proper
15. indicate common mass ratios that were not measured, except $^{238}\text{Pu}$.
16. check for consistency between $^{235}\text{U}$ found flag and presence or absence of measured $^{235}\text{U}/^{239}\text{U}$ or $^{235}\text{U}/^{238}\text{U}$ mass ratio
17. ensure that neutron counts on each side are consistent, that is, observed asymmetry due to environmental influences or failed rotator
18. validate the presence of specified isotopes
19. determine if the net active shielded total rate relative standard deviation (RSD) values are below the defined maximum
20. ensure the active matrix correction factor is correct
21. determine if the JSR shift register gross accidental rates are within statistical limits
22. check the shift register counts to determine if it has been saturated
23. determine whether the passive mass estimate can be used for estimations
24. determine if the drum flux monitor counts are above the prescribed minimum
25. determine if $^{137}\text{Ce}$ activity is present.
A.2 SOFTWARE FUNCTIONAL REQUIREMENTS

Figure A-1 provides an object model of the NDA Data Review Expert System. As can be seen in this object model, the important elements of the expert system are the summary-list and item-list. The item-list class contains the facts to be evaluated by a given rule. The summary-list class contains the rules such that the failure of a rule results in an assay classification. All the functional requirements listed within this section pertain to the methods associated with these classes and their associated and inherited classes. Table A-1 provides the correspondence between the functional requirements and the classes shown in Figure A-1.

The remainder of Section A.2 lists the functional requirements with a description of the requirement, followed by the data inputs and the initiating requirement for the data item and the data dictionary reference (Given in Section C), pseudo-code for the process and the resulting output of the process.

Figure A-1. Expert system object diagram.
Table A-1. List of functional requirements and associated classes.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Requirement Number</th>
<th>Summary List</th>
<th>Item List</th>
<th>Error Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ensure all sections of SAS file are present</td>
<td>A.2.1</td>
<td>ITR</td>
<td>Section</td>
<td>4</td>
</tr>
<tr>
<td>Determine if PAN background check done within 24 hours of assay</td>
<td>A.2.2</td>
<td>ITR</td>
<td>Max_delta</td>
<td>1</td>
</tr>
<tr>
<td>Ensure early gate counts are nonzero</td>
<td>A.2.3</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure late gate counts are nonzero</td>
<td>A.2.4</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure gate timing data are nonzero</td>
<td>A.2.5</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive flux monitor data are nonzero</td>
<td>A.2.6</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive short gate data are nonzero</td>
<td>A.2.7</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive long gate data are nonzero</td>
<td>A.2.8</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure shift register data are nonzero</td>
<td>A.2.9</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure background gate data are nonzero</td>
<td>A.2.10</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure shift register background data are nonzero</td>
<td>A.2.11</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive shielded total counts are nonzero</td>
<td>A.2.12</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive system total counts are nonzero</td>
<td>A.2.13</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive background shielded total counts are nonzero</td>
<td>A.2.14</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Ensure passive background system total counts are nonzero</td>
<td>A.2.15</td>
<td>Reject</td>
<td>Zero</td>
<td>1</td>
</tr>
<tr>
<td>Check alpha activity relativestandard deviation for value above defined minimum.</td>
<td>A.2.17</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Check fissile gram equivalent relative standard deviation for value below defined maximum</td>
<td>A.2.18</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Check $^{235}\text{U} /^{239}\text{Pu}$ mass ratio for value below defined maximum</td>
<td>A.2.19</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Check $^{241}\text{Am} /^{239}\text{Pu}$ mass ratio for value below defined maximum</td>
<td>A.2.20</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Check $^{241}\text{Am} /^{239}\text{Pu}$ mass ratio relative standard deviation for value below defined maximum</td>
<td>A.2.21</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Check $^{235}\text{U} /^{239}\text{Pu}$ mass ratio relative standard deviation for value below defined maximum</td>
<td>A.2.22</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Check on gamma dead time</td>
<td>A.2.24</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Check that the $^{241}\text{Am}$ activity via the 662 keV photopeak is consistent</td>
<td>A.2.25</td>
<td>ITR</td>
<td>Max3</td>
<td>4</td>
</tr>
<tr>
<td>Check net active shielded total rate for value above defined minimum.</td>
<td>A.2.26</td>
<td>ITR</td>
<td>Min3</td>
<td>4</td>
</tr>
<tr>
<td>Ensure active pulse count is at least 4000</td>
<td>A.2.27</td>
<td>ETR</td>
<td>Min3</td>
<td>3</td>
</tr>
<tr>
<td>Perform range check on Pu isotopes</td>
<td>A.2.28</td>
<td>ETR</td>
<td>Range, Fitmax</td>
<td>3,1</td>
</tr>
<tr>
<td>Ensure presence of $^{235}\text{U}$ and $^{238}\text{U}$</td>
<td>A.2.29</td>
<td>ITR</td>
<td>Consistency</td>
<td>4</td>
</tr>
<tr>
<td>$^{233}\text{U}$ Confirmation Check</td>
<td>A.2.30</td>
<td>ITR</td>
<td>Consistency</td>
<td>4</td>
</tr>
<tr>
<td>Validate absorber index for proper value</td>
<td>A.2.31</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Validate moderator index for proper value</td>
<td>A.2.32</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Validate uranium correction factor for value</td>
<td>A.2.33</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Perform a two sigma test of computed $^{235}\text{U}/^{239}\text{Pu}$ mass ratio vs. SAS derived value</td>
<td>A.2.34</td>
<td>ITR</td>
<td>TwoSigma</td>
<td>4</td>
</tr>
<tr>
<td>Requirement</td>
<td>Requirement Number</td>
<td>Summary List</td>
<td>Item List</td>
<td>Error Level</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>--------------------</td>
<td>--------------</td>
<td>-----------</td>
<td>-------------</td>
</tr>
<tr>
<td>Perform a two sigma test of computed $^{241}$Am/$^{239}$Pu mass ratio vs. SAS derived value</td>
<td>A.2.35</td>
<td>ITR</td>
<td>TwoSigma</td>
<td>4</td>
</tr>
<tr>
<td>Check for sufficient quantity of Pu to conduct assay</td>
<td>A.2.36</td>
<td>Reject</td>
<td>OrCombo</td>
<td>1</td>
</tr>
<tr>
<td>Check for presence of $^{241}$Am</td>
<td>A.2.37</td>
<td>ITR</td>
<td>Fitmax</td>
<td>4</td>
</tr>
<tr>
<td>Check Rep $^{241}$Am mass relative standard deviation for value below defined maximum</td>
<td>A.2.38</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Check Rep Pu mass relative standard deviation for value below defined maximum</td>
<td>A.2.39</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Check Rep $^{235}$U mass relative standard deviation for value below defined maximum</td>
<td>A.2.40</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Determine if chamber flux monitor counts are above required minimum</td>
<td>A.2.41</td>
<td>ETR</td>
<td>Min</td>
<td>3</td>
</tr>
<tr>
<td>Perform consistency check for replicate data</td>
<td>A.2.42</td>
<td>Reject</td>
<td>Replicates1</td>
<td>1</td>
</tr>
<tr>
<td>Validate IDC Description codes</td>
<td>A.2.43</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Provide summary report containing severity error level of expert system analysis</td>
<td>A.2.44</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Determine if passive background bare side/average ratio is within established limits</td>
<td>A.2.45</td>
<td>ETR</td>
<td>Cratio_hi</td>
<td>3</td>
</tr>
<tr>
<td>Determine if passive background shielded side/average ratio is within established limits</td>
<td>A.2.46</td>
<td>ETR</td>
<td>Cratio_hi</td>
<td>3</td>
</tr>
<tr>
<td>Determine if passive gross bare side/average ratio is within established limits</td>
<td>A.2.47</td>
<td>ETR</td>
<td>Cratio_hi</td>
<td>3</td>
</tr>
<tr>
<td>Determine if passive gross shielded side/average ratio is within established limits</td>
<td>A.2.48</td>
<td>ETR</td>
<td>Cratio_hi</td>
<td>3</td>
</tr>
<tr>
<td>Validate presence of isotopes</td>
<td>A.2.49</td>
<td>ITR</td>
<td>Isotope_found</td>
<td>4</td>
</tr>
<tr>
<td>Check net active shielded total rate relative standard deviation for value below defined maximum</td>
<td>A.2.50</td>
<td>ITR</td>
<td>Max2</td>
<td>4</td>
</tr>
<tr>
<td>Validate active matrix correction factor for proper value</td>
<td>A.2.51</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
<tr>
<td>Determine if the JSR shift register gross accidental rates are within statistical limits</td>
<td>A.2.52</td>
<td>ITR</td>
<td>3Sigma</td>
<td>4</td>
</tr>
<tr>
<td>Check barrel flux monitor counts are above required minimum</td>
<td>A.2.53</td>
<td>ETR</td>
<td>Min</td>
<td>3</td>
</tr>
<tr>
<td>Validate Systems Totals Singles Rate</td>
<td>A.2.54</td>
<td>ETR</td>
<td>Max3</td>
<td>3</td>
</tr>
</tbody>
</table>
A.2.1 Ensure All Sections of SAS File are Present

A.2.1.1 Description

All sections of the SAS file must be present to ensure a valid assay. Zero date values in a section imply that the SAS file section is invalid or missing, which, in turn, implies a corrupt or invalid assay. Violation of this rule is severity level 4.

A.2.1.2 Input

time_T (Data Dictionary Reference B.170) for:
  - active assay  
    (SAS requirement 3.1.3.4 M.4)
  - passive assay  
    (SAS requirement 3.1.3.4 M.7)
  - JSR passive  
    (SAS requirement 3.1.3.5 M.3)
  - passive background  
    (SAS requirement 3.1.3.4 M7)
  - Gamma mass ratio  
    (SAS requirement 3.1.3.5 M.6)
  - JSR passive background

A.2.1.3 Process

case active assay:
  if Active Section ="
    write to short and long report: “(4) Section is missing: Active Assay”
  else
    write to long report: “Active Assay section is present”

case passive assay:
  if Passive Section ="
    write to short and long report: “(4) Section is missing: Passive Gross”
  else
    write to long report: “Passive Gross section is present”

case JSR passive="":
  if time_T < 0
    write to short and long report: “(4) Section is missing: JSR Passive Gross”
  else
    write to long report: “JSR Passive Gross section is present”

case passive background="":
  if time_T < 0
    write to short and long report: “(4) Section is missing: Passive Background”
  else
    write to long report: “Passive Background section is present”

case gamma mass ratio:
  if
    write to short and long report: “(4) Section is missing: gamma Mass Ratio Data”
  else
    write to long report: “Gamma Mass Ratio Data section is present”
case JSR passive background:
    if time_T< 0
        write to short and long report:“(4) Section is missing: JSR Passive Background”
    else
        write to long report “JSR Passive Background section is present”

A.2.1.4 Output

- output message (Data Dictionary Reference B.79)

A.2.2 Determine if PAN Background Check Done Within MAX_BKG_AGE of Assay

A.2.2.1 Description

A PAN background measurement must be done within MAX_BKG_AGE (end of background check to end of assay) to assure accurate background count readings.

Violation of this rule is severity level 1.

A.2.2.2 Input

- time_T, (Data Dictionary Reference B.170 ) for assay (SAS requirement 3.1.3.4 M.2)
- time_T, (Data Dictionary Reference B.170) for background assay (SAS requirement 3.1.3.4 M7)
- MAX_BKG_AGE, (Data Dictionary Reference B.204) for background assay (SAS requirement 3.1.3.4 M7)

A.2.2.3 Process

- read passive assay Time_T value from JSR section of SAS file
- read background assay Time_T value from JSR section of SAS file
- compute time delta = (passive assay Time_value ) - (background assay Time_value ) seconds
- Compute MAX_BKG_AGE = MAX_BKG_AGE * 3600
- if time delta – background assay time > MAX_BKG_AGE seconds
    write to short and long report: “(1 background age too great. ( “, time delta/3600, “hours”
else
    write to long report: “background performed within MAX_BKG_AGE.”

A.2.2.4 Output

- output message (Data Dictionary Reference B.79)

A.2.3 Ensure Early Gate Counts are Nonzero

A.2.3.1 Description

A detector count value of zero indicates a failed detector. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.
A.2.3.2 Input

- early gate chamber flux monitor counts
  *(SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.52)*
- early gate barrel flux monitor counts
  *(SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.51)*
- early gate shielded totals

A.2.3.3 Process

- if early gate chamber flux monitor counts $\leq 0 \ ||$ early gate barrel flux monitor counts $\leq 0$
  early gate shielded totals
  write to short and long report:
  “(1) early gate “, early gate counts, “= 0, but should not”
  else
  write to long report: “early gate > 0”

A.2.3.4 Output

- output message *(Data Dictionary Reference B.79)*

A.2.4 Ensure Late Gate Counts are Nonzero

A.2.4.1 Description

A late gate count value of zero indicates that the detector has failed. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.

A.2.4.2 Input

- late gate chamber flux monitor counts
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.64)*
- late gate barrel flux monitor counts
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.63)*
- late gate shielded totals

A.2.4.3 Process

- if late gate chamber flux monitor counts $\leq 0 \ ||$ late gate barrel flux monitor counts $\leq 0$
  late gate shielded totals
  write to short and long report:
  “(1) late gate “, late gate counts, “= 0, but should not”
  else
  write to long report: “late gate > 0”

A.2.4.4 Output

- output message *(Data Dictionary Reference B.79)*

A.2.5 Ensure gate and timing data are nonzero

A.2.5.1 Description

If the timing values for the gates are zero, then the SAS results are suspect.

Violation of this rule is severity level 1.
A.2.5.2  **Input**

- number long gates  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.77)*
- number short gates  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.78)*
- passive 10 kHz clock  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.81)*
- passive 1 kHz clock  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.80)*

A.2.5.3  **Process**

- if number long gates ≤ 0  
  write to short and long report “(1) long gate = 0, but should not”  
  else  
  write to long report “long gate > 0”
- if number short gates ≤ 0  
  write to short and long report “(1) short gate = 0, but should not”  
  else  
  write to long report “ short gate > 0”
- if 10 kHz clock ≤ 0  
  write to short and long report “(1) 10 kHz clock = 0, but should not”  
  else  
  write to long report “10 kHz clock > 0”
- if 1 kHz clock ≤ 0  
  write to short and long report “(1) 1 kHz clock = 0, but should not”  
  else  
  write to long report “1 kHz clock > 0”

A.2.5.4  **Output**

- output message *(Data Dictionary Reference B.79)*

**A.2.6  Ensure Passive Flux Monitor Data are Nonzero**

A.2.6.1  **Description**

If any flux monitor counts are zero, then SAS will not compute the correct mass estimates. Violation of this rule is severity level 1.

A.2.6.2  **Input**

- Chamber flux monitor  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.110)*
- Barrel flux monitor  
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.109)*
A.2.6.3 Process

• if Chamber flux monitor ≤ 0
  write to short and long report “(1) Chamber flux monitor = 0, but should not”
  else
  write to long report “Chamber flux monitor > 0”

• if Barrel flux monitor ≤ 0
  write to short and long report “(1) Barrel flux monitor = 0, but should not”
  else
  write to long report “Barrel flux monitor > 0”

A.2.6.4 Output

• output message (Data Dictionary Reference B.79)

A.2.7 Ensure Passive Short Gate Data are Nonzero

A.2.7.1 Description

A short gate count value of zero indicates that the detector has failed. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.

A.2.7.2 Input

• short gate shielded total
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.164)

• short gate 1 Mhz clock
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.163)

A.2.7.3 Process

• if short gate shielded total ≤ 0
  write to short and long report “(1) short gate shielded total = 0, but should not”
  else
  write to long report “short gate shielded total > 0”

• if short gate 1 Mhz clock ≤ 0
  write to short and long report “(1) short gate 1 Mhz clock = 0, but should not”
  else
  write to long report “short gate 1 Mhz clock > 0”

A.2.7.4 Output

• output message (Data Dictionary Reference B.79)

A.2.8 Ensure Long Gate Data are Nonzero

A.2.8.1 Description

A long gate count value of zero indicates that the detector has failed. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.
A.2.8.2 **Input**
- long gate system total
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.66)*
- long gate 1 Mhz clock
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.65)*

A.2.8.3 **Process**
- if long gate system total ≤ 0
  write to short and long report “(1) long gate system total = 0, but should not”
  else
  write to long report “long gate system total > 0”
- if long gate 1 Mhz clock ≤ 0
  write to short and long report “(1) long gate 1 Mhz clock = 0, but should not”
  else
  write to long report “long gate 1 Mhz clock > 0”

A.2.8.4 **Output**
- output message *(Data Dictionary Reference B.79)*

**A.2.9 Ensure Shift Register Data are Nonzero**

A.2.9.1 **Description**
Shift register values of zero indicate that the shift registers have failed.
Violation of this rule is severity level 1.

A.2.9.2 **Input**
- JSR total count
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.162)*
- JSR real + accidental count
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.161)*
- JSR accidental count
  *(SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.157)*

A.2.9.3 **Process**
- if JSR total count ≤ 0
  write to short and long report “(1) JSR total count = 0, but should not”
  else
  write to long report “JSR total count > 0”
- if JSR real + accidental count ≤ 0
  write to short and long report “(1) JSR real + accidental count = 0, but should not”
  else
  write to long report “JSR real + accidental count”
• if JSR accidental count \( \leq 0 \)
  write to short and long report
  “(1) JSR accidental count = 0, but should not”
else
  write to long report “JSR accidental count >0”

### A.2.9.4 Output
• output message (Data Dictionary Reference B.79)

### A.2.10 Ensure Background Gate Data are Nonzero

#### A.2.10.1 Description
If the background data are zero, then the necessary corrections used in the mass estimates will be incorrect.

Violation of this rule is severity level 1.

#### A.2.10.2 Input
• number background long gates
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.75)
• number background short gates
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.76)
• passive background 10 kHz clock
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.83)
• passive background 1 kHz clock
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.82)
• passive background flux monitor
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.88)
• passive background drum flux monitor
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.89)
• background short gate shielded total
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.98)
• passive background short gate 1 Mhz clock
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.97)
• passive background long gate system total
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.91)
• passive background long gate 1 Mhz clock
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.90)

#### A.2.10.3 Process
• if number background long gates \( \leq 0 \)
  write to short and long report
  “(1) number background long gates = 0, but should not”
else
  write to long report “number background long gates >0”
if number passive background short gates \( \leq 0 \)
write to short and long report
“(1) number background short gates = 0, but should not”
else
write to long report “number background short gates >0”

if passive background 10 kHz clock \( \leq 0 \)
write to short and long report
“(1) passive background 10 kHz clock = 0, but should not”
else
write to long report “passive background 10 kHz clock >0”

if passive background 1 kHz clock \( \leq 0 \)
write to short and long report
“(1) passive background 1 kHz clock = 0, but should not”
else
write to long report “passive background 1 kHz clock >0”

if passive background flux monitor \( \leq 0 \)
write to short and long report
“(1) passive background flux monitor = 0, but should not”
else
write to long report “passive background flux monitor >0”

if passive background drum flux monitor \( \leq 0 \)
write to short and long report
“(1) passive background drum flux monitor = 0, but should not”
else
write to long report “passive background drum flux monitor >0”

if passive background short gate shielded total \( \leq 0 \)
write to short and long report
“(1) passive background short gate shielded total = 0, but should not”
else
write to long report “passive background short gate 1 Mhz clock >0”

if passive background short gate 1 Mhz clock \( \leq 0 \)
write to short and long report
“(1) passive background short gate 1 Mhz clock = 0, but should not”
else
write to long report “passive background short gate 1 Mhz clock >0”

if passive background long gate system total \( \leq 0 \)
write to short and long report
“(1) passive background long gate system total = 0, but should not”
else
write to long report “passive background long gate system total >0”

if passive background long gate 1 Mhz clock \( \leq 0 \)
write to short and long report
“(1) passive background long gate 1 Mhz clock = 0, but should not”
else
write to long report “passive background long gate 1 Mhz clock >0”
A.2.10.4 Output

• output message (Data Dictionary Reference B.79)

A.2.11 Ensure Shift Register Background Data are Nonzero

A.2.11.1 Description

If the JSR values are zero, then the assay results will be incorrect.

Violation of this rule is severity level 1.

A.2.11.2 Input

• JSR background total count
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.160)
• JSR background real + accidental count
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.159)
• JSR background accidental count
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.158)

A.2.11.3 Process

• if JSR background total count \(\leq 0\)
  write to short and long report
  “(1) JSR background total count = 0, but should not”
  else
  write to long report “JSR background total count >0”
• if JSR background real + accidental count \(\leq 0\)
  write to short and long report
  “(1) JSR background real + accidental count = 0, but should not”
  else
  write to long report “JSR background real + accidental count >0”
• if JSR background accidental count \(\leq 0\)
  write to short and long report
  “(1) JSR background accidental count = 0, but should not”
  else
  write to long report “JSR background accidental count > 0”

A.2.11.4 Output

• output message (Data Dictionary Reference B.79)

A.2.12 Ensure Passive Shielded Total Counts are Nonzero

A.2.12.1 Description

A passive shielded total count value of zero indicates that the detector has failed. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.

A.2.12.2 Input

• passive shielded total counts
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.125)
A.2.12.3 Process

- if passive shielded total counts $\leq 0$
  write to short and long report:
  "(1) passive shielded " , passive shielded total counts,
  " = 0, but should not"
else
  write to long report: “passive shielded > 0”

A.2.12.4 Output

- output message (Data Dictionary Reference B.79)

A.2.13 Ensure Passive System Total Counts are Nonzero

A.2.13.1 Description

If the passive system total counts are zero, the detector has failed. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.

A.2.13.2 Input

- passive system total counts
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.126)

A.2.13.3 Process

- if passive system total counts $\leq 0$
  write to short and long report:
  "(1) passive system " , passive system total counts,  " = 0, but should not"
else
  write to long report: “passive system counts > 0”

A.2.13.4 Output

- output message (Data Dictionary Reference B.79)

A.2.14 Ensure Passive Background Shielded Total Counts are Nonzero

A.2.14.1 Description

If any of the detector count values are zero, then the detector must either be defective or improperly shielded. Assurance of non-zero counts provides confidence in the validity of the SAS computations.

Violation of this rule is severity level 1.

A.2.14.2 Input

- passive background shielded total counts
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.96)
A.2.14.3 Process

- if passive background shielded total counts ≤ 0
  write to short and long report:
  “(1) passive background shielded total “,
  passive background shielded total counts, “ = 0, but should not”
  else
  write to long report: “passive background shielded total > 0”

A.2.14.4 Output

- output message (Data Dictionary Reference B.79)

A.2.15 Ensure Passive Background System Total Counts are Nonzero

A.2.15.1 Description

If any of the detector count values are zero, then the detector must either be defective or improperly shielded. Assurance of non-zero counts provides confidence in the validity of the SAS computations. Violation of this rule is severity level 1.

A.2.15.2 Input

- passive background system total counts
  (SAS requirement 3.1.3.4 M.4; Data Dictionary Reference B.99)

A.2.15.3 Process

- if passive background system total counts ≤ 0
  write to short and long report:
  “(1) passive background system total “,
  passive background system total counts, “ = 0, but should not”
  else
  write to long report: “passive background system total > 0”

A.2.15.4 Output

- output message (Data Dictionary Reference B.79)

A.2.17 Check Alpha Activity Relative Standard Deviation for Value Below Defined Maximum

A.2.17.1 Description

The alpha activity RSD check is to assure that the assay data is reasonable. If the alpha activity RSD is within limits, then there is increased assurance that the assay results are correct.

Violation of this rule is severity level 4.

A.2.17.2 Input

- alpha activity
  (SAS requirement 3.1.4.3 M.29; Data Dictionary Reference B.20)
- alpha activity standard deviation
  (SAS requirement 3.1.4.3 M.29; Data Dictionary Reference B.21)
- alpha activity counting error
  (SAS requirement 3.1.4.3 M.29 Data Dictionary Reference B.198)
A.2.17.3 Process

- compute alpha activity RSD = alpha activity standard deviation/alpha activity
- if (alpha activity RSD > IDC dependent limit) and (alpha activity counting error > count error limit)
  write to short and long report: “(4) α activity “, RSD, “ > max (limit) and α activity count error > count error limit”
else
  write to long report: “α activity “, RSD, “ ≤ max (limit)”

A.2.17.4 Output

- output message (Data Dictionary Reference B.79)

A.2.18 Check Fissile Gram Equivalent Relative Standard Deviation for Value Below Defined Maximum

A.2.18.1 Description

If the fissile gram equivalent relative standard deviation is above the maximum value, the SAS assay is suspect.

Violation of this rule is severity level 4.

A.2.18.2 Input

- fissile gram equivalent
  (SAS requirement 3.1.4.3 M.29; Data Dictionary Reference B.53)
- fissile gram equivalent standard deviation
  (SAS requirement 3.1.4.3 M.29; Data Dictionary Reference B.55)
- fissile gram equivalent counting error
  (SAS requirement 3.1.4.3 M.29; Data Dictionary Reference B.199)

A.2.18.3 Process

- compute relative standard deviation (RSD) = fissile gram equivalent standard deviation / fissile gram equivalent
- if (fissile gram equivalent relative standard deviation > IDC dependent limit) and (fissile gram equivalent counting error > count error limit)
  write to short and long report:“(4) fissile gram equivalent “, RSD, “ > max (limit)” and fissile gram equivalent count error > count error limit”
else
  write to long report: “Fissile gram equivalent RSD (“ , RSD, “) ≤ max (limit)”

A.2.18.4 Output

- output message (Data Dictionary Reference B.79)

A.2.19 Check $^{235}$U/$^{239}$Pu Mass Ratio for Value Below Defined Maximum

A.2.19.1 Description

If the $^{235}$U/$^{239}$Pu mass ratio is above the maximum value, the SAS assay is suspect.

Violation of this rule is severity level 3.
A.2.19.2 Input
• $^{235}\text{U}/^{239}\text{Pu}$ mass ratio
  
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.181)

A.2.19.3 Process
• if $^{235}\text{U}/^{239}\text{Pu}$ mass ratio > limit
  
  write to short and long report:
  “(3) $^{235}\text{U}/^{239}\text{Pu}$ mass ratio (‘$^{235}\text{U}/^{239}\text{Pu}$ mass ratio,’ $>) > \text{max (limit)}$”
  else
  
  write to long report:
  “$^{235}\text{U}/^{239}\text{Pu}$ mass ratio (‘’, $^{235}\text{U}/^{239}\text{Pu}$ mass ratio,) $\leq \text{max (limit)}$”

A.2.19.4 Output
• output message (Data Dictionary Reference B.79)

A.2.20 Check $^{241}\text{Am}/^{239}\text{Pu}$ Mass Ratio for Value Below Defined Maximum

A.2.20.1 Description
If the $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio is above a defined upper limit, then the assay results are suspect.

Violation of this rule is severity level 3.

A.2.20.2 Input
• $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio
  
  (SAS requirement 3.1.4.3 M36 ; Data Dictionary Reference B.23)
  • Upper limit
  
  (SAS requirement 3.1.4.3 M36; Data Dictionary Reference B.205)

A.2.20.3 Process
• if $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio > limit
  
  write to short and long report:
  “(3) $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio (‘$^{241}\text{Am}/^{239}\text{Pu}$ mass ratio,’ $>) > \text{max (limit)}$”
  else
  
  write to long report:
  “$^{241}\text{Am}/^{239}\text{Pu}$ mass ratio (‘’, $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio,) $\leq \text{max (limit)}$”

A.2.20.4 Output
• output message (Data Dictionary Reference B.79)

A.2.21 Check $^{241}\text{Am}/^{239}\text{Pu}$ Mass Ratio Relative Standard Deviation for Value Below Defined Maximum

A.2.21.1 Description
If the $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio RSD is above the defined upper limit, the assay results are suspect.

Violation of this rule is severity level 3.

A.2.21.2 Input
• $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio
  
  (SAS requirement 3.1.4.3 M36 ; Data Dictionary Reference B.23)
• $^{241}$Am/$^{239}$Pu mass ratio standard deviation
  \((SAS\ requirement\ 3.1.4.3\ M36;\ Data\ Dictionary\ Reference\ B.25)\)
• Upper limit
  \((SAS\ requirement\ 3.1.4.3\ M36;\ Data\ Dictionary\ Reference\ B.205)\)

A.2.21.3 Process
• compute \(RSD = \frac{^{241}\text{Am}/^{239}\text{Pu}}{^{241}\text{Am}/^{239}\text{Pu}}\) mass ratio standard deviation
• if \(RSD >\) upper limit
  write to short and long report:
  “\((3)\) $^{241}$Am/$^{239}$Pu mass ratio RSD (“, RSD, “) > max (limit)”
  else
  write to long report:
  “$^{241}$Am/$^{239}$Pu mass ratio RSD (“, RSD,”) \(\leq\) max (limit)”

A.2.21.4 Output
• output message \((Data\ Dictionary\ Reference\ B.79)\)

A.2.22 Check $^{235}$U/$^{239}$Pu Mass Ratio Relative Standard Deviation for Value Below Defined Maximum

A.2.22.1 Description
If the $^{235}$U/$^{239}$Pu mass ratio RSD is above the defined upper limit, then the assay results are suspect. Violation of this rule is severity level 3.

A.2.22.2 Input
• $^{235}$U/$^{239}$Pu mass ratio
  \((SAS\ requirement\ 3.1.4.3\ M36;\ Data\ Dictionary\ Reference\ B.181)\)
• $^{235}$U/$^{239}$Pu mass ratio standard deviation
  \((SAS\ requirement\ 3.1.4.3\ M36;\ Data\ Dictionary\ Reference\ B.183)\)
• Upper limit
  \((SAS\ requirement\ 3.1.4.3\ M36;\ Data\ Dictionary\ Reference\ B.205)\)

A.2.22.3 Process
• compute relative standard deviation (RSD) = $^{235}$U/$^{239}$Pu mass ratio standard deviation/$^{235}$U/$^{239}$Pu mass ratio
• if $^{235}$U/$^{239}$Pu mass ratio RSD \(\geq\) upper limit
  write to short and long report:
  “\((3)\) $^{235}$U/$^{239}$Pu mass ratio RSD (“, RSD,”) > max (limit)”
  else
  write to long report:
  “$^{235}$U/$^{239}$Pu mass ratio RSD (“, RSD,”) \(\leq\) max (limit)”

A.2.22.4 Output
• output message \((Data\ Dictionary\ Reference\ B.79)\)
A.2.24 Check Gamma Dead Time

A.2.24.1 Description
The check on the gamma dead time ensures that the percentage of gamma dead time is less than 10%. If the dead time exceeds this limit, then the gamma measurements will not be accurate. Violation of this rule is severity level 3.

A.2.24.2 Input
- gamma dead time (Data Dictionary Reference B.59)
- Upper limit
  (SAS requirement 3.1.4.3 M36 ; Data Dictionary Reference B.205)

A.2.24.3 Process
- if gamma dead time > upper limit
  write to short and long report: “(3) gamma dead time (gamma dead time) > limit”
  else
  write to long report: “gamma dead time (gamma dead time) ≤ limit “

A.2.24.4 Output
- output message (Data Dictionary Reference B.79)

A.2.25 Check that the $^{241}$Am Activity is Consistent

A.2.25.1 Description
Inconsistent $^{241}$Am average activity as compared to and computed with the 662 keV gamma line may indicate $^{137}$Cs activity is present. Acceptable knowledge documents may need to be reviewed and modified. Violation of this rule is severity level 4.

A.2.25.2 Input
- $^{241}$Am line 662 micro-Ci/unit
  (Data Dictionary Reference B.74)
- $^{241}$Am line 662 error micro-Ci/unit
  (Data Dictionary Reference B.74)
- $^{241}$Am net micro-Ci/unit
  (Data Dictionary Reference B.38)
- $^{241}$Am net error micro-Ci/unit
  (Data Dictionary Reference B.38)
- Limit = the number of standard deviations (from defaults file)
  (Data Dictionary Reference B.38)

A.2.25.3 Process
- if $|$ $^{241}$Am line 662 micro-Ci/unit activity - $^{241}$Am net micro - Ci/unit activity $| >$
  limit * $\sqrt{($^{241}$Am line 662 error micro-Ci/unit **)^2 + ($^{241}$Am net error micro-Ci/unit **)^2)}$
  write to short and long report “(4) The 662 keV $^{241}$Am activity is not consistent with the average $^{241}$Am activity “
  else
  write to long report “The 622 keV $^{241}$Am activity is consistent with the average $^{241}$Am activity “
A.2.25.4 Output
- output message *(Data Dictionary Reference B.79)*

**A.2.26 Check Net Active Shielded Total Rate for Value Above Defined Minimum**

**A.2.26.1 Description**
If the net active shielded total rate values are below the acceptable IDC dependent limit input from the limit file, then the assay results are suspect.

Violation of this rule is severity level 4.

**A.2.26.2 Input**
- net active shielded total rate *(SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.69)*
- IDC dependent limit *(SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.206)*

**A.2.26.3 Process**
- if net active shielded total rate < IDC dependent limit
  - write to short and long report: “(4) net active shielded total rate for IDC (”,net active shielded total rate,”) < max (limit)”
  - else
    - write to long report: “net active shielded total rate for IDC (”,net active shielded total rate,”) ≥ max (limit)”

**A.2.26.4 Output**
- output message *(Data Dictionary Reference B.79)*

**A.2.27 Ensure Active Pulse Count is at the Required Level**

**A.2.27.1 Description**
If the active pulse count does not equal the required level, correct active assay values will not be derived.

Violation of this rule is severity level 3.

**A.2.27.2 Input**
- total pulses *(SAS requirement 3.1.4.3 M4; Data Dictionary Reference B.17)*
- required pulse count *(SAS requirement 3.1.4.3 M4; Data Dictionary Reference B.18)*

**A.2.27.3 Process**
- if active pulse count = limit
  - write to long report “active pulse limit”
  - else
    - write to short and long report “(3) active pulse not equal to limit”
A.2.27.4 Output
- output message (Data Dictionary Reference B.79)

A.2.28 Perform Range Check on Pu Isotopics

A.2.28.1 Description

If the assay indicates that the quantity of plutonium exceeds established limits, then the drum needs
 to be rejected as it will not be compliant with WIPP storage requirements. This functional requirement
 provides the algorithm to determine the quantity of plutonium estimated to exist within the drum.

If the $^{238}\text{Pu}/^{239}\text{Pu}$ is above the maximum value, then the plutonium is a heat source and the assay
 should be rejected, which is severity level 1. All other violations of this rule are severity level 3.

A.2.28.2 Input
- $^{241}\text{Pu}/^{239}\text{Pu}$ mass ratio
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.138)
- $^{240}\text{Pu}/^{239}\text{Pu}$ mass ratio
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.136)
- $^{239}\text{Pu}$ line 413 keV error
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.134)
- $^{238}\text{Pu}/^{239}\text{Pu}$ mass ratio
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.131)
- Weapons Grade $^{241}\text{Pu}/^{239}\text{Pu}$ mass ratio 50% upper limit
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.195)
- Weapons Grade $^{241}\text{Pu}/^{239}\text{Pu}$ mass ratio 50% lower limit
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.194)
- Weapons Grade $^{240}\text{Pu}/^{239}\text{Pu}$ mass ratio 50% upper limit
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.193)
- Weapons Grade $^{240}\text{Pu}/^{239}\text{Pu}$ mass ratio 50% lower limit
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.192)
- limit1
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.207)
- limitu
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.205)
- limit
  (SAS requirement 3.1.4.3 M.36 via SGRS; Data Dictionary Reference B.208)

A.2.28.3 Process
- set flag1 to true
- set flag2 to true
- set flag3 to true
• if $\text{limit}_l \leq \frac{^{240}\text{Pu}}{^{239}\text{Pu}}$ mass ratio $\leq \text{limit}_u$
  write to long report:
  \(\text{\frac{^{240}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio (", \frac{^{240}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio, }
  "\}) is within range: \text{limit}_l - \text{limit}_u\)"
  flag1 = false
else
  write to short and long report:
  "(3) \frac{^{240}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio (", \frac{^{240}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio, }
  "\}) is outside its allowed range: \text{limit}_l - \text{limit}_u"
• if $\text{limit}_l \leq \frac{^{241}\text{Pu}}{^{239}\text{Pu}}$ mass ratio $\leq \text{limit}_u$
  write to long report:
  \(\text{\frac{^{241}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio (", \frac{^{241}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio, }
  "\}) is within range: \text{limit}_l - \text{limit}_u\)"
  flag2 = false
else
  write to short and long report:
  "(3) \frac{^{241}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio (", \frac{^{241}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio, }
  "\}) is outside its allowed range: \text{limit}_l - \text{limit}_u"
• if $^{239}\text{Pu}$ fit error $\leq \text{limit}$
  write to long report: \(\frac{^{239}\text{Pu}}{\text{fit error (", }^{239}\text{Pu fit error, 
  "\}) \leq \text{limit}\)"
else
  write to short and long report:
  "(3) $^{239}\text{Pu}$ keV fit error (", $^{239}\text{Pu}$ fit error, 
  "\) > \text{limit}\)"
• if flag1 & flag2
  write to short and long report:
  "(1) WGPu failed"
else
  write to long report:
  "WGPu is acceptable"
• if $^{238}\text{Pu} / ^{239}\text{Pu} > \text{limit}$
  write to short and long report:
  "(1) $^{238}\text{Pu} / ^{239}\text{Pu}$ mass ratio $> \text{max (}: \text{limit})$"
  write to short and long report:
  "(1) $^{238}\text{Pu}$ heat source detected."
else
  write to long report: \(\frac{^{238}\text{Pu}}{^{239}\text{Pu}}\text{ mass ratio }\leq \text{max (}: \text{limit})\)"
  set flag4 to false
  set flag5 to false
  set flag6 to false
  set flag7 to false

A.2.28.4 Output

• output message (Data Dictionary Reference B.79)
A.2.29 Check for Concurrent Presence of $^{235}$U and $^{238}$U

A.2.29.1 Description

Both $^{235}$U and $^{238}$U will naturally occur together. If the presence of both are not detected then the assay results for either uranium isotope are suspect.

Violation of this rule is severity level 4.

A.2.29.2 Input

- $^{235}$U NUCLIDE_FOUND
  (Data Dictionary Reference B.186)

A.2.29.3 Process

- if $^{235}$U NUCLIDE FOUND
  if $^{238}$U NUCLIDE FOUND
    write to long report “$^{235}$U and $^{238}$U observed together as expected.”
  else
    write to short and long report “(4) $^{235}$U observed without $^{238}$U
else if $^{238}$U NUCLIDE FOUND
  if $^{235}$U NUCLIDE FOUND
    write to long report “$^{225}$U and $^{238}$U observed together as expected.”
  else
    write to short and long report “(4) $^{238}$U observed without $^{235}$U”

A.2.29.4 Output

- output message (Data Dictionary Reference B.79)

A.2.30 $^{233}$U Confirmation Check

A.2.30.1 Description

If $^{233}$U is present, its presence should be confirmed by the presence of a $^{213}$Bi, 440 keV gamma line. If not, then any flagged presence of $^{233}$U is suspect.

Violation of this rule is severity level 4.

A.2.30.2 Input

- $^{233}$U NUCLIDE FOUND
  (Data Dictionary Reference B.174)
- $^{233}$U line 440 keV error
  (Data Dictionary Reference B.175)
- Upper limit
  (Data Dictionary Reference B.205)

A.2.30.3 Process

- if $^{233}$U NUCLIDE FOUND
  if $^{233}$U line 440 keV error $\leq$ upper limit
    write to long report “$^{233}$U was found and confirmed by $^{213}$Bi, line 440”
  else
    write to short and long report “(4) $^{233}$U found was TRUE; $^{213}$Bi, line 440 was FALSE;
else
write to short and long report “(4) $^{233}$U not detected.”

A.2.30.4 Output

- output message (Data Dictionary Reference B.79)

A.2.31 Validate Absorber Index for Proper Value

A.2.31.1 Description
If wrong absorber indexes were used in SAS, then the mass computations would be invalid. Hence, validity checks of these items will ensure the correctness of the transuranic mass computations. Violation of this rule is severity level 3.

A.2.31.2 Input

- absorber index  
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.1)
- upper limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.205)

A.2.31.3 Process

- if absorber index  > upper limit
  write to short and long report:
  “(3) Absorber index has exceeded the quality limit (limit)”
  else
  write to long report:
  “Absorber index is below the quality limit (limit), do not check further.

A.2.31.4 Output

- output message (Data Dictionary Reference B.79)

A.2.32 Validate Moderator Index for Proper Value

A.2.32.1 Description
If wrong moderator indexes were used in SAS, then the mass computations would be invalid. Hence, validity checks of these terms will ensure the correctness of the transuranic mass computations. Violation of this rule is severity level 3.

A.2.32.2 Input

- moderator index  
  (SAS requirement 3.1.4.3 M.2; Data Dictionary Reference B.67)
- upper limit
  (SAS requirement 3.1.4.3 M.2; Data Dictionary Reference B.205)

A.2.32.3 Process

- if moderator index  > upper limit
  write to short and long report: “(3) Moderator Index “, moderator index, “has exceeded the quality limit (limit)”
  else
  write to long report: “Moderator Index acceptable”
A.2.32.4 Output
- output message (Data Dictionary Reference B.79)

A.2.33 Validate Uranium Correction Factor for Proper Value

A.2.33.1 Description
If wrong correction factors were used in SAS, then the mass computations would be invalid. Hence, validity checks of these factors will ensure the correctness of the transuranic mass computations. Violation of this rule is severity level 3.

A.2.33.2 Input
- uranium correction factor
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.191)
- upper limit
  (SAS requirement 3.1.4.3 M.2; Data Dictionary Reference B.205)

A.2.33.3 Process
- if uranium correction factor > upper limit
  else
    write to short and long report:
    “(3) Uranium Correction Factor (", uranium correction factor, ") has exceeded the quality limit - unacceptable”
  else
    write to long report: “Uranium Correction Factor below the quality limit - acceptable”

A.2.33.4 Output
- output message (Data Dictionary Reference B.79)

A.2.34 Perform a Two Sigma Test of Computed $^{235}\text{U} / ^{239}\text{Pu}$ Mass Ratio vs. SAS Derived Value

A.2.34.1 Description
The measured and calculated mass ratios for $^{235}\text{U} / ^{239}\text{Pu}$ should be internally consistent. Otherwise the mass ratio value is questionable. Violation of this rule is severity level 4.

A.2.34.2 Input
- $^{241}\text{Am} / ^{239}\text{Pu}$ mass ratio
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.23)
- $^{241}\text{Am} / ^{239}\text{Pu}$ mass ratio uncertainty
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.25)
- $^{235}\text{U} / ^{239}\text{Pu}$ mass ratio
  (SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.181)
- $^{235}\text{U} / ^{239}\text{Pu}$ mass ratio uncertainty
  (SAS requirement 3.1.4.3 M36; Data Dictionary Reference B.183)
- $^{241}\text{Am} / ^{235}\text{U}$ mass ratio
  (SAS requirement 3.1.4.3 M36; Data Dictionary Reference B.26)
• $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty
  *(SAS requirement 3.1.4.3 M36; Data Dictionary Reference B.210)*
• $^{235}\text{U}$ NUCLIDE FOUND FLAG
  *(SAS requirement 3.1.4.3 M36; Data Dictionary Reference B.186)*

**A.2.34.3 Process**

- if ($^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty < 0) | ($^{241}\text{Am}/^{239}\text{Pu}$ mass ratio < 0) | ($^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty < 0) | ($^{235}\text{U}/^{239}\text{Pu}$ mass ratio < 0) | ($^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty < 0) | ($^{241}\text{Am}/^{235}\text{U}$ mass ratio $\leq$ 0 | $^{235}\text{U}$ NUCLIDE FOUND FLAG = NO)
  - write to short and long report:
    “(4) $^{235}\text{U}/^{239}\text{Pu}$ mass ratio two sigma test could not be performed.”

- $A$ = measured $^{241}\text{Am}/^{235}\text{U}$ mass ratio
- $B$ = measured $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty
- $C$ = measured $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio
- $D$ = measured $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty
- $E$ = measured $^{235}\text{U}/^{239}\text{Pu}$ mass ratio
- $F$ = measured $^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty
- compute $G = \text{calculated}^{235}\text{U}/^{239}\text{Pu}$ mass ratio $= C * 1/A$
- compute $H = \text{calculated}^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty $= (\sqrt{A**2*D**2 + C**2*B**2})/ A**2$
- if $|\text{abs}[E - G] > 1.96 * \sqrt{(F**2 + H**2)}$
  - write to short and long report:
    “(4) $^{235}\text{U}/^{239}\text{Pu}$ mass ratio two sigma test failed – values:”,
    $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio, $^{241}\text{Am}/^{235}\text{U}$ mass ratio,
    “unc’s: “$^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty,
    $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty
else
  write to long report: “$^{235}\text{U}/^{239}\text{Pu}$ mass ratio two sigma test succeeded”

**A.2.34.4 Output**

- output message *(Data Dictionary Reference B.79)*

**A.2.35 Perform a Two Sigma Test of Computed $^{241}\text{Am}/^{239}\text{Pu}$ Mass Ratio vs. SAS Derived Value**

**A.2.35.1 Description**

The measured and calculated mass ratios are to be internally consistent. Otherwise the results are questionable.

Violation of this rule is severity level 4.

**A.2.35.2 Input**

- $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio
  *(SAS requirement 3.1.4.3 M36 via SGRS ; Data Dictionary Reference B.23)*
• $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.25)*

• $^{235}\text{U}/^{239}\text{Pu}$ mass ratio
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.181)*

• $^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.183)*

• $^{241}\text{Am}/^{235}\text{U}$ mass ratio
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.26)*

• $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.210)*

• $^{241}\text{Am}$ NUCLIDE FOUND FLAG
  
  *(SAS requirement 3.1.4.3 M36 via SGRS; Data Dictionary Reference B.209)*

### A.2.35.3 Process

- if ($^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty < 0) | ($^{241}\text{Am}/^{239}\text{Pu}$ mass ratio < 0) | ($^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty < 0) | ($^{241}\text{Am}/^{235}\text{U}$ mass ratio < 0) | ($^{235}\text{U}/^{239}\text{Pu}$ mass ratio ≤ 0 | NUCLIDE FOUND FLAG)
  
  write to short and long report:
  
  “(4) $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio two sigma test could not be performed.”

- A = measured $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio
- B = measured $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty
- C = measured $^{235}\text{U}/^{239}\text{Pu}$ mass ratio
- D = measured $^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty
- E = measured $^{241}\text{Am}/^{235}\text{U}$ mass ratio
- F = measured $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty
- compute G = calculated $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio = C * E
- compute H = calculated $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio uncertainty = $\sqrt{(D**2*E**2 + C**2*F**2)}$
- if [ abs[ A − G] > 1.96 * $\sqrt{(B**2 + H**2)}$]
  
  write to short and long report:
  
  “(4) $^{241}\text{Am}/^{239}\text{Pu}$ mass ratio two sigma test failed – values: $^{235}\text{U}/^{239}\text{Pu}$ mass ratio, $^{241}\text{Am}/^{235}\text{U}$ mass ratio, $^{235}\text{U}/^{239}\text{Pu}$ mass ratio uncertainty, $^{241}\text{Am}/^{235}\text{U}$ mass ratio uncertainty

else
  
  write to long report: “$^{241}\text{Am}/^{239}\text{Pu}$ mass ratio two sigma test succeeded”

### A.2.35.4 Output

- output message *(Data Dictionary Reference B.79*
A.2.36 Check for Sufficient Quantity of Plutonium to Conduct Assay

A.2.36.1 Description

If either the net active shielded total rate is greater than or equal to the IDC dependent minimum or the Pu 413 keV gamma fit line error < limit, there is a sufficient quantity of plutonium to perform a valid assay.

Violation of this rule is severity level 1.

A.2.36.2 Input

- net active shielded total rate
  * (SAS Requirement 3.1.4.3 M36 ; Data Dictionary Reference B.69)
- $^{239}$Pu line 413 keV error
  * (Data Dictionary Reference B.134)

A.2.36.3 Process

- if net active shielded total rate < IDC dependent limit and Pu 413 keV gamma fit error > limit
  write to short and long report:
  “(1) net active shielded total rate below IDC dependent limit and $^{239}$Pu 413 keV fit error >20%”
  else
  write to long report:
  “net active shielded total rate above minimum IDC dependent limit or $^{239}$Pu 413 keV fit error < limit”

A.2.36.4 Output

- output message (Data Dictionary Reference B.79)

A.2.37 Check for Presence of $^{241}$Am

A.2.37.1 Description

The presence of $^{241}$Am interferes with the detection of plutonium. Consequently, a test is necessary to ascertain if $^{241}$Am is present to assure the reliability of the plutonium assay data.

Violation of this rule is severity level 4.

A.2.37.2 Input

- $^{241}$Am line 125 keV error
  * (Data Dictionary Reference B.29)
- americium weighted average activity
  * (Data Dictionary Reference B.30)
- americium weighted average activity standard deviation
  * (Data Dictionary Reference B.31)
- upper limit
  * (Data Dictionary Reference B.205)
A.2.37.3 Process

- if $^{241}$Am fit error $\leq$ upper limit
  write to long report $^{241}$Am fit error $\leq$ upper limit
  else
  write to short and long report:
  “(4) $^{241}$Am fit error (“$^{241}$Am fit error,”) > limit”

A.2.37.4 Output

- output message (Data Dictionary Reference B.79)

A.2.38 Check Reported $^{241}$Am Mass Relative Standard Deviation for Value Below Defined Maximum

A.2.38.1 Description

If the Reported $^{241}$Am mass RSD is above the maximum value, the SAS assay is rejected. Violation of this rule is severity level 4.

A.2.38.2 Input

- Reported $^{241}$Am mass
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.142)
- Reported $^{241}$Am mass standard deviation
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.144)
- upper limit
  (Data Dictionary Reference B.205)

A.2.38.3 Process

- compute Reported $^{241}$Am mass RSD =
  Reported $^{241}$Am mass standard deviation/Reported $^{241}$Am mass
- if RSD $>$ upper limit
  write to short and long report:
  “(4) Reported $^{241}$Am mass RSD (“, Reported $^{241}$Am mass RSD, “) $>$ max (limit)”
  else
  write to long report:
  “Reported $^{241}$Am mass RSD (“, Reported $^{241}$Am mass RSD,”) $\leq$ max (limit)”

A.2.38.4 Output

- output message (Data Dictionary Reference B.79)

A.2.39 Check Reported Pu Mass Relative Standard Deviation for Value Below Defined Maximum

A.2.39.1 Description

If the Reported Pu mass RSD is above the maximum value, the SAS assay is suspect. Violation of this rule is severity level 4.

A.2.39.2 Input

- Reported Pu mass
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.145)
A.2.39.3 Process

• compute Reported Pu mass relative standard deviation (RSD) =
  Reported Pu mass standard deviation / Reported Pu mass

• if RSD > upper limit
  write to short and long report:
  “(4) Reported Pu mass RSD (“, RSD, “) > max (limit)”
else
  write to long report: “Reported Pu mass relative standard deviation ≤ max (limit)"

A.2.39.4 Output

• output message (Data Dictionary Reference B.79)

A.2.40 Check Reported $^{235}\text{U}$ Mass Relative Standard Deviation for Value Below Defined Maximum

A.2.40.1 Description

If the reported $^{235}\text{U}$ mass relative standard deviation is above the maximum value, the SAS assay is suspect.

Violation of this rule is severity level 4.

A.2.40.2 Input

• Reported $^{235}\text{U}$ mass
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.147)

• Reported $^{235}\text{U}$ mass standard deviation
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.148)

• upper limit
  (Data Dictionary Reference B.205)

A.2.40.3 Process

• compute Reported $^{235}\text{U}$ mass relative standard deviation (RSD) =
  Reported $^{235}\text{U}$ mass standard deviation/Reported $^{235}\text{U}$ mass

• if RSD > upper limit
  write to short and long report: “(1) Reported $^{235}\text{U}$ mass RSD (“, RSD, “) > max (limit)”
else
  write to long report: “Reported $^{235}\text{U}$ mass RSD (“, RSD, “) ≤ max (limit)”

A.2.40.4 Output

• output message (Data Dictionary Reference B.79)
A.2.41 Determine if Flux Monitor Counts are Above Required Minimum

A.2.41.1 Description
If the chamber flux monitor rate is below the accepted minimum, the assay should be rejected. Violation of this rule is severity level 4.

A.2.41.2 Input
• chamber flux monitor rate
  \[(SAS \text{ requirement } 3.1.3.4 \ M.7; \ Data \ Dictionary \ Reference \ B.36)\]

A.2.41.3 Process
• if chamber flux monitor rate < IDC dependent limit
  write to short and long report: “(3) chamber flux monitor rate < IDC dependent limit”
  else
  write to long report: “chamber flux monitor rate \(\geq\) IDC dependent limit”

A.2.41.4 Output
• output message \((Data \ Dictionary \ Reference \ B.79)\)

A.2.42 Perform Consistency Check on Replicate Data

A.2.42.1 Description
A replicate is a random sample reanalysis of at least one waste container in a batch to ensure the proper maintenance of quality assurance. All assay parameters are the same as the previous waste container values. The reanalysis specifically checks to ensure that the alpha activity is within 1.96 sigma of the previous analysis. Violation of this rule is severity level 1.

A.2.42.2 Input
• Data values from initial assay (1):
  • \(\alpha\) activity
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.20)\]
  • \(\alpha\) activity counting error
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.198)\]
• Data values from replicate assay (2):
  • \(\alpha\) activity
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.20)\]
  • \(\alpha\) activity counting error
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.198)\]
  • JSR passive gross count time
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.200)\]
  • active pulse
    \[(SAS \text{ requirement } 3.1.4.3 \ M.36; \ Data \ Dictionary \ Reference \ B.203)\]
A.2.42.3 Process

- repeat
  
  read SAS file
  until “ ;File appended” | end-of-file
  if “;File appended” not read
  write to short and long report:
  “Replicate hypothesis test not applicable:”, SAS file
- read $\alpha_1$ activity, $\alpha_1$ activity counting error from original SAS
- read $\alpha_2$ activity, $\alpha_2$ activity counting error from replicate SAS
- compute $s = \sqrt{(\alpha_1 \text{ activity counting error})^2 + (\alpha_2 \text{ activity counting error})^2}$
- if $|\alpha_1 \text{ activity} - \alpha_2 \text{ activity}| > 1.96 s$
  write to short and long report:
  “(1) Alpha activity replicate hypothesis test failed –“, SAS file,
  “values: “, $\alpha_1$ activity, $\alpha_2$ activity,
  “unc’s: “, $\alpha_1$ activity counting error, $\alpha_2$ activity counting error
  else
  write to long report:
  “Alpha activity passed the replicate hypothesis test –“, SAS file,
  “values: “, $\alpha_1$ activity, $\alpha_2$ activity,
  “unc’s: “, $\alpha_1$ activity counting error, $\alpha_2$ activity counting error
- read JSR passive gross count time from original SAS
- read JSR passive gross count time from replicate SAS
- if original JSR passive gross count time <> replicate JSR passive gross count time
  write to short and long report:
  “(1) replicate JSR passive gross count time –“, SAS file,
  “does not match original JSR passive gross count time:
  else
  write to long report:
  “replicate JSR passive gross count time –“, SAS file,
  “matches original JSR passive gross count time”
- read active pulse from original SAS
- read active pulse from replicate SAS
- if original active pulse <> replicate active pulse
  write to short and long report:
  “original and replicate active pulse –“, active pulse (1), “active pulse (2) not equal”
  else
  write to long report:
  “original and replicate active pulse –“, active pulse (1), active pulse (2)” are equal

A.2.42.4 Output

- output message (Data Dictionary Reference B.79)
A.2.43 Validate IDC

A.2.43.1 Description

The current Expert System is configured to process assay data from Item Description Codes: 001, 002, 007, 300, 301, 303, 310, 311, 312, 330, 335, 336, 337, 338, 360, 376, 440, 441, 442, 480, 481, 800, 803, 807, and 807a.

A.2.43.2 Inputs

- content code
  
  *(SAS requirement 3.1.4.3 M.2; Data Dictionary Reference B.37)*

A.2.43.3 Process

- if content code = 001 | content code = 002 | content code = 007 | content code = 300 | content code = 301 | content code = 303 | content code = 310 | content code = 311 | content code = 312 | content code = 330 | content code = 335 | content code = 336 | content code = 337 | content code = 338 | content code = 360 | content code = 376 | content code = 440 | content code = 441 | content code = 442 | content code = 480 | content code = 481 | content code = 800 | content code = 803 | content code = 807 | content code = 807a
  
  write to long report: “IDC: ”, content code

else

write to short and long report: “Invalid IDC encountered: “, content code

A.2.43.4 Output

- output message *(Data Dictionary Reference B.79)*

A.2.44 Provide Summary Report Containing Severity Error Level of Expert System Analysis

A.2.44.1 Description

A summary of the most severe error noted in the expert system analysis is necessary.

A.2.44.2 Input

- severity_level
  
  *(Data Dictionary Reference B.152)*

A.2.44.3 Process

- compute min(severity_level)

- case severity_level = 1:
  
  write to short and long report: “Assay is Rejected”

- case severity_level = 2
  
  write to short and long report: “Assay is Deficient”

- case severity_level = 3
  
  write to short and long report: “ETR Review Required”

- case severity_level = 4
  
  write to short and long report: “Additional ITR Review Required”

- case severity_level = 5
  
  write to short and long report: “Assay is Acceptable”
A.2.45 Determine if passive background bare side/average ratio is within established limits

A.2.45.1 Description

The ratio of detector measurements from each side to their average are used to ensure that the detectors are functioning properly, the rotator has not failed, and the detectors are not detecting spurious fissile signals from nearby sources. If the passive gross counts on any side are statistically high, then there is a reasonable probability that the detectors are not functioning correctly, or another waste container was left in too close a proximity to the container being assayed.

Violation of this rule is severity level 3.

A.2.45.2 Inputs

- passive background bare door counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.85)
- passive background bare back counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.84)
- passive background bare right counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.87)
- passive background bare left counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.86)
- quality (lower) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.141)
- rescan (upper) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.149)

A.2.45.3 Process

- compute average counts for passive background:
  bare left, bare right, bare door, and bare back:
  \[ \sum \text{(passive background bare counts on side)} / 4 = \text{average counts} \]
- compute ratio of
  - bare left / average
  - bare right / average
  - bare door / average
  - bare back / average
- if abs( 1 - bare left / average ) > lower limit
  write to short and long report:
  “(3) Detector passive background bare left count ratio delta “,
  passive background bare left counts,
  “has exceeded the quality limit (limit)”
else
  write to long report: “Detector passive background bare left “,
  passive background bare left counts, “count ratio delta < limit”
• if abs( 1 - bare right /average ) > lower limit
  write to short and long report:
  “(3) Detector passive background bare right count ratio delta “,
  passive background bare right counts,
  “has exceeded the quality limit (limit)”
else
  write to long report: “Detector passive background bare right “,
  passive background bare right counts, “ count ratio delta < limit”

• if abs( 1 - bare door/average ) > lower limit
  write to short and long report:
  “(3) Detector passive background bare door count ratio delta “,
  passive background bare door counts,
  “has exceeded the quality limit (limit)”
else
  write to long report: “Detector passive background bare door “,
  passive background bare door counts, “ count ratio delta < limit”

• if abs( 1 - bare back/average ) > lower limit
  write to short and long report:
  “(3) Detector passive background bare back count ratio delta “,
  passive background bare back counts,
  “has exceeded the quality limit (limit)”
else
  write to long report: “Detector passive background bare back “,
  passive background bare back counts, “ count ratio delta < limit”

• if abs( 1 - bare left /average ) > upper limit
  write to short and long report:
  “(3) Detector passive background bare left count ratio delta “,
  passive background bare left counts,
  “has exceeded the rescan limit (limit)”
else
  write to long report: “Detector passive background bare left “,
  passive background bare left counts, “ count ratio delta < limit”

• if abs( 1 - bare right /average ) > upper limit
  write to short and long report:
  “(3) Detector passive background bare right count ratio delta “,
  passive background bare right counts,
  “has exceeded the rescan limit (limit)”
else
  write to long report: “Detector passive background bare right “,
  passive background bare right counts, “ count ratio delta < limit”
if abs( 1 - bare door/average ) > upper limit
write to short and long report:
“(3) Detector passive background bare door count ratio delta “,
passive background bare door counts,
“has exceeded the rescan limit (limit)”
else
write to long report: “Detector passive background bare door “,
passive background bare door counts, “ count ratio delta < limit”

if abs( 1 - bare back/average ) > upper limit
write to short and long report:
“(3) Detector passive background back count ratio delta “,
passive background back counts,
“has exceeded the rescan limit (limit)”
else
write to long report: “Detector passive background bare back “,
passive background bare back counts, “ count ratio delta < limit”

A.2.45.4 Output

• output message (Data Dictionary Reference B.79)

A.2.46 Determine if passive background shielded side/average ratio is within established limits

A.2.46.1 Description

The ratio of detector measurements from each side to their average are used to ensure that the detectors are functioning properly, are not working incorrectly, or are not detecting unintended nearby fissile materials. If the passive gross counts on any side are statistically high, then there is a reasonable probability that the detectors are not functioning correctly or another waste container was left in too close a proximity to the container being assayed.

Violation of this rule is severity level 3.

A.2.46.2 Inputs

• passive background shielded door counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.93)
• passive background shielded back counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.92)
• passive background shielded right counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.95)
• passive background shielded left counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.94)
• quality (lower) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.141)
• rescan (upper) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.149)
A.2.46.3 Process

- compute average counts for shielded left, shielded right, shielded door, shielded back:
  \[ \Sigma \text{(passive background shielded counts on side,)} / 4 = \text{average counts} \]

- compute ratio of
  - shielded left / average
  - shielded right / average
  - shielded door / average
  - shielded back / average

- if abs( 1 - shielded left /average ) > lower limit
  write to short and long report:
  "(3) Detector passive background shielded left count ratio delta \(\),
  passive background shielded left counts, 
  has exceeded the quality limit (limit)"

  else
  write to long report: "Detector passive background shielded left \(\),
  passive background shielded left counts, " count ratio delta < limit"

- if abs( 1 - shielded right /average ) > lower limit
  write to short and long report:
  "(3) Detector passive background shielded right count ratio delta \(\),
  passive background shielded right counts, 
  has exceeded the quality limit (limit)"

  else
  write to long report: "Detector passive background shielded right \(\),
  passive background shielded right counts, " count ratio delta < limit"

- if abs( 1 - shielded door/average ) > lower limit
  write to short and long report:
  "(3) Detector passive background shielded door count ratio delta \(\),
  passive background shielded door counts, 
  has exceeded the quality limit (limit)"

  else
  write to long report: "Detector passive background shielded door \(\),
  passive background shielded door counts, " count ratio delta < limit"

- if abs( 1 - shielded back/average ) > lower limit
  write to short and long report:
  "(3) Detector passive background shielded back count ratio delta \(\),
  passive background back counts, 
  has exceeded the quality limit (limit)"

  else
  write to long report: "Detector passive background bare back \(\),
  passive background bare back counts, " count ratio delta < limit"
• if abs( \( 1 - \text{shielded left/average} \) ) > upper limit
  write to short and long report:
  “(3) Detector passive background shielded left count ratio delta “,
  passive background shielded left counts,
  “has exceeded the rescan limit (limit)”

  else
  write to long report: “Detector passive background shielded left “,
  passive background shielded left counts, “ count ratio delta < limit”

• if abs( \( 1 - \text{shielded right/average} \) ) > upper limit
  write to short and long report:
  “(3) Detector passive background shielded right count ratio delta “,
  passive background shielded right counts,
  “has exceeded the rescan limit (limit)”

  else
  write to long report: “Detector passive background shielded right “,
  passive background shielded right counts, “ count ratio delta < limit”

• if abs( \( 1 - \text{shielded door/average} \) ) > upper limit
  write to short and long report:
  “(3) Detector passive background shielded door count ratio delta “,
  passive background shielded door counts,
  “has exceeded the rescan limit (limit)”

  else
  write to long report: “Detector passive background shielded door “,
  passive background shielded door counts, “ count ratio delta < limit”

• if abs( \( 1 - \text{shielded back/average} \) ) > upper limit
  write to short and long report:
  “(3) Detector passive background shielded back count ratio delta “,
  passive background shielded back counts,
  “has exceeded the rescan limit (limit)”

  else
  write to long report: “Detector passive background shielded back “,
  passive background shielded back counts, “ count ratio delta < limit”

A.2.46.4 Output

• output message (Data Dictionary Reference B.79)
A.2.47  Determine if passive gross bare side/average ratio is within established limits

A.2.47.1 Description

The ratio of detector measurements from each side to their average are used to ensure that the detectors are functioning properly, are not working incorrectly, or are not detecting unintended nearby fissile materials. If the passive background counts on any side are statistically high, then there is a reasonable probability that the detectors are not functioning correctly or another waste container was left in too close a proximity to the container being assayed.

Violation of this rule is severity level 3.

A.2.47.2 Input

- passive gross bare back counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.111)
- passive gross bare door counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.112)
- passive gross bare left counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.113)
- passive gross bare right counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.114)
- lower (quality) limit
  (Data Dictionary Reference B.138)
- upper (rescan) limit
  (Data Dictionary Reference B.149)

A.2.47.3 Process

- compute average counts for left, right, door, back:
  \[ \frac{\sum \text{side}_i}{4} = \text{average counts} = \text{average} \]
- compute ratio of
  - passive gross bare left / average
  - passive gross bare right / average
  - passive gross bare door / average
  - passive gross bare back / average

- if \( \text{abs}(1 - \text{bare left} / \text{average}) \) > lower limit
  write to short and long report:
  “(3) Detector passive gross bare left count ratio delta “,
  passive gross bare left counts, “has exceeded the quality limit (limit)”
else
  write to long report: “Detector passive gross bare left “,
  passive gross bare left counts, “count ratio delta < limit”

- if \( \text{abs}(1 - \text{bare right} / \text{average}) \) > lower limit
  write to short and long report:
  “(3) Detector passive gross bare right count ratio delta “,
  passive gross bare right counts, “has exceeded the quality limit (limit)”
else
write to long report: “Detector passive gross bare right “,
passive gross bare right counts, “count ratio delta < limit”

• if abs( 1 – bare door/average ) > lower limit
write to short and long report:
“(3) Detector passive gross bare door count ratio delta “,
passive background bare door counts,
“has exceeded the quality limit (limit)”
else
write to long report: “Detector passive gross bare door “,
passive gross bare door counts, “count ratio delta < limit”

• if abs( 1 – bare back/average ) > lower limit
write to short and long report:
“(3) Detector passive gross bare back count ratio delta “,
passive gross bare back counts,
“has exceeded the quality limit (limit)”
else
write to long report: “Detector passive gross bare back “,
passive gross bare back counts, “count ratio delta < limit”

• if abs( 1 – bare left /average ) > upper limit
write to short and long report:
“(3) Detector passive gross bare left count ratio delta “,
passive gross bare left counts, “has exceeded the rescan limit (limit)”
else
write to long report: “Detector passive gross bare left “,
passive gross bare left counts, “count ratio delta < limit”

• if abs( 1 – bare right /average ) > upper limit
write to short and long report:
“(3) Detector passive gross bare right count ratio delta “,
passive gross bare right counts, “has exceeded the rescan limit (limit)”
else
write to long report: “Detector passive gross bare right “,
passive gross bare right counts, “count ratio delta < limit”

• if abs( 1 - shielded door/average ) > upper limit
write to short and long report:
“(3) Detector passive gross bare door count ratio delta “,
passive gross bare door counts, “has exceeded the rescan limit (limit)”
else
write to long report: “Detector passive gross bare door “,
passive gross bare door counts, “count ratio delta < limit”
• if abs( 1 - shielded back/average ) > upper limit
  write to short and long report:
  “(3) Detector passive gross bare back  count ratio delta “,
  passive gross bare back  counts,
  “has exceeded the rescan limit (limit)”
else
  write to long report: “Detector passive gross bare back “,
  passive gross bare back counts, “ count ratio delta < limit”

A.2.47.4 Output

• output message (Data Dictionary Reference B.79)

A.2.48 Determine if passive gross shielded side/average ratio is within established limits

A.2.48.1 Description

The ratio of detector measurements from each side to their average are used to ensure that the detectors are functioning properly, are not working incorrectly, or are not detecting unintended nearby fissile materials. If the passive background counts on any side are statistically high, then there is a reasonable probability that the detectors are not functioning correctly or another waste container was left in too close a proximity to the container being assayed.

Violation of this rule is severity level 3.

A.2.48.2 Input

• passive gross shielded back counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.115)
• passive gross shielded door counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.116)
• passive gross shielded left counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.117)
• passive gross shielded right counts
  (SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.118)
• quality (lower) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.141)
• rescan (upper) limit
  (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.149)

A.2.48.3 Process

• compute average counts for left, right, door, back:
  \[ \sum \text{side} / 4 = \text{average counts} = \text{average} \]
• compute ratio of
  • passive gross shielded left / average
  • passive gross shielded right / average
  • passive gross shielded door / average
  • passive gross shielded back / average
• if abs( 1 – shielded left /average ) > lower limit
  write to short and long report:
  “(3) Detector passive gross shielded left count ratio delta “,
  passive gross shielded left counts, “has exceeded the quality limit (limit)”
  else
  write to long report: “Detector passive gross shielded left “,
  passive gross shielded left counts, “ count ratio delta < limit”

• if abs( 1 – shielded right /average ) > lower limit
  write to short and long report:
  “(3) Detector passive gross shielded right count ratio delta “,
  passive gross shielded right counts,
  “has exceeded the quality limit (limit)”
  else
  write to long report: “Detector passive gross shielded right “,
  passive gross shielded right counts, “ count ratio delta < limit”

• if abs( 1 – shielded door/average ) > lower limit
  write to short and long report:
  “(3) Detector passive gross shielded door count ratio delta “,
  passive background shielded door counts,
  “has exceeded the quality limit (limit)”
  else
  write to long report: “Detector passive gross shielded door “,
  passive gross shielded door counts, “ count ratio delta < limit”

• if abs( 1 – shielded back/average ) > lower limit
  write to short and long report:
  “(3) Detector passive gross shielded back count ratio delta “,
  passive gross shielded back counts,
  “has exceeded the quality limit (limit)”
  else
  write to long report: “Detector passive gross shielded back “,
  passive gross shielded back counts, “ count ratio delta < limit”

• if abs( 1 – shielded left /average ) > upper limit
  write to short and long report:
  “(3) Detector passive gross shielded left count ratio delta “,
  passive gross shielded left counts,
  “has exceeded the rescan limit (limit)”
  else
  write to long report: “Detector passive gross shielded left “,
  passive gross shielded left counts, “ count ratio delta < limit”

• if abs( 1 – shielded right /average ) > upper limit
  write to short and long report:
  “(3) Detector passive gross shielded right count ratio delta “,
  passive gross shielded right counts,
  “has exceeded the rescan limit (limit)”
  else
  write to long report: “Detector passive gross shielded right “,
  passive gross shielded right counts, “ count ratio delta < limit”
• if abs( 1 - shielded door/average ) > upper limit
  write to short and long report:
  “(3) Detector passive gross shielded door count ratio delta “,
  passive gross shielded door counts,
  “has exceeded the rescan limit (limit)”
else
  write to long report: “Detector passive gross shielded door “,
  passive gross shielded door counts, “ count ratio delta < limit”

• if abs( 1 - shielded back/average ) > upper limit
  write to short and long report:
  “(3) Detector passive gross shielded back count ratio delta “,
  passive gross shielded back counts,
  “has exceeded the rescan limit (limit)”
else
  write to long report: “Detector passive gross shielded back “,
  passive gross shielded back counts, “ count ratio delta < limit”

A.2.48.4 Output
• output message (Data Dictionary Reference B.79)

A.2.49  Validate Presence of Isotopes

A.2.49.1 Description
The current waste containers are anticipated to have the following isotopes: \(^{241}\)Am, \(^{238}\)Pu, \(^{239}\)Pu,
\(^{240}\)Pu, \(^{241}\)Pu. If the expert system does not confirm the presence of these isotopes, then human analysis is
required to determine its contents.

For later versions of SAS (\(\geq 3.1\)), SAS explicitly summarizes the isotopes detected in a section.

Violation of this rule is severity level 4.

A.2.49.2 Inputs
• SAS version
  (Data Dictionary Reference B.151)
• NUCLIDES_FOUND section of SAS
  (Data Dictionary Reference B.73)

A.2.49.3 Process
• if SAS version \(\geq 3.2\)
  read all entries in NUCLIDES_FOUND
  while (not END)
    read nuclide
    if nuclide \(\neq \) \(^{238}\)Pu | nuclide \(\neq \) \(^{239}\)Pu |
      nuclide \(\neq \) \(^{240}\)Pu | nuclide \(\neq \) \(^{241}\)Pu |
      nuclide \(\neq \) \(^{241}\)Am
      write to short and long report: “(4) Isotope: “, nuclide,
      “was not detected. “
    else
      write to long report: “Isotope: “, nuclide, “ detected.”
  endwhile
else
  write to short and long report “(1) incorrect version of SAS File used  Assay rejected.”

A.2.49.4 Output
  • output message (Data Dictionary Reference B.79)

A.2.50 Check net active shielded total rate relative standard deviation for value below defined maximum

A.2.50.1 Description
  If the specified SAS values are above the maximum value, the SAS assay is suspect.
  This is a passive rule. Violation of this rule is severity level 4.

A.2.50.2 Input
  • net active shielded total rate
    (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.69)
  • net active shielded total rate standard deviation
    (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.71)
  • upper limit
    (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.205)

A.2.50.3 Process
  • compute relative standard deviation = net active shielded total rate standard deviation / net active shielded total rate
  • if net active shielded total rate RSD > upper limit
    write to short and long report: “(4) net active shielded total rate relative standard deviation “, relative standard deviation, “ > max (limit)”
    else
      write to long report:
      net active shielded total rate relative standard deviation ≤ max, (limit)”

A.2.50.4 Output
  • output message (Data Dictionary Reference B.79)

A.2.51 Validate active matrix correction factor for proper value

A.2.51.1 Description
  If wrong constant values were used in SAS, then the mass computations would be invalid. Hence, validity checks of the constants will ensure the correctness of the transuranic mass computations.
  Violation of this rule is severity level 3.

A.2.51.2 Input
  • Active Matrix Correction Factor
    (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.13)
  • upper limit
    (SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.205)
A.2.51.3 Process

- if Active Matrix Correction Factor > upper limit
  write to short and long report:
  “(3) Index active matrix correction factor has exceeded the IDC dependent quality limit (limit)”
else
  write to long report:
  “Index active matrix correction factor is below the IDC dependent quality limit (limit)”

A.2.51.4 Output

- output message (Data Dictionary Reference B.79)

A.2.52 Determine if the JSR shift register gross accidental rates are within statistical limits

A.2.52.1 Description

The measured and calculated JSR accidental rates ought to internally consistent. Otherwise the results are dubious.

Violation of this rule is severity level 4.

A.2.52.2 Input

- JSR gross accidental rate
  (SAS requirement 3.1.3.5 M2; Data Dictionary Reference B.61)
- JSR gross accidental rate standard deviation
  (SAS requirement 3.1.3.5 M2; Data Dictionary Reference B.62)
- calculated JSR gross accidental rate
  (SAS requirement 3.1.3.5 M2; Data Dictionary Reference B.34)
- calculated JSR gross accidental rate standard deviation
  (SAS requirement 3.1.3.5 M2; Data Dictionary Reference B.35)

A.2.52.3 Process

- if (JSR gross accidental rate standard deviation ≤ 0 ) | (calculated JSR gross accidental rate standard deviation ≤ 0)
  write to short and long report:
  “(4) JSR gross accidental rate hypothesis test could not be performed.”

- compute s = sqrt[(gross accidental rate standard deviation)^2 + (calculated gross accidental rate standard deviation)^2 ]

- if [ abs[ gross accidental rate – calculated gross accidental rate ] > 3.3 sigma]
  write to short and long report:
  “(4) JSR gross accidental rate hypothesis test failed – values: gross accidental rate, calculated gross accidental rate, unc’s: “, gross accidental rate standard deviation, calculated gross accidental rate standard deviation
else
  write to long report: “JSR gross accidental rate hypothesis test succeeded”
A.2.52.4 Output
- output message *(Data Dictionary Reference B.79)*

**A.2.53 Check Barrel Flux Monitor Counts are Above Required Minimum**

**A.2.53.1 Description**
If the barrel flux monitor counts are below the accepted minimum, the assay should be sent to ETR for review.

Violation of this rule is severity level 3.

**A.2.53.2 Input**
- barrel flux monitor counts *(SAS requirement 3.1.3.4 M.7; Data Dictionary Reference B.32)*

**A.2.53.3 Process**
- if barrel flux monitor rate < IDC dependent limit
  - write to short and long report: 
    “(3) barrel flux monitor rate (“, barrel flux monitor rate, “) < min IDC dependent limit”
  - else
    - write to long report:
      “barrel flux monitor rate (“, barrel flux monitor rate, “) ≥ min IDC dependent limit”

**A.2.53.4 Output**
- output message *(Data Dictionary Reference B.79)*

**A.2.54 Validate System Totals Singles Rate**

**A.2.54.1 Description**
For debris waste, the net passive systems totals rate must be less than 20000 else the assay results are incorrect.

Violation of this rule is severity level 3.

**A.2.54.2 Inputs**
- net passive systems totals rate *(SAS requirement 3.1.4.3 M.36; Data Dictionary Reference B.72)*

**A.2.54.3 Process**
- if net passive systems totals rate > 20000 counts/sec 
  - write to short and long report “(3) Net passive systems totals rate > 20000”
  - else
    - write to long report “Net passive systems totals rate <= 20000”

**A.2.54.4 Output**
- output message *(Data Dictionary Reference B.79)*
Appendix B

Data Dictionary
Data Dictionary

B.1 absorber index
• Data Type - float
• Units – N/A
• Precision - ± .001
• Range – 0.00 – 99.0

B.2 active bias B0
• Data Type - float
• Units – N/A
• Precision – N/A
• Value – 0

B.3 active bias B0 uncertainty
• Data Type – float
• Units – N/A
• Precision – N/A
• Value - 0

B.4 active bias B1
• Data Type - float
• Units – N/A
• Precision – N/A
• Value – 1.55

B.5 active bias B1 uncertainty
• Data Type – float
• Units – N/A
• Precision – N/A
• Value - 0

B.6 active bias B2
• Data Type - float
• Units – N/A
• Precision – N/A
• Value – 0

B.7 active bias B2 uncertainty
• Data Type – float
• Units – N/A
• Precision – N/A
• Value - 0
B.8 **active bias covariance B0 B1**
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0

B.9 **active bias covariance B0 B2**
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0

B.10 **active bias covariance B1 B2**
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0

B.11 **active flag**
- Data Type - boolean
- Units – N/A
- Precision – N/A
- Value – [TRUE | FALSE ]

B.12 **active_rules**
- Data Type - boolean
- Units – N/A
- Precision – N/A
- Value – [TRUE | FALSE ]

B.13 **active matrix correction factor**
- Data Type - float
- Units - N/A
- Precision – N/A
- Value – 7.61844

B.14 **active MP A0**
- Data Type - float
- Units – N/A
- Precision – N/A
- Value - 0
B.15 active MP A1
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.4

B.16 active MP A2
- Data Type - float
- Units – N/A
- Precision – N/A
- Value - 0

B.17 active pulse count
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – [4000 | 16000]

B.18 active zero matrix calibration factor
- Data Type – float
- Units – N/A
- Precision – N/A
- Value – 5.46

B.19 active zero matrix calibration factor standard deviation
- Data Type – float
- Units – N/A
- Precision – N/A
- Value – 0.02

B.20 alpha activity
- Data Type - float
- Units - curies
- Precision - ±0.00001
- Range – 0.00000 – 0.99999

B.21 alpha activity relative standard deviation
- Data Type – float
- Units – curies
- Precision - ±0.00001
- Range - 0.00000 – 0.99999
B.22  *alpha activity standard deviation*
- Data Type - float
- Units - curies
- Precision - ±0.00001
- Range - – 0.00000 – 0.99999

B.23  *\(^{241}\text{Am}/^{239}\text{Pu mass ratio})*
- Data Type - float
- Units – N/A
- Precision - ±0.001
- Range – 0.0001 – 0.0100

B.24  *\(^{241}\text{Am}/^{239}\text{Pu mass ratio relative standard deviation})*
- Data Type – float
- Units – N/A
- Precision - ±0.0001
- Range - 0.0001 – 0.0010

B.25  *\(^{241}\text{Am}/^{239}\text{Pu mass ratio standard deviation})*
- Data Type – float
- Units – N/A
- Precision – ±0.001
- Range - 0.0001 – 0.0100

B.26  *\(^{241}\text{Am}/^{235}\text{U mass ratio})*
- Data Type – float
- Units – N/A
- Precision - ±0.01
- Range - 0.0100 – 0.100

B.27  *\(^{241}\text{Am}/^{238}\text{U mass ratio})*
- Data Type – float
- Units – N/A
- Precision - ±0.001
- Range – 0.00 – 0.99

B.28  *\(^{241}\text{Am}/^{238}\text{U mass ratio standard deviation})*
- Data Type – float
- Units – N/A
- Precision - ±0.0001
- Range – 0.0001 – 0.009
B.29 ²⁴¹Am line 125 keV error
- Data Type – float
- Units – N/A
- Precision – N/A
- Range - – 0.00 – 100.0

B.30 americium weighted average activity
- Data Type – float
- Units – net micro-Ci/g
- Precision - ±0.001
- Range - – 0.0000 – 0.0100

B.31 americium weighted average activity standard deviation
- Data Type – float
- Units – net micro-Ci/g
- Precision - ±0.001
- Range - – 0.0000 – 0.0100

B.32 barrel flux monitor counts
- Data Type - integer
- Units – counts
- Precision – N/A
- Range – 0 … 10000

B.33 batch file_name
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – {a..z|A..Z|0..9}³²

B.34 calculated gross accidental rate
- Data Type – float
- Units – counts /second
- Precision - ±0.0001
- Range – 0.0000 – 999.9999

B.35 calculated gross accidental rate standard deviation
- Data Type - float
- Units – counts / second
- Precision - ±0.0001
- Range - 0.0000 – 999.9999
B.36 chamber flux monitor counts
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – 6000 … 12000

B.37 content code
- Data Type - integer
- Units – N/A
- Precision – N/A
- Sludge Values – [ 1 | 2 | 7 | 800 | 803 | 807 ]
- Debris Values – [300|301|303|310|311|330|335|336|337|338|360|376|440|441|442|480|481]

B.38 $^{137}$Cs net micro-Ci/unit
- Data Type - float
- Units – micro Ci
- Precision – N/A
- Value – [.0000001 .. 10]

B.39 day
- Data Type - integer
- Units - day
- Precision – N/A
- Value – [ 1..31]

B.40 default $^{238}$Pu mass fraction
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.00015

B.41 default $^{238}$Pu mass fraction standard deviation
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 8e-05

B.42 default $^{239}$Pu mass fraction
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.9394
B.43 default $^{239}\text{Pu mass fraction standard deviation}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.0011

B.44 default $^{240}\text{Pu mass fraction}$
- Data Type – float
- Units – N/A
- Precision – N/A
- Value – 0.0587

B.45 default $^{240}\text{Pu mass fraction standard deviation}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0.0007

B.46 default $^{241}\text{Pu mass fraction}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.0014

B.47 default $^{241}\text{Pu mass fraction standard deviation}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.0006

B.48 default $^{242}\text{Pu mass fraction}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.00025

B.49 default $^{242}\text{Pu mass fraction standard deviation}$
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 5e-05
B.50  **duplicate file name**
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – {a..z|A..Z|0..9}

B.51  **early gate barrel flux monitor counts**
- Data Type - integer
- Units - counts
- Precision – N/A
- Range - 0 .. 5000

B.52  **early gate chamber flux monitor counts**
- Data Type - integer
- Units - counts
- Precision – N/A
- Range - 0 - 20000

B.53  **fissile gram equivalent**
- Data Type - float
- Units – gram
- Precision - ±0.00001
- Range – 0.00000 .. 9.99999

B.54  **fissile gram equivalent relative standard deviation**
- Data Type - float
- Units - grams
- Precision - ±0.00001
- Range - – 0.00000 .. 0.99999

B.55  **fissile gram equivalent standard deviation**
- Data Type - float
- Units - grams
- Precision - ±0.00001
- Range - – 0.00000 .. 0.99999

B.56  **gamma assay date**
- Data Type - char
- Units - date
- Precision – N/A
- Range - – 01 / 01 / 1960 .. 01 / 01 / 2050
B.57 gamma attenuation file name (SAS)
  - Data Type - character
  - Units – N/A
  - Precision – N/A
  - Value – \{a .. z | A .. Z | 0 .. 9 \}^{20}

B.58 gamma attenuation file name specified in matrix.lst
  - Data Type - character
  - Units – N/A
  - Precision – N/A
  - Value - \{a .. z | A .. Z | 0 .. 9 \}^{20}

B.59 gamma dead time
  - Data Type - float
  - Units – %
  - Precision – N/A
  - Value – 0.0 – 100.

B.60 gamma efficiency table value
  - Data Type - float
  - Units – N/A
  - Precision – N/A
  - Value – 0.0 – 100.0

B.61 gross accidental rate
  - Data Type float
  - Units – counts /second
  - Precision – ±0.00001
  - Range – 0.00000 .. 999.99999

B.62 gross accidental rate standard deviation
  - Data Type - float
  - Units – counts / second
  - Precision - ±0.00001
  - Range - 0.00000 .. 9.99999

B.63 late gate barrel flux monitor counts
  - Data Type - integer
  - Units - counts
  - Precision – N/A
  - Range – 0..100
B.64 late gate chamber flux monitor counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100

B.65 long gate 1 MHz clock
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100000

B.66 long gate system total
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..20000

B.67 moderator index
- Data Type - float
- Units – N/A
- Precision - ±0.01
- Range – 0.00 – 0.99

B.68 month
- Data Type - integer
- Units - month
- Precision – N/A
- Value – 0..12

B.69 net active shielded total rate
- Data Type - float
- Units – counts /second
- Precision - ±0.001
- Range – 0.00 .. 99.99

B.70 net active shielded total rate relative standard deviation
- Data Type - float
- Units – counts/second
- Precision - ±0.001
- Range - – 0.00 .. 9.99
B.71 net active shielded total rate standard deviation
- Data Type - float
- Units – counts/second
- Precision - ±0.001
- Range - 0.00 .. 9.99

B.72 net passive systems total rate
- Data Type - float
- Units – counts/second
- Precision - ±0.001
- Range - 0.00 .. 9.99

B.73 NUCLIDES_FOUND
- Data Type – char
- Units – N/A
- Precision – N/A
- Value – “NUCLIDES FOUND”

B.74 nuclide net micro-Ci/unit
- Data Type - float
- Units – micro Ci
- Precision – N/A
- Value – [.0000001 .. 10]

B.75 number background long gates
- Data Type – integer
- Units – N/A
- Precision – N/A
- Range – 0 .. 15000

B.76 number background short gates
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0 .. 15000

B.77 number long gates
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0 .. 15000
B.78 number short gates
  - Data Type - integer
  - Units – N/A
  - Precision – N/A
  - Value – 0 .. 15000

B.79 output message
  - Data Type - character
  - Units – N/A
  - Precision – N/A
  - Value – {a .. z| A .. Z | 0 .. 9 | # | , | : | % | + | - | / | * | > | < }^{40}

B.80 passive 1 kHz clock
  - Data Type - integer
  - Units – N/A
  - Precision – N/A
  - Range – 0 .. 100000

B.81 passive 10 kHz clock
  - Data Type - integer
  - Units – N/A
  - Precision – N/A
  - Range – 0 .. 100000

B.82 passive background 1 kHz clock
  - Data Type - integer
  - Units – N/A
  - Precision – N/A
  - Value – 0 .. 100000

B.83 passive background 10 kHz clock
  - Data Type - integer
  - Units – N/A
  - Precision – N/A
  - Value – 0 .. 100000

B.84 passive background bare back counts
  - Data Type - integer
  - Units – counts
  - Precision – N/A
  - Range – 0 .. 1000
B.85 passive background bare door counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.86 passive background bare left counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.87 passive background bare right counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.88 passive background flux monitor
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.89 passive background drum flux monitor
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.90 passive background long gate 1 MHz clock
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..10000000

B.91 passive background long gate system total
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000
B.92 passive background shielded back counts
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – 0..100

B.93 passive background shielded door counts
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – 0..100

B.94 passive background shielded left counts
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – 0..100

B.95 passive background shielded right counts
- Data Type – integer
- Units – counts
- Precision – N/A
- Range – 0..100

B.96 passive background shielded total counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0 .. 10000

B.97 passive background short gate 1 MHz clock
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0 .. 10000000

B.98 passive background short gate shielded total
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0 .. 10000
B.99 passive background system total counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..10000

B.100 passive bias B0
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0

B.101 passive bias B0 uncertainty
- Data Type – integer
- Units – N/A
- Precision – N/A
- Value - 0

B.102 passive bias B1
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0

B.103 passive bias B1 uncertainty
- Data Type – integer
- Units – N/A
- Precision – N/A
- Value - 0

B.104 passive bias B2
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0

B.105 passive bias B2 uncertainty
- Data Type – integer
- Units – N/A
- Precision – N/A
- Value - 0
B.106 passive bias covariance B0 B1
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value - 0

B.107 passive bias covariance B0 B2
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value - 0

B.108 passive bias covariance B1 B2
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value - 0

B.109 passive drum flux monitor
- Data Type - integer
- Units – N/A
- Precision – N/A
- Range – 0 .. 1000

B.110 passive flux monitor
- Data Type - integer
- Units – N/A
- Precision – N/A
- Range – 0 .. 1000

B.111 passive gross bare back counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.112 passive gross bare door counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000
B.113 passive gross bare left counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.114 passive gross bare right counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..1000

B.115 passive gross shielded back counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100

B.116 passive gross shielded door counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100

B.117 passive gross shielded left counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100

B.118 passive gross shielded right counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..100

B.119 passive mass estimate
- Data Type – float
- Units - gram
- Precision – N/A
- Range – 0.00 .. 5.00
B.120 passive mass estimate uncertainty
- Data Type - float
- Units – gram
- Precision – N/A
- Range – 0.00 .. 5.00

B.121 passive mode correction factor
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0.00 .. 1.00

B.122 passive MP A0
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value - 0

B.123 passive MP A1
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value – 0.4

B.124 passive MP A2
- Data Type - integer
- Units – N/A
- Precision – N/A
- Value - 0

B.125 passive shielded total counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0 .. 10000

B.126 passive system total counts
- Data Type - integer
- Units - counts
- Precision – N/A
- Range – 0..10000
B.127 $^{238}$Pu line 99 keV error
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0..100

B.128 $^{238}$Pu line 152 keV error
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0..100

B.129 $^{238}$Pu line 742 keV error
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0..100

B.130 $^{238}$Pu/$^{239}$Pu mass ratio
- Data Type - float
- Units – N/A
- Precision - $\pm 0.000000001$
- Range – 0.0 – 0.001

B.131 $^{238}$Pu/$^{239}$Pu mass ratio relative standard deviation
- Data Type - float
- Units – N/A
- Precision - $\pm 0.000000001$
- Range – 0.0 – 0.001

B.132 $^{238}$Pu/$^{239}$Pu mass ratio standard deviation
- Data Type - float
- Units – N/A
- Precision - $\pm 0.000000001$
- Range - 0.0 – 0.001
B.134  $^{239}$Pu line 413 keV error
- Data Type - float
- Units – N/A
- Precision – N/A
- Range – 0..100

B.135 $^{239}$Pu NUCLIDE FOUND flag
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – $^{239}$Pu

B.136 $^{240}$Pu/$^{239}$Pu mass ratio
- Data Type - float
- Units – N/A
- Precision - $\pm$0.0000001
- Range – 0.0 – 0.100000000

B.137 $^{240}$Pu/$^{239}$Pu mass ratio standard deviation
- Data Type - float
- Units – N/A
- Precision - $\pm$0.0000001
- Range - 0.0 – 0.100000000

B.138 $^{241}$Pu/$^{239}$Pu mass ratio
- Data Type - float
- Units – N/A
- Precision - $\pm$0.0000001
- Range - 0.0 – 0.100000000

B.139 $^{241}$Pu/$^{239}$Pu mass ratio standard deviation
- Data Type – float
- Units – N/A
- Precision – $\pm$0.0000001
- Range - 0.0 – 0.100000000

B.140 Pu mass assay type
- Data Type – char
- Units – N/A
- Precision – N/A
- Value - Pu
B.141 quality limit

- Data Type – float
- Units – N/A
- Precision - N/A
- Value – [0.2 | 0.4]

B.142 Rep $^{241}$Am mass

- Data Type – float
- Units – gram
- Precision – N/A
- Value - 0.0 – 1.0

B.143 Rep $^{241}$Am mass relative standard deviation

- Data Type - float
- Units – gram
- Precision - ±0.0000001
- Range – 0.0 – 0.100000

B.144 Rep $^{241}$Am mass standard deviation

- Data Type - float
- Units – gram
- Precision - ±0.0000001
- Range – 0.0 – 0.100000

B.145 Rep Pu mass

- Data Type – float
- Units – gram
- Precision - ±0.0001
- Range – 0.0 – 10.0

B.146 Rep Pu mass standard deviation

- Data Type - float
- Units – gram
- Precision - ±0.000001
- Range – 0.0 – 10.0

B.147 Rep $^{235}$U mass

- Data Type – float
- Units – gram
- Precision - ±0.00001
- Range – 0.0 – 10.0
B.148 Rep $^{235}$U mass standard deviation
- Data Type – float
- Units – gram
- Precision - ±0.00001
- Range - 0.0 – 10.0

B.149 rescan limit
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – [ 0.35 | 0.45 ]

B.150 SAS defined matrix.lst file name
- Data Type – character
- Units – N/A
- Precision – N/A
- Value – \{[a…z] + [a…z | 0 .. 9 ]\}^{32}

B.151 SAS Version
- Data Type – character
- Units – N/A
- Precision – N/A
- Value – ≥ 2

B.152 severity_level
- Data Type – integer
- Units – N/A
- Precision – N/A
- Value – [ 1 | 2 | 3 | 4 | 5 ]

B.153 shielded coincidence zero matrix calibration factor
- Data Type float
- Units – N/A
- Precision – N/A
- Value – 38.6

B.154 shielded coincidence zero matrix calibration factor standard deviation
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.6
<table>
<thead>
<tr>
<th>B.155</th>
<th>shielded detector efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - float</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Value – 0.0272</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.156</th>
<th>shielded detector efficiency standard deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - float</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Value – 0.0002</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.157</th>
<th>shift register accidental count</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - integer</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Range – 0..1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.158</th>
<th>shift register background accidental count</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - integer</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Range – 0 .. 1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.159</th>
<th>shift register background real + accidental count</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - integer</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Range – 0..1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.160</th>
<th>shift register background total count</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - integer</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Range – 0 .. 1000</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B.161</th>
<th>shift register real + accidental count</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Data Type - integer</td>
<td></td>
</tr>
<tr>
<td>• Units – N/A</td>
<td></td>
</tr>
<tr>
<td>• Precision – N/A</td>
<td></td>
</tr>
<tr>
<td>• Range – 0 .. 1000</td>
<td></td>
</tr>
</tbody>
</table>
B.162 shift register total count
- Data Type - integer
- Units – N/A
- Precision – N/A
- Range – 0..1000

B.163 short gate 1 MHz clock
- Data Type - integer
- Units – N/A
- Precision – N/A
- Range – 0..10000000

B.164 short gate shielded total
- Data Type - integer
- Units – N/A
- Precision – N/A
- Range – 0..1000

B.165 system coincidence zero matrix calibration factor
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 1.85

B.166 system coincidence zero matrix calibration factor standard deviation
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.01

B.167 system detector efficiency
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.113

B.168 system detector efficiency standard deviation
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.002
B.169 time_delta
- Data Type – float
- Units – seconds
- Precision – N/A
- Range – 0.0 .. 86400.0

B.170 time_T
- Data Type – float
- Units – seconds
- Precision – N/A
- Range – 0.0 .. 86400.0

B.171 total activity
- Data Type – float
- Units – micro curies
- Precision – N/A
- Range – 0.00000001 .. 30.0

B.172 TRU activity concentration
- Data Type - float
- Units - curies
- Precision - ±0.1
- Range – 0.0 – 9999.9

B.173 TRU activity concentration standard deviation
- Data Type - float
- Units - curies
- Precision - ±0.1
- Range – 0.0 – 9999.9

B.174 233U NUCLIDE FOUND flag
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – 233U

B.175 233U line 440 keV error
- Data Type - float
- Units – N/A
- Precision – N/A
- Value – 0.00..100.00
B.176 233U/239Pu mass ratio
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range – 0.0 – 0.1

B.177 233U/239Pu mass ratio standard deviation
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range - 0.0 – 0.1

B.178 233U/238U mass ratio
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range - 0.0 – 1.0000

B.179 233U/238U mass ratio relative standard deviation
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range - 0.0 – 0.1000

B.180 233U/238U mass ratio standard deviation
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range - 0.0 – 0.1000

B.181 235U/239Pu mass ratio
  • Data Type - float
  • Units – N/A
  • Precision - ±0.001
  • Range – 0.0 – 1.0000

B.182 235U/239Pu mass ratio relative standard deviation
  • Data Type – float
  • Units – N/A
  • Precision - ±0.001
  • Range - 0.0 – 0.1000
B.183 $^{235}\text{U}/^{239}\text{Pu}$ mass ratio standard deviation
- Data Type – float
- Units – N/A
- Precision - ±0.001
- Range - 0.0 – 0.10000

B.184 $^{235}\text{U}/^{238}\text{U}$ mass ratio
- Data Type - float
- Units – N/A
- Precision - ±0.0001
- Range – 0.0 – 0.10000

B.185 $^{235}\text{U}/^{238}\text{U}$ mass ratio standard deviation
- Data Type - float
- Units – N/A
- Precision - ±0.0001
- Range - 0.0 – 0.010000

B.186 $^{235}\text{U}$ NUCLIDE FOUND flag
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – $^{235}\text{U}$

B.187 $^{238}\text{U}/^{239}\text{Pu}$ mass ratio
- Data Type – float
- Units – N/A
- Precision - ±0.001
- Range - 0.0 – 1.0000

B.188 $^{238}\text{U}/^{239}\text{Pu}$ mass ratio relative standard deviation
- Data Type - float
- Units – N/A
- Precision - ±0.001
- Range - 0.0 – 0.10000

B.189 $^{238}\text{U}/^{239}\text{Pu}$ mass ratio standard deviation
- Data Type - float
- Units – N/A
- Precision - ±0.001
- Range - 0.0 – 0.10000
B.190 $^{238}$U NUCLIDE FOUND flag
- Data Type - char
- Units – N/A
- Precision – N/A
- Value – $^{238}$U

B.191 uranium correction factor
- Data Type - float
- Units – N/A
- Precision - ±0.001
- Range – 0.000 – 9.999

B.192 weapons grade $^{240}$Pu/$^{239}$Pu mass ratio 50% lower limit
- Data Type – float
- Units - gram
- Precision – N/A
- Value - 2.9e-02

B.193 weapons grade $^{240}$Pu/$^{239}$Pu mass ratio 50% upper limit
- Data Type – float
- Units - gram
- Precision – N/A
- Value - 8.7e-02

B.194 weapons grade $^{241}$Pu/$^{239}$Pu mass ratio 50% lower limit
- Data Type – float
- Units - gram
- Precision – N/A
- Value - 8.5e-04

B.195 weapons grade $^{241}$Pu/$^{239}$Pu mass ratio 50% upper limit
- Data Type – float
- Units - gram
- Precision – N/A
- Value - 2.55e-03

B.196 weight
- Data Type - float
- Units - kilograms
- Precision - ±0.1
- Range – 175.0 – 300.0
B.197 year  
- Data Type - integer  
- Units - year  
- Precision – N/A  
- Range – 1900 .. 2100

B.198 α-activity counting error  
- Data Type – float  
- Units – none  
- Precision – N/A  
- Range – range of float

B.199 FGE counting error  
- Data Type – float  
- Units – none  
- Precision – N/A  
- Range – range of float

B.200 JSR passive gross count time  
- Data Type – integer  
- Units – none  
- Precision – N/A  
- Range – 0 - maxint

B.201 Chamber flux rate  
- Data Type – float  
- Units – counts/sec  
- Precision – N/A  
- Range – range of float

B.202 Barrel flux monitor rate  
- Data Type – float  
- Units – count/sec  
- Precision – N/A  
- Range – range of float

B.203 Active pulse  
- Data Type – float  
- Units – count/sec  
- Precision – N/A  
- Range – range of float
B.204 MAX_BKG_AGE
- Data Type – float
- Units – none
- Precision – N/A
- Range – range of float

B.205 Upper limit
- Data Type – float
- Units – none
- Precision – N/A
- Range – range of float

B.206 IDC dependent limit
- Data Type – float
- Units – N/A
- Precision – N/A
- Value – \{a..z | A..Z | 0..9\}^{32}

B.207 Lower limit
- Data Type – float
- Units – none
- Precision – N/A
- Range – range of float

B.208 Limit
- Data Type – float
- Units – none
- Precision – N/A
- Range – range of float

B.209 $^{241}\text{Am}$ NUCLIDE FOUND flag
- Data Type – char
- Units – N/A
- Precision – N/A
- Range – $^{233}\text{U}$

B.210 $^{241}\text{Am}/^{235}\text{U}$ mass ratio relative standard deviation
- Data Type – float
- Units – N/A
- Precision – ±0.001
- Range – 0.0 – 0.10000