## ENGINEERING DATA TRANSMITTAL

2. To: (Receiving Organization) WRAP 1
3. From: (Originating Organization) WRAP 1
5. Proj./Prog./Dept./Div.: WO26/Solid Waste Construction
8. Originator Remarks: For release

### DATA TRANSMITTED

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<th>Sheet No.</th>
<th>Rev. No.</th>
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1. Project Manager
2. Project Engineer
3. Cognizant Engineer
4. Cognizant Manager

18. Signature of EDT Originator
19. Authorized Representative for Receiving Organization
20. Design Authority/Cognizant Manager
21. DOE APPROVAL (if required)

BD-7400-172-2 (05/96) GEF097

BD-7400-172-1 (07/91)
W-026, Acceptance Test Report
Gamma Energy Assay (GEA) System A
(Submittal # 39.8) C3

TL Watson
Westinghouse Hanford, Richland, WA 99352
U.S. Department of Energy Contract DE-AC06-87RL10930

EDT/ECN: EDT-14/144
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Key Words: GEA, ATR, PLC, Source, Transmission, Counter, Shield, Detector, Collimator, Analysis, Sample, Background, Menu, Absorber, Energy, Efficiency

Abstract: Acceptance testing of the Gamma Energy Assay (GEA) systems was conducted during the period June-August, 1996. Testing was conducted for all modes of operation, and the systems were verified as having met all requirements of the design specification. This document contains a report of the testing, along with comments to indicate temporary findings and their resolutions.

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Approved for Public Release

A-6400-073 (10/95) GEF321
ACCEPTANCE TEST PROCEDURE
FOR
SITE TESTING OF
WRAP GEA SYSTEM

Document Number: GEAATP_B
Revision: B
Date of this revision: 30-May-96

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Revision History

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<td>Initial release</td>
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<tr>
<td>Rev. B</td>
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1. Introduction

1.1 Description of Test Procedure

This test procedure is designed to test all of the functions of the GEA system at the WRAP facility at Hanford, Washington. The procedure is designed to be executed in the sequence given, starting with:

- verification of components and labeling
- verification or entry of all of the setup parameters
- performing the calibrations (energy, efficiency, transmission, and reference peak)
- performing the measurements in local mode
- performing the measurements in remote mode
- confirming the message formats
- utility operations (LN2 fill, archiving, password maintenance)

The system is designed to be operated in a remote mode in which all commands are received over a network, and the results are returned over the same network. A manual mode is provided for the setup and calibration operations, and for maintenance functions.

The system is designed to start up in remote mode. The user can go to local mode when at the keyboard by selecting Exit on the screen shown during remote mode. A user logon screen, requiring a username and password, limits access to local mode.

1.2 Relevant Documents

The primary reference document for this test procedure is the Detailed Software Design Specification. All of the material covered here has been described in that document. It is number 11 in the list below. Other contract documents are also listed.

Note that the description of the general purpose Genie PC Waste Assay Software (GWAS) software is given in references 12 and 13, the GWAS User Manual and the GWAS Technical Reference Manual. Although these are not yet in final form, they are complete enough to serve as guides to using the system.


4) "GEA System Design Description," Canberra Industries, version 1.1, 6-Jan-95.


6) WHC-EP-0063, as duplicated in specification 13026, Table 1.


2. Inspection of Components and Labeling

Inspection of components and labeling is to be done with reference to drawings of the system. These drawings are supplied separately. The inspection of components and labeling has been done previously by Canberra for Pajarito Scientific Co., so it is suggested that only selected miscellaneous components and labels be checked.

Mechanical System

- Locate the following drawing number and sheets in Appendix A.2. of the WRAP GEA System KEH 5369 Installation and Maintenance Manual. (Referred to hereafter as I&M.)

<table>
<thead>
<tr>
<th>Drawing number</th>
<th>Sheet number</th>
<th>Title</th>
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<tbody>
<tr>
<td>94104</td>
<td>1</td>
<td>GEA Shield. Top level assembly.</td>
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<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Examine the system to see that it is anchored properly.
- Confirm that the detectors are in place, that the signals and HV are connected, and have the LN2 fill lines connected.
- Confirm that all junction boxes are closed and secured.
- Confirm that the overtravel tape switches are in place.
- Ensure that there is access to all junction boxes.
- Confirm that the access door to the transmission sources is locked.

Go to the PC for the GEA system and turn on power.

- After the system has booted up, open an OS/2 window and enter the commands:
The program will respond with:
PLC COM port assumed to be COM1.
PLC baud rate assumed to be 19200.
Asynchronous communications mode has been set.

Enter the number of your selection:
1. Read a PLC register
2. Write a PLC register
3. Send a PLC command
4. Get PLC status
5. Clear PLC error
X. Exit utility

This program is a general purpose routine. We will use only the sections for writing a value into a PLC register and sending commands to the PLC.

**Loading a 55-gallon drum**
- Select 2 for writing into a PLC register, then enter a 1 into register R19. (This is for container type 1, the 55 gallon drum.) A series of menus prompt for the input required:
  - Select register: R
  - Enter number: 19
  - Length of message: 1 (word)
  - Data format: D (decimal)

- Return to the main menu.
- Place a 55-gallon drum on the in-feed conveyor.

- Enter a 3 for sending a command to the PLC.

The program will then prompt for primary or secondary commands. There are no secondary commands for the GEA system. We will use only the primary counter commands.

- Select the menu item for counter commands.

The counter commands will be listed:

```
LOAD_I = 20  (container type no. in R19)
LOAD_II = 21
```
WRAP GEA Site Acceptance Test Procedure

<table>
<thead>
<tr>
<th>Command</th>
<th>Value</th>
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<tbody>
<tr>
<td>UNLOAD_I</td>
<td>22</td>
</tr>
<tr>
<td>UNLOAD_II</td>
<td>23</td>
</tr>
<tr>
<td>OPEN_TRANSMISSION_SHUTTER</td>
<td>24</td>
</tr>
<tr>
<td>CLOSE_TRANSMISSION_SHUTTER</td>
<td>25</td>
</tr>
<tr>
<td>SET_TRANSMISSION_POSITION</td>
<td>26    (N/A)</td>
</tr>
<tr>
<td>MOVE</td>
<td>27    (scanning position in R11, R12)</td>
</tr>
<tr>
<td>SET_GEOMETRY</td>
<td>28    (det./coll. position in R19)</td>
</tr>
<tr>
<td>POSITION_ADD_A_SOURCE</td>
<td>29    (N/A)</td>
</tr>
<tr>
<td>PREPARE_FOR_BACKGROUND</td>
<td>30</td>
</tr>
<tr>
<td>READ_WEIGHT</td>
<td>31    (N/A)</td>
</tr>
<tr>
<td>READ_DOSIMETER</td>
<td>32    (N/A)</td>
</tr>
<tr>
<td>READ_GEOMETRY</td>
<td>33    (returns geo. no. in R19)</td>
</tr>
<tr>
<td>TRANSPORT</td>
<td>34    (N/A)</td>
</tr>
<tr>
<td>PREPARE_FOR_MEASUREMENT</td>
<td>35    (container type no. in R19)</td>
</tr>
</tbody>
</table>

- Enter 20 for "LOAD_I" which is load phase 1.
- Note that the conveyors turn on and the drum is moved into the station.
- Enter 21 for "LOAD_II" which is load phase 2.
- Note that the door closes. The turntable will start rotating, as indicated by the yellow light on the light stack remaining on after the door is closed.

Transmission Source Motion

- Enter 24 for opening the transmission shutter (actually it is moving the transmission sources up into position).
- Note that there is a sound of the sources being moved into position.
- Enter 25 for closing the transmission shutter (moving the sources down).
- Note that there is a sound of the sources moving down.
Unload Phase I and Absorber

- Enter 22 for “UNLOAD_I” for unload phase 1.
- The turntable will stop rotating, and the door will open.
- Enter 28 for setting geometry (the absorber position).
- Note that the absorber moves into place.

Platform Position

- Return to the main menu and select option 2 for writing a PLC register.
- Enter 200 into register R11. (The value is mm above “load” position. 0 = load position)
- Return to the main menu and select 3 for sending a PLC command.
- Select the primary counter commands.
- Enter a 27 for move scanning position.
- Note that the platform moves.
- Return to the main menu and select option 2 for writing a PLC register.
- Enter 0 into register R11. (The value is mm above “load” position. 0 = load position)
- Return to the main menu and select 3 for sending a PLC command.
- Select the primary counter commands.
- Enter a 27 for move scanning position.
- Note that the platform moves back to original position.
Return to the main menu and select 3 for sending a PLC command.

Select the primary counter commands.

Enter a 23 for unload phase 2.

Note that the conveyors turn on and the drum is unloaded.

When finished, exit the program and exit the OS/2 window.

---

Electrical and Electronics Assembly

Locate the following drawings and sheet numbers in the I & M Manual.

<table>
<thead>
<tr>
<th>Drawing number</th>
<th>Sheet number</th>
<th>Title</th>
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<tr>
<td>94114</td>
<td>1</td>
<td>System block diagram</td>
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<tr>
<td>94115</td>
<td>1</td>
<td>Power distribution</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Safety interlocks</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Position and safety device inputs</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>PLC inputs</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>PLC outputs</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>LN2 autofill components</td>
</tr>
</tbody>
</table>
For each of the drawings, locate a representative terminal strip or junction box tie point or motor connection on the drawing, then on the equipment.

- Confirm that the labeling is adequate to locate the item selected.
3. Definitions for Counter / Arrangement / Group

It is important to understand the concepts of counters, arrangements and groups, as used in GWAS. The relationship of these to count types and analysis sequence files is also important to know.

Here are the definitions:

**counter**
The physical configuration of shield, detectors, collimators, transmission sources, and electronics.

**arrangement**
A specific position of detectors, collimators, or movable platforms in the counter.

**detector group, or group**
The actual detectors used. The full counter may consist of several different detector groups.

**count type**
A particular counting operation, like sample counting, calibration check, or background.

**analysis sequence file**
The prescription for the data analysis to be performed on a particular detector group.

The hierarchy is the following:

Counter

```
  Arrangement ---- count type

  Detector group ---- analysis sequence file
```

When creating a counter and defining the arrangement, default count types are created for you by the software.

Similarly, when creating the detector groups, default analysis sequence files are defined.

The menu sequence is arranged in the following way:
Since the detector group's analysis functions will depend upon the count type, the count type must be selected before setting up any of the detector group and analysis.

At the counter level, the user must specify if there is scanning, movable collimators, transmission sources, or multi-spectrum storage (MSS) modules for data as a function of angle. Also, the instrument interface must be specified as PLC. The PLC is for controlling platform movement, collimators, and transmission shutter.

At the arrangement level, for scanning systems, the segment definition must be provided.

The count type screen allows definition of:
- container type
- preset time
- whether manual load/unload or not
- barcode reader or not

(enabling/disabling of MSS and scanning is also provided)

The detector group definition consists of:
- segmented or not (to be used with scanning system)
- the actual detectors

The analysis definition consists of defining the analysis sequence files to be used in the standard and batch analyses.

GEA Definitions

The GEA counter definition includes two arrangements, with two count types each, and three detector groups. (Additional count times are also provided in the standard software for background measurement, background check, and calibration check.) In summary these are:
The counter has:
- two arrangements:
  1) 55-gallon drum segment definitions for the PLC
  2) 85-gallon drum segment definitions for the PLC

Each arrangement has the three detector groups and two count types:
- detector groups
  1) Lower LEGE detector
  2) Upper LEGE detector
  3) Four scanning coax (SEGE) detectors
- count types
  1) \( \leq 250 \) pound drums
  2) > 250 pounds drums

Note: By default the GWAS system defines four count types:
  Sample
  Background check
  Calibration check
  Environmental background

The "sample" count type has been defined as \( \leq 250 \) pound drums, and
a new count type has been added for > 250 pounds.

Note: In the GWAS software, "collimator" specifications are used to set
up the attenuator positions of "attenuated" and "not attenuated." These
can also be referred to as "absorber in position" or "absorber out."

The number of collimator positions is set up in the arrangement editor,
and the use of automatic selection of collimator position is selected in the
count type editor.

Detector Groups
In the GWAS software, if a detector group has more than one detector, the
spectra are summed and analyzed. If the group is "non-segmented," then the
individual detector spectra are not saved or analyzed. There can only be one
segmented detector group in the GWAS software.

The four SEGE detectors are defined as a segmented, scanning group.
Individual segment spectra are saved and analyzed, as well as the sum of the
spectra. (The spectra from different detectors are shifted to the same energy
calibration before being summed.)

Each LEGE detector is defined as a single-detector group.
Preset count time
This time is based upon the weight of the drum. The preset count time is contained in the count types defined for each arrangement, and these are for drums of less than or equal to 250 pounds, and more than 250 pounds.

Pre-Count
The pre-count option is used to select one of the two absorber (collimator) positions. The selection is based on the dead time in the detector selected in a setup screen. (The count time and limiting dead time to switch between absorbers is also entered in the setup screen.)
4. Verify Setup and Parameters: GWAS Functions

These functions are performed in local mode.

- The system should be powered on. It will automatically start in the automatic mode.
- Select Exit on the screen shown for automatic counting (remote mode).
- On the login screen, enter "manager" for the username, and nothing for the password.
- The main menu will now appear.

4.1 Setup of Units and Data Location

- On the main menu select Utility Operations.
- On the Utility Operations menu select Genie PC WAS Setup.
- On the next screen select disk C: and enter directory WAS_DATA for the data archive directory.
- Select units as follows (Choose set desired - used in Container Parameters):
  
  Length: cm in
  Weight: Kg lbs.
  Volume: liters (l) gal.

- Do not check matching container type under background.

4.2 Container Type Setup

- Return to the main menu by pressing the Escape key or the Prev button on the screen.
- On the main menu select Utility Operations, then Editors.
- On this menu, select Container Type Editor.
If more than one container has been defined, select one of the definitions.

On the next screen, confirm that the following data has been entered:
Note: Empty container weight of zero is used since SIE computer supplies net weight, and GWAS automatically subtracts empty weight.

**Standard 55 gallon drum**
- Type: 55-gal. drum
- Material handling type: 1
- Diameter: 61.0 cm 22.5 in.
- Geometric correction factor: 0.823
- Volume: 208 liters 55 gal.
- Empty weight: 0 Kg 0 lbs.

**85 gallon overpack**
- Type: 85-gal. overpack
- Material handling type: 0
- Diameter: 63.5 cm 26 in.
- Geometric correction factor: 0.823
- Volume: 322 liters 85 gal.
- Empty weight: 0 Kg 0 pounds

4.3 Counter / Arrangement / Group Setup

4.3.1 Counter definition

- On the main menu, select Utility Operations, then Counter Maintenance.
- The next screen (the Counter Maintenance screen) will show the existing counter definitions. (In the discussion below, if the data or items do not exist, then create them to match the information provided.)
- There is only one counter defined. Select Edit. The Counter Parameter Edit screen will appear.
- The description should be "GEA" or the like.
4.3.2 Arrangement Setup

- Return to the Counter Maintenance screen and select Arrangements.
- The Arrangement Operations screen will appear, listing two arrangements, “55 gal. drum” and “85 gal. overpack.”
- Select 55 gallon drum, then Edit.
- On the Edit Arrangement Parameters screen, the description should be “55 gal. drums.”
- Start position should be 178 mm (7.01”)
- Position delta should be -89 mm (3.50”)
- Number of positions should be 3.
- Separated segments? should not be checked.
- For number of segments should be 11.
- Segment offset should be 1.
- For number of collimator positions, enter 2.
4.3.3 Count Type Setup

- Return to the Arrangement Operations screen.
- Select 55 gallon drums.
- Select count type. The Count Type Operations screen will appear.
- Select the count type “<= 250 pound drums”, then Edit.
- Set the description to <= 250 pound drums
- Check the box for default count type in automatic operations.
- Under the sample information section,
  - Set the information type to “Sample”
  - “Use sample database?” should not be checked.
  - Container type should be “55 gallon drum.”
- Under the preset time section,
  - Set preset time with transmission to 30 seconds.
  - Set preset time without transmission to 110 seconds.
  - Set transmission selection to “Two-pass”
  - Set collimator position to 0 (it will be automatically set to the position needed.)
  - “Auto collimation?” should be checked.
  - “MSS enabled?” should be checked.
  - “Scanning enabled?” should be checked.
  - “Barcode reader?” should not be checked.
  - “Disable load/unload?” should not be checked.
Return to the Count Type Operations screen.
Select "> 250 pound drums", then Edit.
Set the parameters all the same as for the <= 250 pound drums, except for the preset times, which should be:
- 50 seconds for with transmission
- 190 seconds for without transmission

Return to the Arrangement Operations screen.
Select 85 gallon drums.
Select count type.
Select the count type "<= 250 pound drums" then Edit.
Set the description to <= 250 pound drums
Check the box for default count type in automatic operations.
Under the sample information section,
- Set the information type to "Sample"
- "Use sample database?" should be not checked.
- Container type should be "85 gal. overpack"
Under the preset time section,
- Set preset time with transmission to 30 seconds.
- Set preset time without transmission to 110 seconds.
- Set transmission selection to "Two-pass"
- Set collimator position to 0 (it will be automatically set to the position needed.)
- "Auto collimation?" should be checked.
- "MSS enabled?" should be checked.
- "Scanning enabled?" should be checked.
- "Barcode reader?" should not be checked.
- "Disable load/unload?" should not be checked.

Return to the Edit Count Type Parameters screen (with 85 gallon overpacks)
Select "> 250 pound drums", then Edit.
WRAP GEA Site Acceptance Test Procedure

- Set the parameters all the same as for the <= 250 pound drums, except for the preset times, which should be:
  - 50 seconds for with transmission
  - 190 seconds for without transmission

4.3.4 Group (Detector Group) Setup

**LEGE Detectors, 55-gallon drum arrangement**

- Return to the Arrangement Operations screen and highlight 55-gal drums, then select Groups. The Detector Group Operations screen will be displayed.
- There should be three groups listed:
  - Upper LEGE
  - Lower LEGE
  - SEGEs
- Highlight "Upper LEGE" then Edit.
- There should be a single detector listed: DET:LEGE5
- The "Segmented?" box should not be checked.

- Return to the Detector Group Operations screen, highlight "Upper Lege" and select Analysis.
- On the next screen (Analysis Setup Operations) highlight the count type "<= 250 pound drums" and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report check box should be checked.
- The analysis sequence file selected should be MGA.ASF.
- Processing information should be set to Normal, and View report not checked.
- Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report check box should be checked.
- The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>C. E. W. A</td>
<td>6/13/96</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Return to the Detector Group Operations screen and select the “Lower LEGE”, then Edit.
- There should be a single detector listed: DET:LEGGE6
- The “Segmented?” box should not be checked.

<table>
<thead>
<tr>
<th>Verified</th>
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</tr>
</thead>
<tbody>
<tr>
<td>C. E. W. A</td>
<td>6/13/96</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

• Return to the Detector Group Operations screen, highlight “Lower LEGE” and select Analysis.
• On the next screen (Analysis Setup Operations) highlight the count type “<= 250 pound drums” and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.
• Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>C. E. W. A</td>
<td>6/13/96</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LeGe Detectors, 85-gallon drum arrangement**

- Return to the Arrangement Operations screen and highlight 85-gal drums, then select Groups. The Detector Group Operations screen will be displayed.
- There should be three groups listed:
Upper LEGE
Lower LEGE
SEGEs

- Highlight “Upper LEGE” then Edit.
- There should be a single detector listed: DET: LEGE5
- The “Segmented?” box should not be checked.

Return to the Detector Group Operations screen, highlight “Upper LEGE” and select Analysis.

On the next screen (Analysis Setup Operations) highlight the count type “<= 250 pound drums” and select Edit.

On the next screen (Edit Analysis Parameters) the Group Analysis/Report check boxes should be checked.

The analysis sequence file selected should be MGA.ASF.

Processing information should be set to Normal, and View report not checked.

Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.

On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.

The analysis sequence file selected should be MGA.ASF.

Processing information should be set to Normal, and View report not checked.

Return to the Detector Group Operations screen and select the “Lower LEGE”.

There should be a single detector listed: DET: LEGE6

The “Segmented?” box should not be checked.

Return to the Detector Group Operations screen, highlight “Lower LEGE” and select Analysis.
WRAP GEA Site Acceptance Test Procedure

- On the next screen (Analysis Setup Operations) highlight the count type "\( \leq 250 \) pound drums" and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.
- The analysis sequence file selected should be MGA.ASF.
- Processing information should be set to Normal, and View report not checked.
- Return to the previous screen (Analysis Setup Operations), highlight \( > 250 \) pound drums, and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.
- The analysis sequence file selected should be MGA.ASF.
- Processing information should be set to Normal, and View report not checked.

SEGE Detectors. 55-gal. Arrangement

- Return to the menu for Arrangement Operations, highlight 55-gal. Drums, and select Groups.
- On the next menu select "SEGEs" and press Edit.
- The detectors listed should be:
  - DET: SEGE4
  - DET: SEGE3
  - DET: SEGE2
  - DET: SEGE1
- The "Segmented?" box should be checked.

- Return to the Detector Group Operations screen and select Analysis.
- On the next screen (Analysis Setup Operations) highlight the count type "\( \leq 250 \) pound drums" and select Edit.
- On the next screen (Edit Analysis Parameters) the setup should be:
  - Enable and select ASF file for non-transmission segment:
    - SEGTRCOR.ASF
Enable and select ASF file for transmission segment: SEGTRANS.ASF
- Enable Combine non-segmented groups: COMBMGA.ASF
- Enable Analyze shift-summed segments: SEGSUM.ASF
- Enable Merge segment NID results: COMBSEG.ASF
- Enable Combine segment shift-summed with NID results: COMBNID.ASF
- Enable Combine all results: COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

---

Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.

On the next screen (Edit Analysis Parameters) the setup should be:
- Enable and select ASF file for non-transmission segment: SEGTRCOR.ASF
- Enable and select ASF file for transmission segment: SEGTRANS.ASF
- Enable Combine non-segmented groups: COMBMGA.ASF
- Enable Analyze shift-summed segments: SEGSUM.ASF
- Enable Merge segment NID results: COMBSEG.ASF
- Enable Combine segment shift-summed with NID results: COMBNID.ASF
- Enable Combine all results: COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

---

SEGE Detectors, 85-gal. Arrangement

- Return to the menu for Arrangement Operations, highlight 85-gal. Overpacks, and select Groups.
- On the next menu highlight “SEGEs” and select Edit.
The detectors listed should be:
- DET: SEGE4
- DET: SEGE3
- DET: SEGE2
- DET: SEGE1

The "Segmented?" box should be checked.

Return to the Detector Group Operations screen and select Analysis.
On the next screen (Analysis Setup Operations) highlight the count type "<= 250 pound drums" and select Edit.
On the next screen (Edit Analysis Parameters) the setup should be:
- Enable and select ASF file for non-transmission segment: SEGTRCOR.ASF
- Enable and select ASF file for transmission segment: SEGTRANS.ASF
- Enable Combine non-segmented groups: COMBMGA.ASF
- Enable Analyze shift-summed segments: SEGSUM.ASF
- Enable Merge segment NID results: COMBSEG.ASF
- Enable Combine segment shift-summed with NID results: COMBSEG.ASF
- Enable Combine all results: COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
On the next screen (Edit Analysis Parameters) the setup should be:
- Enable and select ASF file for non-transmission segment: SEGTRCOR.ASF
- Enable and select ASF file for transmission segment: SEGTRANS.ASF
- Enable Combine non-segmented groups: COMBMGA.ASF
- Enable Analyze shift-summed segments: SEGSUM.ASF
- Enable Merge segment NID results: COMBSEG.ASF
- Enable Combine all results: COMBALL.ASF
- Enable Combine segment shift-summed with NID results: COMBNID.ASF
- Enable Combine all results: COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

### 4.4 MID Setup

- On the main menu select Utility Operations, then Editors.

- On the Editors menu select MID Editor.

- When the editor screen is displayed, select Database, then Unload from. A file name will appear (such as WRAP2). Highlight it, then select Unload.

- Select File, then Open. A new window will appear. Select the name shown (such as WRAP2), then Open.

- The screen will then display all of the detectors (one line per detector) and their electronics units, with AIM in the left column, under MCA, DET01, etc. under Input. The size value will be 4096 for each line, and there will be numbers and letters under the ADC, Amp, and HV labels.

- Highlight the first line, then select Settings, then MCA to get the AIM address.

- Repeat for lines 3 and 5 to get the other AIM addresses.

- Highlight the first line again, select Settings, then select ADC and note the ICB address.

- Return to Settings, then select Amplifier and note its address.

- Repeat to Settings, then select High voltage.

- Repeat for the next 5 lines, getting the other detector information.

Confirm that the address numbers match those in the table below.
Detector # | Description | HVPS | Amp | ADC | ICB | Aim address
---|---|---|---|---|---|---
5 | LEGE5 | 5 | 3 | 2 | #3 | 079E
6 | LEGE6 | 4 | 1 | 0 | | |
1 | SEGE1 | 5 | 3 | 2 | #1 | 07A1
2 | SEGE2 | 4 | 1 | 0 | | |
3 | SEGE3 | 5 | 3 | 2 | #2 | 0799
4 | SEGE4 | 4 | 1 | 0 | | |

HV values, amplifier gains, and ADC parameters have already been set up for proper operation.

(The DMSS setup parameters are performed in a separate menu.)

- Now reload the MID file by first selecting Database, then Load.
- On the load file selection screen, select the name examined, then Load.
- Exit with File, then Exit.

4.5 DMSS Setup

- On the main menu select Utility Operations, then Editors.
- On the Editors menu select DMSS Setup Parameter Editor.
- On the next screen choose the 55-gal. drums.
- The next screen will be for detector selection, after which a screen allows input of the DMSS parameters for that detector. Use these two screens to set up all of the following parameters.

**MSS values:**
- ICB Address
- Input number
- check box (MSS first in memory)

<table>
<thead>
<tr>
<th>Detector</th>
<th>SEGE1</th>
<th>SEGE2</th>
<th>SEGE3</th>
<th>SEGE4</th>
</tr>
</thead>
<tbody>
<tr>
<td>ICB Address</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Input number</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>check box</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
<td>yes</td>
</tr>
</tbody>
</table>
- Total memory 32678 32678 32678 32678
- ADC conversion gain 4096 4096 4096 4096
- Number of MSS groups 8 8 8 8
- Dwell time (microsec) 0.72 0.72 0.72 0.72

- Repeat the review of DMSS setup for the 85 gal. Container. (It should be identical.)

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EULA 6/19/96</td>
<td>6/19/96</td>
</tr>
</tbody>
</table>

4.6 Certificate Files

4.6.1 Energy and efficiency calibration certificate files

- On the main menu select Utility Operations.
- On the next menu select Editors.
- On the screen select Certificate Editor.
- On the certificate file editor screen, select File, then Open, and confirm that there are certificate files such as: EU-AM-CS.CTF

These certificate files will be used in energy and efficiency calibration.

<table>
<thead>
<tr>
<th>Verified</th>
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</tr>
</thead>
<tbody>
<tr>
<td>EULA 6/15/96</td>
<td>6/19/96</td>
</tr>
</tbody>
</table>

4.6.2 Transmission source certificate file

- On the main menu select Utility Operations.
- On the next menu select Editors.
- On the next menu select Transmission Source Certificate Editor
- On the next menu select Eu-152, then Edit.
On the next screen confirm or edit the data as follows:

<table>
<thead>
<tr>
<th>Nuclide Name</th>
<th>Peak Energy</th>
<th>Half-Life (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eu-152</td>
<td>121.8</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>244.69</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>344.5</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>778.9</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>964.1</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1112.1</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1408.0</td>
<td>4.19E8</td>
</tr>
</tbody>
</table>

4.7 Nuclide Library

- On the main menu select Utility Operations, the Editors, then Nuclide Library Editor.

- Open the file WRAP_GEA.NLB.

- Confirm that the nuclide names and energy lines correspond to those shown on the following library list report. (A similar report can be obtained by selecting Report in the File drop-down menu in the library editor.)
On the main menu select Utility Operations, then Editors, then Mass Attenuation Coefficients Editor.

- Open file for Lucite.
- On the next screen confirm or edit the data to that below:

These values are:

<table>
<thead>
<tr>
<th>Energy (keV)</th>
<th>Mass Absorption Coefficient (for lucite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40</td>
<td>.234</td>
</tr>
<tr>
<td>50</td>
<td>.208</td>
</tr>
<tr>
<td>60</td>
<td>.193</td>
</tr>
<tr>
<td>80</td>
<td>.176</td>
</tr>
<tr>
<td>100</td>
<td>.164</td>
</tr>
<tr>
<td>150</td>
<td>.146</td>
</tr>
<tr>
<td>200</td>
<td>.133</td>
</tr>
<tr>
<td>300</td>
<td>.115</td>
</tr>
<tr>
<td>400</td>
<td>.103</td>
</tr>
<tr>
<td>500</td>
<td>.0941</td>
</tr>
<tr>
<td>600</td>
<td>.0871</td>
</tr>
<tr>
<td>800</td>
<td>.0765</td>
</tr>
<tr>
<td>1000</td>
<td>.0687</td>
</tr>
<tr>
<td>1500</td>
<td>.0559</td>
</tr>
<tr>
<td>2000</td>
<td>.0480</td>
</tr>
</tbody>
</table>

The degree of fit is 4.

4.9 Analysis Sequence Files

- On the main menu select Utility Operations, then Editors, then Analysis Sequence Editor.

- Select File, then Open, then confirm that the following files exist:
  - MGA.ASF
  - SEGTRCOR.ASF
  - SEGTRANS.ASF
  - COMBMGA.ASF
  - SEGSUM.ASF
  - COMBSEG.ASF
  - COMBNID.ASF
  - COMBALL.ASF

Confirm that the files are set up with the following steps and parameters by highlighting each step in turn, and using the Setup Algorithm button to see the parameters.
MGA.ASF

Unidentified peak search
  Ch. 50 - 4096
  5.00 significance level
  1.5 keV tolerance
Peak area
  Ch. 50 - 4096
  fixed tail, reject zero area peaks
  4 channel continuum
  step function
  4 ch. ROI limits
MGA
  Only the "Ignore fatal MGA errors" box should be checked.

SEGTRCOR.ASF

Unidentified peak search
  Ch. 50 - 4096
  5.00 significance level
  1.5 keV tolerance
Peak area
  Ch. 50 - 4096
  fixed tail, reject zero area peaks
  4 channel continuum
  step function
  4 ch. ROI limits
Reference peak correction (New algorithm)
  1.5 keV tolerance
Efficiency correction
  Dual
Attenuation correction
  Min. Trans. 0.5 %
  Transmission error limit 50%
  Mass attenuation: C:\WAS\CALIB\LUCITE.MAC
NID with interference
  Ch. 50 - 4096
  Library C:\WAS\LIB\WRAP_GEA.NLB
  1.5 keV tolerance
  0.3 confidence threshold
  5.00 MDA confidence factor
MDA
  5 % confidence factor
SEGTRANS.ASF

Unidentified peak search
   Ch. 50 - 4096
   5.00 significance level
   1.5 keV tolerance

Peak area
   Ch. 50 - 4096
   fixed tail
   4 channel continuum
   step function
   4 ch. ROI limits

Reference peak correction (New algorithm)
   1.5 keV tolerance

COMBMGA.ASF

MGA averager
   Pu-239 normalization nuclide
      "ok" to error message, then cancel

SEGSUM.ASF

Unidentified peak search
   Ch. 50 - 4096
   5.00 significance level
   1.5 keV tolerance

Peak area
   Ch. 50 - 4096
   fixed tail
   4 channel continuum
   step function
   4 ch. ROI limits

Reference peak correction (New algorithm)
   1.5 keV tolerance

Multi-curve efficiency
   Dual

Efficiency correction
   Dual

NID with interference
   Ch. 50 - 4096
   Library C:\WAS\NLIB\WRAP_GEA.NLB
   1.5 keV tolerance
   0.3 confidence threshold
   5.00 MDA confidence factor
WRAP GEA Site Acceptance Test Procedure

MDA
5% confidence factor

COMBSEG.ASF
Sum/average NID
Sum the data
NUDS
121.8 keV transmission peak energy
Eu-152 - Cs-137
C:\WINLIB\WRAP_GEA.NLB

COMBNID.ASF
Best of NID (autosetup)

COMBALL.ASF
Best of MGA/NID
Pu239 normalization nuclide

Verified: [Signature] 6/15/96
Reviewed: [Signature] 6/15/96
5. Verify Setup and Parameters: GEA-Specific Functions

- Click on the icon for the GEA Setup Utility in the GEA icon view on the OS/2 desktop.
- When the logon screen appears, log in to the GEA-specific setup with the username and password supplied by the System Manager.

5.1 High Count Rate Threshold

- On the next menu, select High Count Rate Threshold.
- Confirm that a value has been entered for the dead time.
- Confirm that a value has been entered for the count time, like 10 sec.
- Confirm that a SEGE detector has been selected, such as SEGE2 or SEGE3.

5.2 Listed/Non-listed Nuclide Flags

- On the GEA Setup menu, select Listed / Non-listed Nuclides.
- Note on the screen that appears that there is a field for nuclide name, followed by a check box for listed.
- Note that in the list box below, an "*" appears in the same row as the nuclide name if the nuclide is "listed."
- Change one of the nuclides by highlighting it in the list box, changing the checkbox, and clicking on Update.
- Note that the asterisk appears or disappears, depending upon the check box status.
- Reverse the status of Liste/Non-Listed to restore to current value.
5.3 ROI Start and Stop Channels

- Select one of the detectors on the MCA view for GWAS.

The MCA View can be used to take data if desired, or just enter the ROIs. The ROIs are entered in the usual way for Genie PC, by placing the left and right cursors at the boundaries of the ROI desired, and pressing the Insert key on the keyboard.

One can jump from one ROI to another with the + or - buttons, and any ROI on which the cursors are located can be deleted with the Delete key.

- Open Datasource file C:\WAS\ROI.CNF.
- Enter several ROIs, then select File and Save.
- Select ROI Setup on the GEA setup menu.
- Open the file just saved. Then exit the option. The ROIs will be saved.

5.4 Pu Criticality Level

- On the GEA Setup menu, select Pu Criticality Level.
- Confirm that a value has been entered for the criticality level.

5.5 TMU Setup

- Select the TMU setup option on the GEA setup menu.
- Confirm that a sample error value has been entered into the field.
5.6 Automatic Operation Setup

- On the GEA Setup menu, select Counter, Arrangement and C. Type Sel.
- On the first screen, select GEA counter, then Ok.
- On the next screen, select the arrangement for the 55 gallon drum, then Ok.
- On the next screen, select <= 250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 55 gallon drum again, then Ok.
- On the next screen, select the >250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 85 gallon overpack, then Ok.
- On the next screen, select the <=250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 85 gallon drum again, then Ok.
- On the next screen, select the >250 pound drum, then Ok.
- On the GEA menu select Automatic Data File Purge.
- Confirm that a number of days has been entered, such as 4.

Note: A value of 0 means no purging.

The GEA parameters are now set up.
- Confirm the setup by selecting Review Setup on the GEA menu.
- Confirm that the numbers (internal to GEA) for the arrangements are different, and that within an arrangement, the numbers for count types are different.
6. Calibration Operations

The user has the choice of manually or automatically loading and unloading a calibration drum for calibration. The procedure shown below will use manual loading and unloading. (Manual loading and unloading uses the mechanical system, but is manually controlled with individual software functions, rather than from the computer control of counting and analysis.)

Note also that when you first select Calibration Operations, you must then select one of the two arrangements, 55-gal. drums or 85-gal. overpacks. When switching between 55 and 85 gallon arrangements below, you must go back to the main menu.

6.1 Energy Calibration of SEGE and LEGE Detectors

This calibration must be performed for each SEGE detector, in either arrangement, and for each LEGE detector.

In addition, a group energy calibration must be performed for each SEGE group, once for each of the two arrangements.

Note: It is assumed in this procedure that Canberra has been allowed to provide a set of line sources for the calibration process. These sources are expected to be a mixture of Am-241, Ba-133, Cs-137 and Co-60. The procedure below is based on using these sources. If these are not available for some reason, an alternate set using Am-241 and Eu-152 will be used, perhaps with Cs-137 as well.

6.1.1 Energy Calibration Setup

Energy calibration requires that a certificate file be set up that contains the energies of the peaks to be used in the radioactive source. This has already been done for the sources provided, and is file AMBACSCO.CTF. (Am-241, Ba-133, Cs-137 and Co-60)

- Go to the main menu and select Calibration Operations.
- Select the 55-gal. Drum arrangement.
- Select Calibration Setup on the Calibration Operations menu.
- Select Energy/Shape calibration on the next menu.
Select Detector.

On the next menu, select the SEGE1 detector.

On the next screen enter:

- Continuum function: Linear or Step
- Channels, fixed: 4
- Channels, variable: 1
- Use variable channels: Not checked
- Energy cal tolerance, fixed: 1.5
- Energy tolerance, variable: 1.5
- Eff & Match, fixed: 1
- Eff & Match, variable: 1
- Use variable tolerance (FWHM): Not checked

- Units: keV
- Use low tail: checked
- Recal analysis sequence: CALENG.ASF

- ROI limits determination, left: 4
- ROI limits determination, right: 4

The parameters are explained in the standard Genie PC documentation, and are used in the energy and efficiency calibrations and analysis. The parameters have been chosen for good results with Ge detectors for this energy range.

Repeat these setup values for the remaining detectors SEGE2, SEGE3, and SEGE4, LEGE5 and LEGE6.

Return to the Calibration Operations menu, then select Calibration Setup, then Energy/Shape calibration.

On the Detector/Group screen, select Group, then SEGEs.

Then enter or confirm the setup parameters as above.

Return to the main menu, then select Calibration Operations again.

Select the 85-gal overpack arrangement.

Select Calibration Setup, then Energy/Shape calibration.
- On the Detector/Group screen, select Group, then SEGEs.
- Then enter or confirm the setup parameters as above.

Place the calibration source in a drum and place at the load position.

Under manual operations, load the drum, choosing the appropriate size.

Return to the main menu, then select Calibration Operations.

Select 55-gal. drum on the arrangement selection menu.

Select Calibration count on the Calibration Operations menu.

On the next screen select Energy/Shape for Calibration type

On the next screen

Preset count time 300 seconds
Disable manual load/unload unchecked
Platform position 2

The other fields should not be checked, and can be ignored.

Select Start. The calibration count will then be started, and when finished, will be saved to files.

On the Calibration Operations menu, select Full/Energy Shape Calibration

On the next menu select Detector.

On the next menu select SEGE1.

On the next menu select the certificate file to be used, AMBUSCO.CTF.
The next screen will show the initial lines to be used for the energy calibration, 59.5 and the 1332 keV at the high end.

Highlight the 59.5 keV line in the list box.

In the spectrum displayed in the lower half of the screen, place the cursor on the 59.5 keV line.

Click on Cursor in the dialog box. The cursor channel will then be displayed in the channel field. Click on Update to move the information to the list box.

Repeat the last three steps for the 1332 keV line.

Now click on Ok. The calibration will then be displayed as a graph.

If the graph line is very close to going through zero, accept it. If not, cancel and go back to the previous steps, making sure that you have the lowest strong peak and the highest strong peak.

The program will then do the full calibration with all peaks, and the next screen will then show the full set of data. If all peaks are very close to the line, accept the data. The detector is then fully calibrated for energy and shape. Detector shape parameters are viewed by clicking on the Shape button in the upper right box.

Repeat the energy calibration for SEGE2.

Repeat the energy calibration for SEGE3.

Repeat the energy calibration for SEGE4.
Select Full Energy/Shape calibration.

- Select Group on the Detector/Group menu, then SEGEs.
- Repeat the energy calibration as specified for an individual detector.

- Return to the Calibration Operations menu and select Full Energy/Shape Calibration.

- Select Group on the Detector/Group menu, then SEGEs.
- Repeat the energy calibration as specified for an individual detector.

6.2 Energy Calibration of Low-Energy Detectors

- Place one or more of the Am-Ba-Cs-Co line sources in the center of the shield (or in a low density calibration drum) so that both LEGE detectors can view the source.

- The setup of gains for the amplifiers can be performed with the MCA View. Select Datasource, then Upper LEGE (det. 5).

- We wish to confirm that the energy range is 0 to 307 keV (about 0.075 keV/channel in a 4096-channel spectrum). The 59.5 keV peak should be in channel 793, the 81 keV line in channel 1080, and the 276 keV line in channel 3684.
WRAP GEA Site Acceptance Test Procedure

- If not close to these channels, adjust the amplifier gains until this is so. Adjust the amplifier gain by selecting MCA on the menu bar, then Adjust, then Amp. Then change the gain.

- Confirm similarly for the other low-energy detector, Lower LEGE (det. 6).

The setup of parameters has been done above.

**LEGE Energy Calibration Count and Calibration**

- Use the same sources as for the SEGE detectors.

- Select Calibration count on the Calibration Operations menu.

- On the next screen select Energy/Shape for Calibration type

- On the next screen
  - Preset count time 200 seconds
  - Disable manual load/unload not checked

  The other fields should not be checked, and can be ignored.

- Select Start. The calibration count will then be started, and when finished, will be saved to files.

- On the Calibration Operations menu, select Full/Energy Shape Calibration

- On the next menu select Detector.

- On the next menu select Upper LEGE.

- On the next menu select the certificate file AMBACSCO.CTF. (Higher energy lines than 307 keV can be ignored.)

- Enter a description, if desired, then select OK.

- The next screen will show the initial lines to be used for the energy calibration, 59.5 keV at the low end and the 276 keV in the middle (at the high end of the LEGE).
• Highlight the 59.5 keV line in the list box.

• In the spectrum displayed in the lower half of the screen, place the cursor on the 59.5 keV line.

• Click on Cursor in the dialog box. The start and end channels will then be filled in the list box. Click on Update to accept the information.

• Repeat the last three steps for the 276.4 keV line.

• Now click on Ok. The calibration will then be displayed as a graph.

• If the graph line is very close to going through zero, accept it. If not, cancel and go back to the previous steps, making sure that you have the lowest strong peak and the highest strong peak.

• The program will then do the full calibration with all peaks (if there are more), and the next screen will then show the full set of data. If all peaks are very close to the line, accept the data. The detector is then fully calibrated for energy and shape. Detector shape parameters are viewed by clicking on the Shape button in the upper right box.

Note: For the LEGE detectors, make sure that the final calibration is first order only. This is required by the MGA program.
6.3 Reference Peak Calibration

Note: No calibration setup required before performing a count. Reference peak calibration is for the SEGE detectors and SEGE groups, not the LEGE.

Start with no source in the station. The door may be open.

- On the main menu select Calibration Operations, then 55-gal. Drum, then Calibration Count.
- On the next screen select Reference Peak Calibration.
- On the next screen enter 300 seconds. The container type, collimator position and platform positions do not matter since it is only a detector electronics function.
- Check Disable Load/Unload
- Select Start and allow the count to start and complete.
- On the main menu select Calibration Operations, then Reference Peak Calibration.
- On the next menu select Detector, then SEGE1.
- On the next screen press Select Peak.
- The next screen displayed lists the peaks found. Select the pulser peak and press Ok.
- Back on the screen for pulser, source, etc., there will now be peak energy, rate and rate error values.
- The pulser rate should be a little less than 50 Hz.
- Set the pulser/source designation to pulser, and set the half-life to zero.
- Set the Accept by pressing Ok.
Repeat the calibration for each of the other SEGE detectors, SEGE2, SEGE3, SEGE4.

- Return to the detector/group menu and select group, then SEGEs.
- Repeat the calibration for the group (in 55-gal. drum arrangement).

Now go to Calibration Approval on the Calibration Operations menu.

- Select Reference Peak. A list of the calibrations performed will appear.
- Select and approve each one.
- When asked if you want to set the calibration as the default, answer Yes.

Return to the main menu, then select Calibration Operations, then 85-gal. Overpack.

- Select Reference Peak Calibration, then group, then SEGEs.
- Repeat the calibration for the group.

Now go to Calibration Approval on the Calibration Operations menu.

- Select Reference Peak. A list of the calibrations performed will appear.
- Select and approve each one.
- When asked if you want to set the calibration as the default, answer Yes.

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<td>[Signature] 6/15/96</td>
<td>[Signature] 11/10/96</td>
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6.4 Transmission Calibration

- Load an empty 55 gallon drum into the station.
- On the main menu select Calibration Operations, then 55-gal. drum.
- On the Calibration Operations menu select Calibration Setup, then Transmission
- Set the tolerance to 1 or 1.5 keV.
- Return to the Calibration Operations menu and select Calibration Count.
- On the next menu select Transmission calibration.
- Take a count for 200 seconds, at platform position 2, with absorber out (collimator position 0). Do not check Use Sample Database.

- When the count is finished, return to the Calibration Operations menu and select Transmission Source Calibration.
- On the detector menu, select SEGE1.
- The next screen to be shown requires selection of the transmission source certificate. This has been set up, and is EU152.

- Press Ok to start the transmission calibration.

- The transmission results will be displayed.

  Confirm that there are results for the peaks listed below, and that the peak areas are approximately in the percentages listed.

  122 keV $^{35}$ $^{2}$ $^{5}$ - 28.4% (this will be lower because of absorption in the drum walls)
  244 10/10 7.5
  345 26/5 26.6
  779 8/7 13.0
  964 8/3 14.5
  1112 6/5 13.6
  1408 9/9 20.8

- Select Ok if the results are consistent with the percentages above.

- Back at the detector menu, the calibration just done will be indicated by an asterisk at the left of the detector. Then select SEGE2, then transmission certificate, then accept the results.

- Repeat for SEGE3 and SEGE4.

- Return to the Calibration Operations menu and select Calibration Approval.

- Select Transmission. The next screen will list the transmission calibrations just made, for each detector.
• Approve the calibration for each SEGE detector, and select it as the default calibration on the next screen.

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<td>J. Seeman 6/19/96</td>
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• Repeat the calibration process for the 55 gallon drum with absorber in place (collimator position 1):
  • Make transmission count for platform position 2, collimator position 1.
  • Select detector SEGE1.
  • Select Transmission Calibration, certificate, and Ok, and accept the results, if the peaks exist as listed above, and if the percentages are similar (but lower for the lower energies).
  • Repeat for SEGE2, SEGE3, SEGE4.
  • Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.
  • Select this calibration as the default each time.

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• Repeat the calibration count and calculation process for an empty 85 gallon overpack with absorber out. (The setup remains the same.)
  • Return to the main menu, then select Calibration Operations, then 85-gal. Overpack, the Transmission calibration.
  • Make transmission count for platform position 2, collimator position 0.
  • Select Transmission Calibration, certificate, check the peak results, and select Ok.
  • Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.
  • Select this calibration as the default.

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</tr>
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</table>

• Repeat the process for the 85 gallon drum with absorber in place.
  • Make transmission count for platform position 2, collimator position 1.
  • Select Transmission Calibration, certificate, check the peak results, and select Ok.
• Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.
• Select this calibration as the default.
6.5 Segment Efficiency Calibration

Efficiency calibration will be done only for the group of SEGE detectors. (The LeGE detectors only measure relative isotopic composition for Pu isotopes.)

The segment efficiency calibration follows the usual SGS practice of measuring the response in the smooth section of the drum (platform position 2, in this case) and using the efficiency for that segment in all segments viewed by that detector.

The efficiency calibration requires that a certificate file be set up with the calibration source energies and intensities. For the segment efficiency, the certificate file must have the source intensity given by the sum of the source activities, divided by the number of segments used. Since there are 10 segments for the 55-gal. drum and 11 for the 85-gal. drum, two different certificate files are used. These files are named something like (the exact names will be provided at the SAT):

- 10SEGEFF.CTF for the 55-gal. drum
- 11SEGEFF.CTF for the 85-gal. overpack.

By dividing the total source intensity by the number of segments, when performing the segment analysis, the sum of the segment results can be added in order to get the total activity for the drum.

The calibration process involves data acquisition and analysis for line sources, which are used to approximate a uniform distribution of radiation throughout the drum by placing them at specific radial positions.

Calibration must be performed for both 55 and 85 gallon drums, and for the two cases of with and without absorber. For the 85-gallon overpack, it is planned to use the line sources in a 55-gallon drum inside of the 85-gallon overpack.

A drum with a foam matrix (density of about 0.014) is equivalent to an empty drum, and can be used if an empty drum with the correct source positioning tubes is not available.

- Place the calibration source set in the foam matrix drum and load into the station.
- Go to the Manual Operations menu, then select Load/Unload/Transport.
- Select Prepare for Measurement. This will close the door and start the platform rotating.
Select Calibration Operations on the main menu, then 55-gal. drum.

Select Calibration Setup on the Calibration Operations menu.

Select Efficiency Calibration on the next menu.

On the next menu select SEGE for Standard electrode Ge detectors.

On the next screen enter:

- Use Eff Crossover Not checked
- Sequence: CALEFF.ASF

Repeat the selection of CALEFF.ASF for both LEGE detectors (even though it will not be used).

Return to the main menu, then select Calibration Operations, then 85-gal. Overpack, then Calibration Setup.

On the next menu select SEGE for Standard electrode Ge detectors.

On the next screen enter:

- Use Eff Crossover Not checked
- Sequence: CALEFF.ASF

Repeat the selection of CALEFF.ASF for both LEGE detectors (even though it will not be used).

Return to the main menu and select Calibration Operations, then 55-gal. drum.

Select Calibration Count on the Calibration Operations menu.

On the next screen select Efficiency for Calibration type.

On the next screen:

- Preset count time 300 seconds
- Collimator position 0 (no absorber)
- Disable manual load/unload Not checked

The other fields should not be checked, and can be ignored.
Select Start. The calibration count will then be started, and when finished, will be saved to files. On the sample information screen that appears, enter and ID number that is unique, and enter the proper density.

Segment Efficiency Calibration Calculation

- On the Calibration Operations menu select Efficiency calibration

- On the next screen, press Find, then select the count to be used by highlighting the count, checking the box for Select, pressing change, then pressing Ok.

- On the next screen select the SEGE4 for platform position 2.

- On the next screen select the appropriate certificate file.

- After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.

- If the graph looks reasonable, select Ok. The graph should be a smooth curve very close to all of the points, with a maximum value between 81 and 256 keV. The Gamma Waste Assay Software User manual shows examples of efficiency curves in the calibration section.

- Back on the detector group selection screen, select platform position 2 for each of the other SEGE detectors, then get the plot and select Ok.

- Repeat the calibration process of count and calculation for the 55 gallon light foam drum with the absorber in place (collimator position 1):
  
  - Select count, then efficiency calibration, then SEGE4 for platform position 2.
  
  - Select Efficiency calibration, then certificate file as needed.
  
  - Make sure that the summed spectrum and all SEGE detectors are done.

  *used 2nd order plot*
Repeat the process of count and calculation for the 85 gallon drum:
- Select count, then efficiency calibration.
- Select Efficiency calibration, then certificate file as needed.
- Make sure that the summed spectrum and all SEGE detectors are done.

Repeat the calibration process of count and calculation for the 85 gallon drum, with the absorber in place (collimator position 1):
- Select count, then efficiency calibration.
- Select Efficiency calibration, then certificate file as needed.
- Make sure that the summed spectrum and all SEGE detectors are done.
6.6 Calibration Approval for Segment Efficiency

An efficiency calibration must be approved and selected as default before it can be used. For the segment efficiencies, it is also required to perform the approval in such a way that the efficiency for position 2 is used for each of the positions, on a detector-by-detector basis.

- On the Calibration Operations menu, select Calibration Approval.
- On the next menu, select Efficiency Calibration.
- On the next screen you will get the un-segmented, summed segments and segments selection. Select Summed Segments.
- The next screen will list all unapproved calibrations.
- Delete any calibrations not desired.
- Approve the calibration just made for the sum of the segments.
- On the next screen, when asked if this should be the default calibration, select Yes, with "matching container" checked.

**Note:** If a valid calibration has already been made, do not approve this latest one, but delete it.

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- Now perform the approval for each of the detectors, for platform position 2.
- On the non-segmented, etc. selection screen, select Segments.
- The platform position is indicated in the last number of the file extension, which is Sdp. (d = detector number, p = platform position number)
- Select the segment efficiency calibration for detector 1, position 2.
- On the next screen, do **not** check "matching only" for the platform position.
- Repeat for detector 2, position 2.
- Repeat for detector 3, position 2.
- Repeat for detector 4, position 2.

- Repeat this process for the 55 gallon drum with absorber in.

- Return to the main menu, then select Calibration Operations, then 85-gal pack, then repeat this process for the 85 gallon drum with absorber out.

- Repeat this process for the 85 gallon drum with absorber in.
6.7 Summed Spectrum Efficiency Calibration

We will calibrate the spectrum formed from the sum of the segment spectra by using the multiple density efficiency calibration. This process determines the actual efficiency by using the average density of the drum to interpolate between efficiencies measured at several different densities. A set of 55-gallon calibration drums of four different densities has been provided in order to make this efficiency calibration.

This summed spectrum analysis is used to detect weaker intensity radiation that may be more apparent than in the individual segment spectra.

The efficiency calibration requires that a certificate file be set up with the calibration source energies and intensities. This has been done already, and is the same file AMBACSCO.CTF already used for energy calibration.

The calibration process involves data acquisition and analysis for four different drums, each with a different average density. It is important to know which drum is which throughout the process, and to label the data correctly. It is best to use the drums in a known sequence, such as light to heavy, to avoid confusion.

We will use four different drums:

<table>
<thead>
<tr>
<th>Description</th>
<th>Approx. Density</th>
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<tbody>
<tr>
<td>1) foam</td>
<td>0.01</td>
</tr>
<tr>
<td>2) soft board</td>
<td>0.4</td>
</tr>
<tr>
<td>3) hard board</td>
<td>0.7</td>
</tr>
<tr>
<td>4) sand</td>
<td>1.7</td>
</tr>
</tbody>
</table>

6.7.1 Calibration Setup

- Select Calibration Operations on the main menu.
- Select 55-gal. drum arrangement.
- Select Calibration Setup on the Calibration Operations menu.
- Select Efficiency Calibration on the next menu.
- On the next menu select SEGEs.
- On the next screen enter:
  - Use Eff Crossover Crossover Not checked
  - Sequence: CALEFF.ASF
6.7.2 55-gallon drums without absorber

First drum
- Place the calibration source set in the drum of density 0.01 and load into the station.
- Select Calibration Count on the Calibration Operations menu.
- On the next screen select Efficiency for Calibration type
- On the next screen
  - Preset count time: 300 seconds
  - Disable manual load/unload: Checked
  - Select collimator geometry position: 0
  - The other fields should not be checked, and can be ignored.
- Select Start. The calibration count will then be started, and then a screen for sample information will be presented.
- Enter in the correct information, including the density.
- When the count is finished, it will be saved to files.

Second drum
Repeat the last section for the drum of approx. density 0.4.

Third drum
Repeat the last section for the drum of approx. density 0.7.
Fourth drum

Repeat the last section for a drum of approx. density 1.7, but use a longer count time, of 600 seconds.

Efficiency Calibration Calculation

We will now calculate the efficiency for all four drums in sequence, then combine the results into a multi-curve efficiency. The multi-curve efficiency is indicated by a density of 999.

First drum

- On the Calibration Operations menu select Efficiency calibration
- The next screen is a logbook search screen. Select only Calib in the counts type of drop down box, then press Find.
- A list of calibration counts will be displayed.
- Select the first drum data collected (density about 0.01) by highlighting the line, checking the box for Select (*) , then pressing Change.
- Then select Ok to go to the next screen.
- On the next screen select the certificate file, AMBACSCO.CTF
- After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.
- If the graph looks reasonable, select Ok. If it does not, repeat the calibration count with a longer count time.

The graph should be a smooth curve very close to all of the points, with a maximum value between 81 and 256 keV. The Gamma Waste Assay Software User manual shows examples of efficiency curves in the calibration section.
Then to go to the fourth screen, select the fourth drum data collected (density about 1.7) by highlighting the line, checking the box for Select, then pressing Change.

Then select Ok to go to the next screen. On the next screen select the certificate file, \texttt{AMBACGEO.CTF}.

After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.

\textbf{Multi-Curve Efficiency}

- Return to the Calibration Operations menu and select Add to Efficiency Calibration Points.
- On the next screen select Summed Segments.
- On the next screen select Unapproved.
- The next screen displays all of the unapproved calibration Summed Segments files, and lists the date and time, density, and detector group.
- Select the 0.01 density data and Geo 0 and press Ok.
- On the next screen check Matching Container Type, then Ok.
- On the next screen select Unapproved, then Ok.
- The next screen again displays the list of data for date and time, density, etc.
- Select the second drum calibrated (0.4 density), then Ok.
- The program will then display a graph of the two curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer Yes.

- On the next screen select Unapproved.
- The next screen will display the list of calibrations by date and time, density, etc.
- Select the third drum calibrated (0.7 density), then Ok.
- The program will then display a graph of the three curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer Yes.

- On the next screen select Unapproved.
- The next screen will display the list of calibrations by date and time, density, etc.
- Select the third drum calibrated (1.7 density), then Ok.
- The program will then display a graph of the four curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer No.
- You will then exit the Add Density option.
6.7.3 55-gallon Drums with Absorber

- Repeat the previous section, but selecting collimator/geometry position 1 (Geo. 1) for absorber in place.

6.7.4 85-gallon Overpack without Absorber

- Exit the Calibration Operations section, then re-enter, selecting 85-gallon overpack arrangement.
- Place the 55-gallon drum calibration drums inside of an 85-gallon empty overpack.
- Repeat the previous section, without absorber. Be careful to label the calibrations properly.

6.7.5 85-Gallon Overpack with Absorber

- Repeat the previous section, with absorber.

6.8 Calibration Approval for Summed Segment Spectra

An efficiency calibration must be approved before it can be used.

- Return to the main menu, then select Calibration Operations, then 55-gal. Drum arrangement.
- On the Calibration Operations menu, select Calibration Approval.
- On the next menu, select Efficiency Calibration.
- On the next screen select Summed Segments
- The next screen will list all unapproved calibrations.
- Highlight one of the multi-curve density calibrations just made (density=999 and geo 0), then press Approve.
- The next screen will prompt for setting the default. Leave the check boxes checked (matching container), and press Ok.
- You will be returned to the unapproved calibration list. The one you just approved will no longer be present.
- Highlight the other multi-curve density (density=999, geo = 1), and press Ok.
- You will be returned to the unapproved calibration list. Neither density=999 calibration will be present.
- Return to the Calibration Operations menu. (The individual densities do not need to be approved.)

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- We will now confirm that the calibration can be used. Go to Calibration Operations on the main menu, then Report/Plot Efficiency Calibration.

- Select Plot Efficiency Calibration on the next screen.
- Select Summed Segments on the next screen.
- Select Default Efficiency calibration on the next screen.
- Select the calibration for density 999, and either geo = 0 or 1.
- On the next screen select:
  - Type: Dual
  - Scale: Linear
  - Effic. Vs. Energy for all Densities
  - Energy 1
  - Density 0.01

  and press Ok.
The efficiency curve will be plotted, with four separate curves.

Examine the four curves to see if they are reasonable. Each density curve should be separate from the other densities, with no crossing of the lines. The lower density curves should be higher (have greater efficiency values) than the higher density curves. An example of a four-density multi-curve is shown in section 10.14 of the Genie PC Waste Assay Software User manual.

- Return to the efficiency selection screen and repeat, selecting the other geometry.

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- Return to the main menu, then select Calibration Operations again, then 85-gal. Overpack.

- Now repeat the approval and plotting as just above for the 55-gal. drums.

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7. Measurement in Local Mode

Manual operations consist of individual steps that can be performed for a measurement, such as loading a drum, turning on the HVPS, collecting the data, and analyzing the data. We will perform most of the possible operations, using a 55-gallon drum.

7.1 Start a Count

Manual Load of a Drum

- Place a low-density 55-gallon drum at the load position.
- On the arrangement selection screen, select 55-gallon drum.
- On the next screen select 55-gallon drum, then Load.
  
  Note that the drum IS moved to the center of the station, and the door closed.

  Perform a Count

- Next return to the Manual Operations menu, then select Start a Count.
- On the next screen for count type, select <= 250 pounds or >250 pounds.
- On the next screen, confirm or enter the data:
  Count time
  With transmission : 30 seconds
  Without transmission: 110 seconds
  Use Sample database Not checked
  Use Bar code reader Not checked
  Collimator/geometry position 0

- The system will then start counting for all detectors defined in the Assay 55 gallon drum count type. At the end of the count, all data will be saved to files.

Manual Unload of a Drum

• Select 55-gallon drum on the container type screen.

• Select Unload on the next menu.

• Note that the door opens, and that the drum is returned to the conveyor.

7.2 Analyze Existing Count

• On the Manual Operations menu, select Analyze Existing Count.

• On the next screen, press Find, then select the count just taken by highlighting it, then pressing Select, then Change. An asterisk will appear beside the ID. Press Ok.

• On the next screen, press Analyze Entire Count. The analysis will be performed.

• Display the report by opening an OS/2 window and entering:

  > CD \WAS
  > DISPREP MORE

• The report will be displayed on the screen.

• Review the report for completeness, and for activities that correspond to those in the drum assayed.

7.3 Turn On/Off HVPS

• Select Turn On/Off HVPS on the Manual Operations menu.

• On the next screen, select Off, then Ok.

• Note that the LEDs on the HV supplies start "dropping down" by gradually turning off the upper LEDs.
After all HVPSs are off, repeat the process, but select On.

Note that all of the LEDs turn on at increasing higher positions until the full voltage has been reached.

7.4 Manual Load / Unload

We have already done a light 55-gallon drum. We will now do a heavy 55-gallon drum and light and heavy 85-gallon overpacks.

- Place a high-density (up to 1000 pound maximum weight, per specification), 55-gallon waste drum at the starting load point.
- On the next screen select the 55-gallon drum.
- On the next screen select Load.
- Note that the drum is moved into the shield, and the door closed.
- On the next screen select Unload.
- Select the 55-gallon drum.
- Note that the door opens, and the drum moved to the unload point.

Repeat the load and unload process for a low-density 85-gallon overpack, as follows:
- Return to the main menu, then select Manual Operations.
- On the arrangement selection screen select 85-gal. overpack.

On the container selection screen select 85-gal. overpack.

On the next screen select Load.

Return to the Load/Unload/Transport screen and select Unload.

Select the 85-gal. overpack.

Note that the container is unloaded.

Repeat the load and unload process for a heavy 85-gallon overpack, close to 1000 pounds (maximum value for the specification).

Return to the main menu, then select Manual Operations.

On the arrangement selection screen select 85-gal. overpack.


On the container selection screen select 85-gal. overpack.

On the next screen select Load.

Return to the Load/Unload/Transport screen and select Unload.

Select the 85-gal. overpack.

Note that the container is unloaded.
8. Routine Counts

- Place sources in one of the calibration drums, and place the drum at the load point.

- Select Routine Counts on the main menu.

- Select 55 gal. drum on the next menu.

- On the next screen, enter or accept:
  
  Transm. count time: 30 seconds
  Non-transm. Count time: 110 sec.
  Use sample database: Not checked
  Use barcode reader: Not checked
  Disable Load/Unload: Not checked

  Then select Start.

- The drum will then be loaded, data collected, then analyzed.

- The drum will then be unloaded.

- Display the report by opening an OS/2 window and entering:
  
  > CD \WAS
  > DISPREP | MORE

- The report will be displayed on the screen.

- Examine the report to see that the activity measured is close to the activity of the source(s).
9. Test of Minimum Transmission

This test is to verify that if the drum absorption is greater than 95% for a peak in the transmission source (and that is selected in the transmission source certificate) the transmission is set to 0.5%.

- Set up the test by going to the main menu and selecting Utilities, then Counter Maintenance, then Arrangement, then 55-gallon drum, then Group, then SEGEs, then Analysis. For the report option, enable the report change the analysis sequence file selected to V_TRANS.ASF. (This will show the transmission results on the screen.) If a printer is available, select P_TRANS.ASF for the analysis sequence file. (This will print the results.)

- Select Ok, then return to the main menu.

- Now load the 55-gallon calibration drum with density of about 0.7, (particle board) by placing it at the load point, then going to Manual Operations and selecting Load/Unload/Transport.

- Now perform a routine measurement, with Disable Load/Unload checked.

- When the count and analysis is finished, examine the report. Note that for the low energy transmission source lines, the report has a section for each segment and results that look something like:

Analysis Warnings:
Minimum transmission used.

--- Transmission Correction ---

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Energy</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eu-152</td>
<td>121.80</td>
<td>0.005 +/- 0.0025</td>
</tr>
<tr>
<td>Eu-152</td>
<td>244.50</td>
<td>0.005 +/- 0.0025</td>
</tr>
<tr>
<td>Eu-152</td>
<td>344.50</td>
<td>0.036 +/- 0.0013</td>
</tr>
<tr>
<td>Eu-152</td>
<td>778.00</td>
<td>0.062 +/- 0.0078</td>
</tr>
<tr>
<td>Eu-152</td>
<td>964.00</td>
<td>0.073 +/- 0.0086</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1112.00</td>
<td>0.077 +/- 0.0098</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1408.00</td>
<td>0.126 +/- 0.0125</td>
</tr>
</tbody>
</table>

- Note that the low energy lines have minimum transmission values of 0.005.
Note that this minimum value is an editable parameter in the transmission correction engine.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Signature] 7/29/06</td>
<td>[Signature] 7/29/06</td>
</tr>
</tbody>
</table>

- Now restore the analysis to no report (remove the check from the report box in the Analysis section for the SEGEs group).
10. Sensitivity Testing

10.1 Pu-239 Sensitivity

Load a drum with the appropriate level of Pu-239 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering

```c
cd \WAS
disprep more
```

Determine that Pu-239 activity is reported.

View the SEGE2 data on the screen and note whether either of the peaks at 129 and 414 keV have a net peak area that is at least three times the one sigma background (in the region under the peak).

10.2 Sensitivity

Load a drum with the appropriate level of U-235 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering

```c
cd \WAS
disprep more
```

Determine that U-235 activity is reported.

View the SEGE2 data on the screen and note whether the peak at 186 keV has a net peak area that is at least three times the one sigma background (in the region under the peak).
10.3 Cs-137 and Co-60 Sensitivity

Load a drum with the appropriate level of Co-60 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering
> CD WAS
> DISPREP | MORE

Determine that Cs-137 and Co-60 activity is reported.

View the SEGE2 data on the screen and note whether the peaks at 661, 1173 and 1332 keV have a net peak area that is at least three times the one sigma background (in the region under the peak).
11. TMU Setup and Test

TMU is determined by added the "TMU Error" in the GEA-specific setup to the statistical error determined in the analysis.

- Click on the GEA Setup icon, then select TMU setup on the menu.
- Enter a value of 0%.
- Make a routine measurement of some source and note the activity and uncertainty.
- Return to the GEA TMU setup, and set the value to 10%.
- Make a routine measurement of the same source, and now note the activity and uncertainty.
- Confirm that the TMU % error is added in quadrature to the original error.

Verified

Reviewed

Does not incorporate TMU into calculations
12. Test of Remote (Automatic) Operation

For these tests it is assumed that the PCS and SIE are running, and the GEA system has been powered on.

Note: When used on GEA system B, the Subsystem indicated will be B, not A (third record of the message).

12.1 Status Messages

12.1.1 GEA Initialization

If the SIE and PCS have been started before the GEA system is running, then as the GEA is initialized, three status messages will be sent to the PCS. These are:

GEAPCS / SGEA / A / 00190010 / 0 / Initialization in process
GEAPCS / SGEA / A / 00090010 / 0 / Initialization in process
GEAPCS / SGEA / A / 00090010 / 0 / Initialization in process

12.1.2 GEA in Manual (Local) Mode

- On the PCS request status.
- The message should be:

   GEAPCS / SGEA / A / 00090010 / 0 / System ready to process drums

- Confirm that the message format is correct.
- Set the GEA into manual mode by pressing Exit in the upper right window.
- A logon screen will appear.
- On the PCS request status.
- The message should be:


- Now logon by entering a valid username and password. The main GWAS menu will appear in the upper left.
- On the PCS request status.
- The message should be:

- Return to automatic mode by going to the main menu in manual mode, and selecting the first option, Automatic Counting.

12.2 Drum Measurement

We will go through an entire drum measurement sequence, including getting status messages automatically, and requesting status messages.

- On the SIE send a message for assaying a 55 gallon drum of less than 250 pounds, with drum status of "PROC".

  SIE message records are:

  1  SIEGEA
  2  DGEA
  3  (drum ID)
  4  55 or 85
  5  Net weight (Kg)
  6  % Pu-239
  7  Drum status. Possible status values are:
      PROC
      CERT
      VERF_HI
      VERF_LO
      BACK

- On the PCS send "Request to drop off drum" (RDOD) message.

  Note: These last two commands can be issued in either order.

- Note that the GEA system upper left screen has message boxes indicating the status of the system and the operation in progress, and that the screen in the upper right allowing access to manual mode has disappeared.

- The GEA system will send a message back to the PCS that it is ready to accept drum. The PCS will receive:

  GEAPCS / RAD / A (Ready to accept drum)
At this point the station conveyor will turn on. Turn on the transfer conveyor manually as the drum will move into the station. Turn off the transfer conveyor when the drum has left it.

The GEA will send a message to the PCS when the drum is in the assay position.

GEAPCS / DPS / A (Drum presence sensed in station)

On the PCS request the status. Depending upon how long after the RDOD message was sent, you will get one of the following messages at the PCS (you can get status before DPS message received by PCS):

GEAPCS / SGEA / A / 00190020 / 0 / Drum loading or unloading

GEAPCS / SGEA / A / 00000020 / 0 / Data acquisition in progress

(In this case the 19 has been cleared since read once. The 2 remains because data acquisition is still in progress.)

When the measurement analysis has been completed, the GEA sends to the PCS a status message for task finished:

GEAPCS / SGEA / A / 00000040 / 0 / Task finished

You then need to unload the drum by sending PCS command ready to pick up drum - RPUD.

The unload will start by lowering the platform to unload position, stopping rotation, and opening the door.

Request status immediately after the RPUD command. The PCS will receive:

GEAPCS / SGEA / A / 00000040 / 0 / Drum loading or unloading

Request status again and again until you get the following:

GEAPCS / SGEA / A / 00000010 / 0 / System ready to process drums

When the report message is ready, it will be sent to the SIE.

Confirm that the report message is in the proper format, and that the activity is correct.

The report message is also saved in a file on the GEA system.

On the GEA system open an OS/2 window.

Run the command C:\WASIDISREP | MORE to see the report.
- (Print the report with the commands C:\WAS\DISPREP > file.lis and PRINT file.lis)
- Review the results to confirm that the system is operating properly.

```plaintext
Verified
Signed 8/26/96

Reviewed
8/26/96
```

- Repeat the process for a 55 gallon drum of greater than 250 pounds.
- The process will be identical, except that the absorber will be placed in front of the detector. This can be observed by noting the rotation of the absorber motion shaft.

```plaintext
Verified
Signed 8/26/96

Reviewed
8/26/96
```

- If the 85 gallon overpacks have been calibrated, repeat the process for 85 gallon overpacks, less than or equal to 250 pounds.

```plaintext
Verified
Signed 8/26/96

Reviewed
8/26/96
```

- Repeat the process for 85 gallon overpacks of more than 250 pounds.

```plaintext
Verified
Signed 8/26/96

Reviewed
8/26/96
```

### 12.3 Test of Absorber Use

This test will demonstrate that for count rates above a user-specified minimum, the absorber will be placed between the drum and the detectors. (In the GWAS software this absorber is defined as a collimator position.)

Note: The system must have been calibrated for drums with the absorber in place.

- Place a radioactive source in a 55 gallon drum and load into the cell.
WRAP GEA Site Acceptance Test Procedure

- Use the MCA View in GWAS or in Spectroscopy Assistant in the Utility Operations and measure the dead time on the ADC for the detector specified in GEA-specific setup.
- Set the dead time limit in the GEA setup to less than the dead time measured.
- Repeat a measurement. Note that the absorber goes into place by watching the absorber shaft turn.
- Compare the results with the activity expected.

Note: Absorber in means that a different calibration is used.

<table>
<thead>
<tr>
<th>Verified</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Signature]</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Signature]</td>
</tr>
</tbody>
</table>

12.4 Test of SIE Message Drum Status

12.4.1 SIE Message with Drum Status CERT

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of CERT.

<table>
<thead>
<tr>
<th>SIE message records are:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 SIEGEA</td>
</tr>
<tr>
<td>2 DGEA</td>
</tr>
<tr>
<td>3 (drum ID)</td>
</tr>
<tr>
<td>4 55</td>
</tr>
<tr>
<td>5 Net weight (Kg)</td>
</tr>
<tr>
<td>6 % Pu-239</td>
</tr>
<tr>
<td>7 Drum status. Possible status values are:</td>
</tr>
<tr>
<td>PROC</td>
</tr>
<tr>
<td>CERT</td>
</tr>
<tr>
<td>VERF_HI</td>
</tr>
<tr>
<td>VERF_LO</td>
</tr>
<tr>
<td>BACK</td>
</tr>
</tbody>
</table>

- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.
12.4.2 SIE Message with Drum Status CERT-

- Prepare a 55-gallon drum with known activity sources.

- Send an SIE message for a 55 gallon drum with drum status of CERT-

SIE message records are:
1. SIEGEA
2. DGEA
3. (drum ID)
4. 55
5. Net weight (Kg)
6. % Pu-239
7. Drum status. Possible status values are:
   - PROC
   - CERT
   - VERF_HI
   - VERF_LO
   - BACK

- Issue the PCS messages necessary to load a drum and start the measurement.

- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.3 SIE Message with Drum Status VERF_HI

- Prepare a 55-gallon drum with known activity sources.

- Send an SIE message for a 55 gallon drum with drum status of VERF_HI.

- Issue the PCS messages necessary to load a drum and start the measurement.
When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.4 SIE Message with Drum Status VERF_LO

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of VERF_LO.
- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.5 SIE Message with Drum Status BACK

- Prepare a 55-gallon drum without any sources.
- Send an SIE message for a 55 gallon drum with drum status of BACK.
- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

Note: GEA does not distinguish between drum types (PROC, VERF, BACK, etc).
13. Test of Pu Criticality Message

- Load a drum with enough plutonium to find a measurable amount. (The specification for the GEA system is about 1 gram of Pu-239.)

- Perform an automatic measurement of the drum, and note the amount of Pu-239 reported.

- Go to the OS/2 desktop and click on the GEA Setup icon.

- Logon and select the option for Pu mass criticality level.

- Set the Pu-239 criticality mass level to less than the amount measured.

- Perform a measurement again, with the same drum and amount of Pu.

- Display the report by opening an OS/2 window and entering:
  
  > CD \WAS
  
  > DISPREP | MORE

- The report will be displayed on the screen.

- Confirm that the message at the SIE is as required.
14. Test of Plutonium Isotopic Ratios

- Obtain a drum with plutonium of known isotopic ratios, including at least Pu-239 and Pu-241, with a quantity of more than 1 gram total Pu. The drum should have a density of 0.2 g/cc or less.

- Perform a routine measurement of this drum.

- Display the report and compare the relative isotopic abundances reported to the known isotopic ratios. Display the report with the following commands:

- Display the report by opening an OS/2 window and entering:
  > CD WAS
  > DISPREP | MORE

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Wt. % Pu-238</th>
<th>Ratio to Pu-239</th>
<th>Ratio to Pu-241</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pu-238</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pu-239</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pu-240</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pu-241</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pu-242</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Am-241</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See next page.
15. Repeatability Measurements

Repeatability measurements must meet the requirement of two-thirds of the measurements being within 5% of the mean. This test will include loading and unloading. Six measurements will be made in each of four cases:

1) Low-density 55-gallon drum
2) High-density 55-gallon drum
3) Low-density 85-gallon overpack
4) High-density 85-gallon overpack

15.1 Repeatability Measurement with Low-Density 55-gallon Drum

First load the system with a low-density 55-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pu-239</td>
<td>190mCi</td>
<td>4.6mCi</td>
</tr>
<tr>
<td>Pu-241</td>
<td>13.7μCi</td>
<td>0.826μCi</td>
</tr>
<tr>
<td>Am-241</td>
<td>11.0mCi</td>
<td>0.260mCi</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pu-239</td>
<td>93.83%</td>
<td>±0.13</td>
</tr>
<tr>
<td>Pu-240</td>
<td>51.92%</td>
<td>±2.1</td>
</tr>
<tr>
<td>Pu-238</td>
<td>1.77% x 10^-2</td>
<td>±7.98</td>
</tr>
<tr>
<td>Pu-241</td>
<td>2.08% x 10^-2</td>
<td>±6.55</td>
</tr>
<tr>
<td>Pu-242</td>
<td>2.36% x 10^-2</td>
<td>±7.78</td>
</tr>
<tr>
<td>Am-241</td>
<td>9.80% x 10^-2</td>
<td>±2.59</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cs-137</td>
<td>6.06</td>
<td>± 2.09</td>
</tr>
<tr>
<td>Am</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-60</td>
<td>6.20</td>
<td>± 2.11</td>
</tr>
<tr>
<td>Ba-133</td>
<td>3.63</td>
<td>± 1.25</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.06</td>
<td>± 2.09</td>
</tr>
</tbody>
</table>

Includes TM errors.
• Make an automatic measurement of the drum activity. (#5)

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{60}$Co</td>
<td>5.37</td>
<td>$\pm 1.93$</td>
</tr>
<tr>
<td>$^{137}$Ba</td>
<td>32.74</td>
<td>$\pm 12.0$</td>
</tr>
<tr>
<td>$^{137}$Cs</td>
<td>7.21</td>
<td>$\pm 2.36$</td>
</tr>
</tbody>
</table>

Includes TMU error. #7/28/96
• Make an automatic measurement of the drum activity. (#4)

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>5.31</td>
<td>± 0.15</td>
</tr>
<tr>
<td>Ba-133</td>
<td>39.7</td>
<td>± 0.92</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.04</td>
<td>± 0.29</td>
</tr>
<tr>
<td>Co-60</td>
<td>6.23</td>
<td>± 0.15</td>
</tr>
<tr>
<td>Ba-133</td>
<td>35.02</td>
<td>± 0.66</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.65</td>
<td>± 0.27</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#6)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.24</td>
<td>± 0.25</td>
</tr>
<tr>
<td>Ba-133</td>
<td>36.46</td>
<td>± 0.88</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.23</td>
<td>± 0.27</td>
</tr>
<tr>
<td>Co-60</td>
<td>6.05</td>
<td>± 0.15</td>
</tr>
<tr>
<td>Ba-133</td>
<td>35.43</td>
<td>± 0.87</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.05</td>
<td>± 0.25</td>
</tr>
</tbody>
</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>CO-60</td>
<td>6.07</td>
<td>5.76</td>
<td>6.37</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>82-133</td>
<td>35.94</td>
<td>34.14</td>
<td>37.74</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.54</td>
<td>6.21</td>
<td>6.87</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.

Verified  
Reviewed
15.2 Repeatability Measurement with High-Density 55-gallon Drum

First load the system with a low-density 55-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>7.06</td>
<td>± .14</td>
</tr>
<tr>
<td>Ba 133</td>
<td>39.57</td>
<td>± .52</td>
</tr>
<tr>
<td>Cs 137</td>
<td>7.50</td>
<td>± .23</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>C060</td>
<td>7.12</td>
<td>± 0.14</td>
</tr>
<tr>
<td>Ba133</td>
<td>39.48</td>
<td>± 0.51</td>
</tr>
<tr>
<td>Cs137</td>
<td>7.59</td>
<td>± 0.23</td>
</tr>
</tbody>
</table>

---

Note: The table entries for Cs137 and Ba133 are listed twice, but the values are identical in each instance.
• Make an automatic measurement of the drum activity. (#3)

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>7.04</td>
<td>± .14</td>
</tr>
<tr>
<td>Ba 133</td>
<td>38.93</td>
<td>± .52</td>
</tr>
<tr>
<td>Cs 137</td>
<td>7.83</td>
<td>± .24</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#4)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>7.21</td>
<td>± 0.14</td>
</tr>
<tr>
<td>Ba 133</td>
<td>38.74</td>
<td>± 0.51</td>
</tr>
<tr>
<td>Cs 137</td>
<td>7.87</td>
<td>± 0.24</td>
</tr>
</tbody>
</table>
Make an automatic measurement of the drum activity. (#5)

Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{60}\text{Co}$</td>
<td>7.02</td>
<td>± 0.14</td>
</tr>
<tr>
<td>$^{133}\text{Ba}$</td>
<td>38.4 ± 2</td>
<td>± 0.51</td>
</tr>
<tr>
<td>$^{137}\text{Cs}$</td>
<td>7.22</td>
<td>± 0.22</td>
</tr>
<tr>
<td>$^{60}\text{Co}$</td>
<td>7.08</td>
<td>± 0.14</td>
</tr>
<tr>
<td>$^{133}\text{Ba}$</td>
<td>39.3 ± 4</td>
<td>± 0.53</td>
</tr>
<tr>
<td>$^{137}\text{Cs}$</td>
<td>7.4 ± 0</td>
<td>± 0.23</td>
</tr>
</tbody>
</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>7.37</td>
<td>6.72</td>
<td>7.42</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Ba-133</td>
<td>39.09</td>
<td>37.14</td>
<td>41.04</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.57</td>
<td>7.19</td>
<td>7.95</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.

Verified: [Signature] 7/29/96
Reviewed: [Signature] 7/29/96
15.3 Repeatability Measurement with Low-Density 85-gallon Overpack

First load the system with a low-density 5-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.54</td>
<td>± 0.13</td>
</tr>
<tr>
<td>Cs-133</td>
<td>38.83</td>
<td>± 0.51</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.47</td>
<td>± 0.21</td>
</tr>
<tr>
<td>Am-241</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-60</td>
<td>6.42</td>
<td>± 0.12</td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.91</td>
<td>± 0.51</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.85</td>
<td>± 0.20</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.52</td>
<td>± .13</td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.74</td>
<td>± .49</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.17</td>
<td>± .21</td>
</tr>
<tr>
<td>Am-241</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co-60</td>
<td>6.45</td>
<td>± .12</td>
</tr>
<tr>
<td>Ba-133</td>
<td>29.23</td>
<td>± .51</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.37</td>
<td>± .21</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (##)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>6.42</td>
<td>±.13</td>
</tr>
<tr>
<td>Ba 133</td>
<td>39.21</td>
<td>±.52</td>
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<tr>
<td>Cs 137</td>
<td>7.01</td>
<td>±.20</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WASIDISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>6.43</td>
<td>± 0.12</td>
</tr>
<tr>
<td>Ba 133</td>
<td>39.18</td>
<td>± 0.51</td>
</tr>
<tr>
<td>Cs 137</td>
<td>7.31</td>
<td>± 0.21</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#6)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
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</thead>
<tbody>
<tr>
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<tr>
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</tr>
<tr>
<td>already recorded</td>
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</tr>
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</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
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<td>6.79</td>
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<td>0</td>
</tr>
<tr>
<td>82 132</td>
<td>39.01</td>
<td>38.06</td>
<td>40.96</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>137 137</td>
<td>7.20</td>
<td>6.84</td>
<td>7.56</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/28/96</td>
<td>7/29/91</td>
</tr>
</tbody>
</table>
15.4 Repeatability Measurement with High-Density 85-gallon Overpack

First load the system with a low-density 85-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.43</td>
<td>0.13</td>
</tr>
<tr>
<td>Ba-133</td>
<td>37.83</td>
<td>0.61</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.18</td>
<td>0.23</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.58</td>
<td>0.14</td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.66</td>
<td>0.60</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.23</td>
<td>0.23</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#3)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.53</td>
<td>± 1.13</td>
</tr>
<tr>
<td>Be-133</td>
<td>39.46</td>
<td>± 0.58</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.13</td>
<td>± 0.23</td>
</tr>
</tbody>
</table>
• Make an automatic measurement of the drum activity. (#4)

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.53</td>
<td>0.14</td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.46</td>
<td>0.61</td>
</tr>
<tr>
<td>Cs-137</td>
<td>6.93</td>
<td>0.22</td>
</tr>
</tbody>
</table>

...
- Make an automatic measurement of the drum activity. (#5)
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Particle bowl #5</th>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.55</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.66</td>
<td>.61</td>
<td></td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.10</td>
<td>.22</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Particle bowl #6</th>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.55</td>
<td>.14</td>
<td></td>
</tr>
<tr>
<td>Ba-133</td>
<td>38.45</td>
<td>.57</td>
<td></td>
</tr>
<tr>
<td>Cs-137</td>
<td>7.09</td>
<td>.23</td>
<td></td>
</tr>
</tbody>
</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>6.52</td>
<td>6.20</td>
<td>6.85</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Ba 133</td>
<td>38.42</td>
<td>36.50</td>
<td>40.34</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cs 137</td>
<td>7.11</td>
<td>6.75</td>
<td>7.47</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, there are no more than 2 measurements outside of ±5% of the mean value.

Verified: [Signature] 7/29/96
Reviewed: [Signature] 7/29/96
16. Abort and Error Conditions

16.1 Abort of Measurement during Automatic Operation

When a measurement is in progress, there will occasionally be a message box with an Abort button. While this is displayed, the measurement can be aborted. The abort message issued when this message box is not displayed will be saved in the message queue, and will be processed when the next valid abort period occurs.

- Send an Abort command at different stages of the measurement.
- Confirm that abort occurs.

16.2 Software Error During Automatic Measurement

- Have the project engineer set up the system to fail during analysis, such as bad setup of analysis operations.
- Perform an automatic measurement, and note the status when the failure occurs.

16.3 Software Error During Manual Measurement

- Continue with the system still set up to fail during analysis, such as bad setup of analysis operations.
- Perform a manual measurement, and note the error message when the failure occurs.
16.4 Mechanical Failure During Automatic Measurement

- Start with the drum unloaded from the station.
- Place some material in the path so that a drum cannot be fully loaded.
- Start an automatic measurement, and note that a status is reported for mechanical difficulty in the load process.
- Remove the obstruction and restore the system.

16.5 Mechanical Failure During Manual Measurement

- Start with the drum unloaded from the station.
- Place some material in the path so that a drum cannot be fully loaded.
- Start a manual measurement, and note the error reported for mechanical difficulty in the load process.
- Remove the obstruction and restore the system.
17. Test of Safety Conditions

17.1 Transmission Source

- Go to Manual Operations on the main menu.
- Check that the door is open, as if a drum has been unloaded. If it is not open, unload the drum.
- Select Other Controller Functions.
- Select Open transmission source shutter.
- Note that an error occurs, and that there is no noise indicating the shutter opening.

With the door still open, go to Calibration Operations.
- Select count, then Transmission.
- On the next screen check Disable Load/Unload. Enter a count time of 100 seconds. (The other settings do not matter.) Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.

With the door still open, start a count in Manual Operations.
- Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.

With the door still open, start a count in Routine Operations, with Disable Load/Unload checked.
- Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.
17.2 Door Tape Switch

Manual Operations
- Start with the door open after a drum unload.
- Go to Manual Operations, and select Load/Unload/Transport
- Perform a Load operation, and as the door starts to shut, hit the tape switch.
- Note that the door motion stops, and an error message is displayed on the screen.
- Turn power back on to the PLC.
- Acknowledge the error, then return to the manual operations menu. (If you acknowledge the error before turning power back on, a new error message will be generated.) The PLC will be initialized.

Temporary Operations
- Perform an automatic measurement of a drum, starting with loading a drum.
- As the door starts to shut, hit the tape switch.
- Note that the door motion stops since power to the PLC will be turned off.
- When the PC next sends a command to the PLC, an error message is displayed on the screen, and a status message is sent to the PCS.

Note: If a motion is occurring when the tape switch is hit, the error message and PCS status message will occur at that time. If there is no motion, other than rotation, then the error message will occur at the next command to the PLC.

- Turn power back on to the PLC.
- Acknowledge the error. The PLC will be initialized.
- Now exit to manual mode, then logon to the system and go to Manual Operations
- Now restore the system, by unloading the drum.

17.3 Emergency Stop
This is equivalent to the tape switch, but has a different error code in the status message.

- Perform a routine count, including drum loading.
- At some point in the process, press either one of the emergency stop buttons.
- Note that the system stops, and an error message is displayed.
- Turn PLC power back on.
- Acknowledge the error.
- Then go to Manual Operations and unload the drum so that it is ready for the next count.

Perform an automatic measurement of a drum.
- At some point in the process, press either one of the emergency stop buttons.
- Note that the system stops because there is no power to the PLC.
- When the GEA PC next sends a command to the PLC, an error message is displayed on the screen, and a status message is sent to the PCS.
- Acknowledge the error.
- Now exit to manual mode, then logon to the system and go to Manual Operations
- Unload the drum.
18. Maintenance Functions

18.1 Liquid Nitrogen Fill Sequence

- Select Manual Operations on the main menu.
- Select Start LN2 Fill.
- A screen will be displayed asking for confirmation. Select Yes.
- The LN2 filling will start, and will continue until complete. (The filling is performed automatically on a clock cycle so that manual filling is not required in normal operation.)

18.2 Add or Change of Username or Password

- Select User Management on the main menu.
- Select Edit Password File on the User Management menu.
- On the next screen highlight one of the usernames, and press Edit Security Settings.
- On the next screen note privileges and password options.
- If desired, go back one screen and create a new username and password.
- Then log out of the software.
- Then log on with the new username and password to confirm that it has been accepted.
3-21-96  08:26p  Directory A:\*.*

| Current  <Dir>                      | ..  Parent  <Dir>                      |
| 21600260.TXT  3,296 08-21-96 05:08p | 21600261.TXT  3,337 08-21-96 05:56p |
| 21600262.TXT  3,296 08-21-96 05:56p | 21600263.TXT  3,296 08-21-96 06:21p |
| 21600264.TXT  3,296 08-21-96 06:21p |                  |

GEA 20-grnm manual

Assays

8/21/96
**General Message Type:** GEASIE  
**Specific Message Type:** RESG  
**Ornament Identification:** 1  
**Measurement Start Time:** Wed Aug 21 17:50:24 1996  
**Number of Radionuclides:** 25

<table>
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<th>Listed</th>
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**MGA Results**

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<th>SOD</th>
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**Live Time:** 8.300400e+02
Real Time: 1.022170e+03

NUDS data
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0.000000  0.000000

Number of Segments: 10
Pu Activity Matrix Correction Method 1 2 3 4 5

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ECAL data
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Number of ROIs: 3
Start  Stop  Count
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3392  3680  9963.786692
General Message Type : GEASIE
Specific Message Type : RESG
Drum Identification : 2
Number of Radionuclides : 25

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MGA Results
Pu-238 3.691063e-02 3.208044e+00
Pu-239 9.101748e+01 0.543536
Pu-240 8.601739e+00 1.172693e+00
Pu-241 3.061884e+00 9.233958e+00
Pu-242 3.767449e+00 7.118827e+00
Am-241 2.367155e+00 1.073867e+00

Number of Peaks : 10

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Real Time: 5.581500e+02

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Number of Segments: 10

Pu Activity Matrix Correction Method 1 2 3 4 5

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| 0.000000 MEAN | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 | 0.000000 |

ECAL data

| -0.864970 | 0.500322 | 0.000000 |

Number of ROIs: 3

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Specific Message Type :RESG  
Drum Identification :3  
Number of Radionuclides : 25  
Radionuclide Name | Activity | Uncert | MDA | Listed | SOD  
--- | --- | --- | --- | --- | ---  
K-40 | 0.000001 | 0.000000 | T | F | LOD  
CO-60 | 0.000000 | 0.000000 | T | F | LOD  
KR-85 | 0.000038 | 0.000000 | T | F | LOD  
NB-94 | 0.000000 | 0.000000 | T | F | LOD  
NB-95 | 0.000000 | 0.000000 | T | F | LOD  
ZR-95 | 0.000000 | 0.000000 | T | F | LOD  
RU-166 | 0.000001 | 0.000000 | T | T | LOD  
SB-125 | 0.000000 | 0.000000 | T | F | LOD  
BA-133 | 0.000000 | 0.000000 | T | F | LOD  
CS-134 | 0.000000 | 0.000000 | T | F | LOD  
CS-137 | 0.000000 | 0.000000 | T | F | LOD  
CE-144 | 0.000012 | 0.000000 | T | F | LOD  
PR-144 | 0.000013 | 0.000000 | T | F | LOD  
EU-152 | 0.000001 | 0.000000 | T | F | LOD  
EU-154 | 0.000000 | 0.000000 | T | F | LOD  
TH-232 | 0.000000 | 0.000000 | T | F | LOD  
U-233 | 0.013297 | 0.000000 | T | T | LOD  
U-235 | 0.000000 | 0.000000 | T | F | LOD  
NP-237 | 0.000001 | 0.000000 | T | F | LOD  
U-238 | 0.000017 | 0.000000 | T | F | LOD  
Pu-239 | 0.113020 | 0.007402 | F | T | DEFAULT  
AM-241 | 0.016164 | 0.001059 | F | T | DEFAULT  
Pu-241 | 0.625818 | 0.040987 | F | F | DEFAULT  
AM-243 | 0.000021 | 0.000002 | F | F | DEFAULT  
CM-245 | 0.000008 | 0.000000 | T | F | LOD  

MGA Results  
Pu-238 3.711113e-02 3.217699e+00  
Pu-239 9.088183e+01 0.559459  
Pu-240 8.739835e+00 1.176166e+00  
Pu-241 3.030774e-01 1.280704e+00  
Pu-242 3.814741e+02 7.119501e+00  
Am-241 2.352268e+00 1.095714e+00  

Number of Peaks : 9  
Energy Centroid | Net Peak Area | Uncert on Area  
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745.850769 | 6185.564453 | 216.797241  
823.169861 | 7638.696289 | 180.330704  
3559.221436 | 83371.218750 | 390.553314  
3628.805908 | 411903.593750 | 862.226990  
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Live Time :4.529200e+02
Real Time: 5.591100e+02

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Number of Segments: 10

Pu Activity Matrix Correction Method 1 2 3 4 5

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ECAL data

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Number of ROIs: 3

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Specific Message Type :RESG
Drum Identification :4
Number of Radionuclides : 25

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<th>MDA</th>
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<th>LOD</th>
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MGA Results
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Pu-239 9.094949e+01 0.529633
Pu-240 8.667862e+00 1.047216e+00
Pu-241 3.062181e-01 8.236647e-01
Pu-242 3.7587254e-02 7.105432e+00
Am-241 2.331033e-01 9.748092e-01

Number of Peaks : 9

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Number of Segments: 10

Pu Activity Matrix Correction Method 1 2 3 4 5

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**MGA Results**
- Pu-238: 4.149100e-02, 2.998574e+00
- Pu-239: 9.069640e+01, 0.566559
- Pu-240: 8.902921e+00, 1.189342e+00
- Pu-241: 3.199250e-01, 7.123848e+00
- Pu-242: 3.882226e-01, 1.13016e+00

**Number of Peaks:** 9

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**Live Time:** 4.517500e+02
Real Time: 5.577300e+02

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Pu Activity Matrix Correction Method 1 2 3 4 5

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Revision History

Rev. A  Initial release
Rev. B  Revisions to include comments from WHCo.
1. INTRODUCTION

1.1 Description of Test Procedure

1.2 Relevant Documents

2. INSPECTION OF COMPONENTS AND LABELING

3. DEFINITIONS FOR COUNTER / ARRANGEMENT / GROUP

4. VERIFY SETUP AND PARAMETERS: GWAS FUNCTIONS

4.1 Setup of Units and Data Location

4.2 Container Type Setup

4.3 Counter / Arrangement / Group Setup

4.4 MID Setup

4.5 DMSS Setup

4.6 Certificate Files

5. VERIFY SETUP AND PARAMETERS: GEA-SPECIFIC FUNCTIONS

5.1 High Count Rate Threshold

5.2 Listed/Non-listed Nuclide Flags

5.3 ROI Start and Stop Channels

5.4 Pu Criticality Level

5.5 TMU Setup
5.6 Automatic Operation Setup

6. CALIBRATION OPERATIONS

6.1 Energy Calibration of SEGE and LEGE Detectors
   6.1.1 Energy Calibration Setup

6.2 Energy Calibration of Low-Energy Detectors

6.3 Reference Peak Calibration

6.4 Transmission Calibration

6.5 Segment Efficiency Calibration

6.6 Calibration Approval for Segment Efficiency

6.7 Summed Spectrum Efficiency Calibration
   6.7.1 Calibration Setup
   6.7.2 55-gallon drums without absorber
   6.7.3 55-gallon Drums with Absorber
   6.7.4 85-gallon Overpack without Absorber
   6.7.5 85-Gallon Overpack with Absorber

6.8 Calibration Approval for Summed Segment Spectra

7. MEASUREMENT IN LOCAL MODE

7.1 Start a Count

7.2 Analyze Existing Count

7.3 Turn On/Off HVPS

7.4 Manual Load / Unload

8. ROUTINE COUNTS

9. TEST OF MINIMUM TRANSMISSION

10. SENSITIVITY TESTING

   10.1 Pu-239 Sensitivity

   10.2 Sensitivity

   10.3 Cs-137 and Co-60 Sensitivity

11. TMU SETUP AND TEST
12. TEST OF REMOTE (AUTOMATIC) OPERATION

12.1 Status Messages
   12.1.1 GEA Initialization
   12.1.2 GEA in Manual (Local) Mode

12.2 Drum Measurement

12.3 Test of Absorber Use

12.4 Test of SIE Message Drum Status
   12.4.1 SIE Message with Drum Status CERT
   12.4.2 SIE Message with Drum Status CERT
   12.4.3 SIE Message with Drum Status VERF_HI
   12.4.4 SIE Message with Drum Status VERF_LO
   12.4.5 SIE Message with Drum Status BACK

13. TEST OF PU CRITICALITY MESSAGE

14. TEST OF PLUTONIUM ISOTOPIC RATIOS

15. REPEATABILITY MEASUREMENTS

15.1 Repeatability Measurement with Low-Density 55-gallon Drum

15.2 Repeatability Measurement with High-Density 55-gallon Drum

15.3 Repeatability Measurement with Low-Density 85-gallon Overpack

15.4 Repeatability Measurement with High-Density 85-gallon Overpack

16. ABORT AND ERROR CONDITIONS

16.1 Abort of Measurement during Automatic Operation

16.2 Software Error During Automatic Measurement

16.3 Software Error During Manual Measurement

16.4 Mechanical Failure During Automatic Measurement

16.5 Mechanical Failure During Manual Measurement

17. TEST OF SAFETY CONDITIONS

17.1 Transmission Source

17.2 Door Tape Switch

17.3 Emergency Stop
18. MAINTENANCE FUNCTIONS

18.1 Liquid Nitrogen Fill Sequence

18.2 Add or Change of Username or Password
1. Introduction

1.1 Description of Test Procedure

This test procedure is designed to test all of the functions of the GEA system at the WRAP facility at Hanford, Washington. The procedure is designed to be executed in the sequence given, starting with:

- verification of components and labeling
- verification or entry of all of the setup parameters
- performing the calibrations (energy, efficiency, transmission, and reference peak)
- performing the measurements in local mode
- performing the measurements in remote mode
- confirming the message formats
- utility operations (LN2 fill, archiving, password maintenance)

The system is designed to be operated in a remote mode in which all commands are received over a network, and the results are returned over the same network. A manual mode is provided for the setup and calibration operations, and for maintenance functions.

The system is designed to start up in remote mode. The user can go to local mode when at the keyboard by selecting Exit on the screen shown during remote mode. A user logon screen, requiring a username and password, limits access to local mode.

1.2 Relevant Documents

The primary reference document for this test procedure is the Detailed Software Design Specification. All of the material covered here has been described in that document. It is number 11 in the list below. Other contract documents are also listed.

Note that the description of the general purpose Genie PC Waste Assay Software (GWAS) software is given in references 12 and 13, the GWAS User Manual and the GWAS Technical Reference Manual. Although these are not yet in final form, they are complete enough to serve as guides to using the system.


4) "GEA System Design Description," Canberra Industries, version 1.1, 6-Jan-95.


6) WHC-EP-0063, as duplicated in specification 13026, Table 1.


2. Inspection of Components and Labeling

Inspection of components and labeling is to be done with reference to drawings of the system. These drawings are supplied separately. The inspection of components and labeling has been done previously by Canberra for Pajarito Scientific Co., so it is suggested that only selected miscellaneous components and labels be checked.

Mechanical System

- Locate the following drawing number and sheets in Appendix A.2. of the WRAP GEA System KEH 5369 Installation and Maintenance Manual. (Referred to hereafter as I&M.)

<table>
<thead>
<tr>
<th>Drawing number</th>
<th>Sheet number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>94104</td>
<td>1</td>
<td>GEA Shield. Top level assembly.</td>
</tr>
<tr>
<td>1A</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- Examine the system to see that it is anchored properly.
- Confirm that the detectors are in place, that the signals and HV are connected, and have the LN2 fill lines connected.
- Confirm that all junction boxes are closed and secured.
- Confirm that the overtravel tape switches are in place.
- Ensure that there is access to all junction boxes.
- Confirm that the access door to the transmission sources is locked.

Go to the PC for the GEA system and turn on power.

After the system has booted up, open an OS/2 window and enter the commands:
The program will respond with:
PLC COM port assumed to be COM1.
PLC baud rate assumed to be 19200.
Asynchronous communications mode has been set.

Enter the number of your selection:
1. Read a PLC register
2. Write a PLC register
3. Send a PLC command
4. Get PLC status
5. Clear PLC error
X. Exit utility

This program is a general purpose routine. We will use only the sections for writing a value into a PLC register and sending commands to the PLC.

**Loading a 55-gallon drum**
- Select 2 for writing into a PLC register, then enter a 1 into register R19. (This is for container type 1, the 55 gallon drum.) A series of menus prompt for the input required:
  - Select register: R
  - Enter number: 19
  - Length of message: 1 (word)
  - Data format: D (decimal)

- Return to the main menu.

- Place a 55-gallon drum on the in-feed conveyor.

- Enter a 3 for sending a command to the PLC.

The program will then prompt for primary or secondary commands. There are no secondary commands for the GEA system. We will use only the primary counter commands.

- Select the menu item for counter commands.

The counter commands will be listed:

```
LOAD_I = 20   (container type no. in R19)
LOAD_II = 21
```
UNLOAD_I = 22
UNLOAD_II = 23
OPEN_TRANSMISSION_SHUTTER = 24
CLOSE_TRANSMISSION_SHUTTER = 25
SET_TRANSMISSION_POSITION = 26
MOVE = 27

SET_GEOMETRY = 28  (N/A)
POSITION_ADD_A_SOURCE = 29  (N/A)
PREPARE_FOR_BACKGROUND = 30
READ_WEIGHT = 31  (N/A)
READ_DOSIMETER = 32  (N/A)
READ_GEOMETRY = 33  (returns geo. no. in R19)
TRANSPORT = 34  (N/A)
PREPARE_FOR_MEASUREMENT = 35  (container type no. in R19)

- Enter 20 for "LOAD_I" which is load phase 1.
- Note that the conveyors turn on and the drum is moved into the station.
- Enter 21 for "LOAD_II" which is load phase 2.
- Note that the door closes. The turntable will start rotating, as indicated by the yellow light on the light stack remaining on after the door is closed.

Transmission Source Motion

- Enter 24 for opening the transmission shutter (actually it is moving the transmission sources up into position).
- Note that there is a sound of the sources being moved into position.
- Enter 25 for closing the transmission shutter (moving the sources down).
- Note that there is a sound of the sources moving down.
Unload Phase I and Absorber

- Enter 22 for “UNLOAD_I” for unload phase 1.
- The turntable will stop rotating, and the door will open.
- Enter 28 for setting geometry (the absorber position).
- Note that the absorber moves into place.

Platform Position

- Return to the main menu and select option 2 for writing a PLC register.
- Enter 200 into register R11. (The value is mm above “load” position. 0 = load position)
- Return to the main menu and select 3 for sending a PLC command.
- Select the primary counter commands.
- Enter a 27 for move scanning position.
- Note that the platform moves.
- Return to the main menu and select option 2 for writing a PLC register.
- Enter 0 into register R11. (The value is mm above “load” position. 0 = load position)
- Return to the main menu and select 3 for sending a PLC command.
- Select the primary counter commands.
- Enter a 27 for move scanning position.
- Note that the platform moves back to original position.
(Note: It is not necessary to specify container type to do an unload. Whatever container is present will be unloaded.)

- Return to the main menu and select 3 for sending a PLC command.
- Select the primary counter commands.
- Enter a 23 for unload phase 2.
- Note that the conveyors turn on and the drum is unloaded.
- When finished, exit the program and exit the OS/2 window.

---

**Electrical and Electronics Assembly**

- Locate the following drawings and sheet numbers in the I & M Manual.

<table>
<thead>
<tr>
<th>Drawing number</th>
<th>Sheet number</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>94114</td>
<td>1</td>
<td>System block diagram</td>
</tr>
<tr>
<td>94115</td>
<td>1</td>
<td>Power distribution</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Safety interlocks</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>Position and safety device inputs</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>PLC inputs</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>PLC outputs</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>LN2 autofill components</td>
</tr>
</tbody>
</table>
For each of the drawings, locate a representative terminal strip or junction box tie point or motor connection on the drawing, then on the equipment.

Confirm that the labeling is adequate to locate the item selected.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Signature] 6/12/96</td>
<td>[Signature] 6/17/96</td>
</tr>
</tbody>
</table>
3. Definitions for Counter / Arrangement / Group

It is important to understand the concepts of counters, arrangements and groups, as used in GWAS. The relationship of these to count types and analysis sequence files is also important to know.

Here are the definitions:

counter The physical configuration of shield, detectors, collimators, transmission sources, and electronics.

arrangement A specific position of detectors, collimators, or movable platforms in the counter.

detector group, or group

The actual detectors used. The full counter may consist of several different detector groups.

count type A particular counting operation, like sample counting, calibration check, or background.

analysis sequence file

The prescription for the data analysis to be performed on a particular detector group.

The hierarchy is the following:

Counter

Arrangement ---- count type

Detector group ---- analysis sequence file

When creating a counter and defining the arrangement, default count types are created for you by the software.

Similarly, when creating the detector groups, default analysis sequence files are defined.

The menu sequence is arranged in the following way:
Counter
  | Arrangement
  | Count Type
  | Detector Group
  | Analysis

Since the detector group's analysis functions will depend upon the count type, the count type must be selected before setting up any of the detector group and analysis.

At the counter level, the user must specify if there is scanning, movable collimators, transmission sources, or multi-spectrum storage (MSS) modules for data as a function of angle. Also, the instrument interface must be specified as PLC. The PLC is for controlling platform movement, collimators, and transmission shutter.

At the arrangement level, for scanning systems, the segment definition must be provided.

The count type screen allows definition of:
- container type
- preset time
- whether manual load/unload or not
- barcode reader or not

(abling/disabling of MSS and scanning is also provided)

The detector group definition consists of:
- segmented or not (to be used with scanning system)
- the actual detectors

The analysis definition consists of defining the analysis sequence files to be used in the standard and batch analyses.

**GEA Definitions**

The GEA counter definition includes two arrangements, with two count types each, and three detector groups. (Additional count times are also provided in the standard software for background measurement, background check, and calibration check.) In summary these are:
The counter has:
- two arrangements:
  1) 55-gallon drum segment definitions for the PLC
  2) 85-gallon drum segment definitions for the PLC

Each arrangement has the three detector groups and two count types:
- detector groups
  1) Lower LEGE detector
  2) Upper LEGE detector
  3) Four scanning coax (SEGE) detectors
- count types
  1) <= 250 pound drums
  2) > 250 pounds drums

Note: By default the GWAS system defines four count types:
  Sample
  Background check
  Calibration check
  Environmental background

The “sample” count type has been defined as “<= 250 pound drums,” and a new count type has been added for > 250 pounds.

Note: In the GWAS software, “collimator” specifications are used to set up the attenuator positions of “attenuated” and “not attenuated.” These can also be referred to as “absorber in position” or “absorber out.”

The number of collimator positions is set up in the arrangement editor, and the use of automatic selection of collimator position is selected in the count type editor.

Detector Groups
In the GWAS software, if a detector group has more than one detector, the spectra are summed and analyzed. If the group is “non-segmented,” then the individual detector spectra are not saved or analyzed. There can only be one segmented detector group in the GWAS software.

The four SEGE detectors are defined as a segmented, scanning group. Individual segment spectra are saved and analyzed, as well as the sum of the spectra. (The spectra from different detectors are shifted to the same energy calibration before being summed.)

Each LEGE detector is defined as a single-detector group.
Preset count time
This time is based upon the weight of the drum. The preset count time is contained in the count types defined for each arrangement, and these are for drums of less than or equal to 250 pounds, and more than 250 pounds.

Pre-Count
The pre-count option is used to select one of the two absorber (collimator) positions. The selection is based on the dead time in the detector selected in a setup screen. (The count time and limiting dead time to switch between absorbers is also entered in the setup screen.)
4. Verify Setup and Parameters: GWAS Functions

These functions are performed in local mode.

- The system should be powered on. It will automatically start in the automatic mode.

- Select Exit on the screen shown for automatic counting (remote mode).

- On the login screen, enter "manager" for the username, and nothing for the password.

- The main menu will now appear.

4.1 Setup of Units and Data Location

- On the main menu select Utility Operations.

- On the Utility Operations menu select Genie PC WAS Setup.

- On the next screen select disk C: and enter directory WAS_DATA for the data archive directory.

- Select units as follows (Choose set desired - used in Container Parameters):

  Length: cm in
  Weight: Kg lbs.
  Volume: liters (l) gal.

- Do not check matching container type under background.

4.2 Container Type Setup

- Return to the main menu by pressing the Escape key or the Prev button on the screen.

- On the main menu select Utility Operations, then Editors.

- On this menu, select Container Type Editor.
If more than one container has been defined, select one of the definitions.

On the next screen, confirm that the following data has been entered:
Note: Empty container weight of zero is used since SIE computer supplies net weight, and GWAS automatically subtracts empty weight.

<table>
<thead>
<tr>
<th>Standard 55 gallon drum</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: 55-gal. drum</td>
<td></td>
</tr>
<tr>
<td>Material handling type:</td>
<td>1</td>
</tr>
<tr>
<td>Diameter:</td>
<td>61.0 cm 22.5 in.</td>
</tr>
<tr>
<td>Geometric correction factor:</td>
<td>0.823</td>
</tr>
<tr>
<td>Volume:</td>
<td>208 liters 55 gal.</td>
</tr>
<tr>
<td>Empty weight:</td>
<td>0 Kg 0 lbs.</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
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</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>85 gallon overpack</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Type: 85-gal. overpack</td>
<td></td>
</tr>
<tr>
<td>Material handling type:</td>
<td>0</td>
</tr>
<tr>
<td>Diameter:</td>
<td>63.5 cm 26 in.</td>
</tr>
<tr>
<td>Geometric correction factor:</td>
<td>0.823</td>
</tr>
<tr>
<td>Volume:</td>
<td>322 liters 85 gal.</td>
</tr>
<tr>
<td>Empty weight:</td>
<td>0 Kg 0 pounds</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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<tbody>
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<td>[Signature] 6/19/96</td>
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</tbody>
</table>

4.3 Counter / Arrangement / Group Setup

4.3.1 Counter definition

- On the main menu, select Utility Operations, then Counter Maintenance.

- The next screen (the Counter Maintenance screen) will show the existing counter definitions. (In the discussion below, if the data or items do not exist, then create them to match the information provided.)

- There is only one counter defined. Select Edit. The Counter Parameter Edit screen will appear.

- The description should be "GEA" or the like.
Enter the facility name, "WRAP."

For the interface setup, Select PLC.

For the analysis section,
- "Scanning platform?" should be checked.
- "Transmission source?" should be checked.
- "MSS module?" should be checked.
- "Collimator?" should be checked.

Set the sequence number to some integer value (it is incremented for each data acquisition).

Select Interface setup on this screen to get a new screen with PLC parameters:
- The Comm. port should be set to COM1.
- The baud rate should be set to 19200.
- All register values should be zero except for R21 and R22.
  R21 = time until next autofill, in minutes
  For 12 hours, set this to 12 x 60 = 720
  If zero, there is no autofill.
  R22 = error timeout for the fill, in minutes.
  Default PLC value is 20 minutes. Set to 20 or longer so that the fill is terminated in case of problems. (If det. are warm, a longer time may be needed.)

4.3.2 Arrangement Setup

Return to the Counter Maintenance screen and select Arrangements.

The Arrangement Operations screen will appear, listing two arrangements, "55 gal. drum" and "85 gal. overpack."

Select 55 gallon drum, then Edit.

On the Edit Arrangement Parameters screen, the description should be "55 gal. drums."

Start position should be 178 mm (7.01")

Position delta should be -89 mm (3.50")

Number of positions should be 3.

Separated segments? should not be checked.

For number of segments should be 11.

Segment offset should be 1.

For number of collimator positions, enter 2.
• Return to the previous menu (Arrangement Operations).
• Select the 85 gallon overpack and then Edit.
• On the Edit Arrangement Parameters screen, the Start position should be 178 mm (7.01")
• Position delta should be -89 mm (3.50")
• Number of positions should be 3.
• Separated segments? should not be checked.
• For number of segments should be 12.
• Segment offset should be 1.
• For number of collimator positions, enter 2.

4.3.3 Count Type Setup

• Return to the Arrangement Operations screen.
• Select 55 gallon drums.
• Select count type. The Count Type Operations screen will appear.
• Select the count type “<= 250 pound drums”, then Edit.
• Set the description to “< 250 pound drums
• Check the box for default count type in automatic operations.
• Under the sample information section,
  - Set the information type to “Sample”
  - “Use sample database?” should not be checked.
  - Container type should be “55 gallon drum.”
• Under the preset time section,
  - Set preset time with transmission to 30 seconds.
  - Set preset time without transmission to 110 seconds.
  - Set transmission selection to “Two-pass”
  - Set collimator position to 0 (it will be automatically set to the position needed.)
  - “Auto collimation?” should be checked.
  - “MSS enabled?” should be checked.
  - “Scanning enabled?” should be checked.
  - “Barcode reader?” should not be checked.
  - “Disable load/unload?” should not be checked.
Return to the Count Type Operations screen.
Select “> 250 pound drums”, then Edit.
Set the parameters all the same as for the <= 250 pound drums, except for the preset times, which should be:
50 seconds for with transmission
190 seconds for without transmission

Return to the Arrangement Operations screen.
Select 85 gallon drums.
Select count type.
Select the count type “<= 250 pound drums” then Edit.
Set the description to <= 250 pound drums
Check the box for default count type in automatic operations.
Under the sample information section,
- Set the information type to “Sample”
- “Use sample database?” should be not checked.
- Container type should be “85 gal. overpack”
Under the preset time section,
- Set preset time with transmission to 30 seconds.
- Set preset time without transmission to 110 seconds.
- Set transmission selection to “Two-pass”
- Set collimator position to 0 (it will be automatically set to the position needed.)
- “Auto collimation?” should be checked.
- “MSS enabled?” should be checked.
- “Scanning enabled?” should be checked.
- “Barcode reader?” should not be checked.
- “Disable load/unload?” should not be checked.

Return to the Edit Count Type Parameters screen.(with 85 gallon overpacks)
Select “> 250 pound drums”, then Edit.
• Set the parameters all the same as for the <= 250 pound drums, except for
the preset times, which should be:
  50 seconds for with transmission
  190 seconds for without transmission

4.3.4 Group (Detector Group) Setup

**LEGE Detectors, 55-gallon drum arrangement**

• Return to the Arrangement Operations screen and highlight 55-gal drums,
then select Groups. The Detector Group Operations screen will be
displayed.
• There should be three groups listed:
  Upper LEGE
  Lower LEGE
  SEGEs
• Highlight “Upper LEGE” then Edit.
• There should be a single detector listed: DET:LEGE5
• The “Segmented?” box should not be checked.

• Return to the Detector Group Operations screen, highlight “Upper Lege” and
select Analysis.
• On the next screen (Analysis Setup Operations) highlight the count type “<=
250 pound drums” and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report
check box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not
checked.
• Return to the previous screen (Analysis Setup Operations), highlight >250
pound drums, and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report
check box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.

Return to the Detector Group Operations screen and select the “Lower LEGE”, then Edit.
• There should be a single detector listed: DET:LEGEO
• The “Segmented?” box should not be checked.

Return to the Detector Group Operations screen, highlight “Lower LEGE” and select Analysis.
• On the next screen (Analysis Setup Operations) highlight the count type “<= 250 pound drums” and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.
• Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the box should be checked.
• The analysis sequence file selected should be MGA.ASF.
• Processing information should be set to Normal, and View report not checked.

Return to the Arrangement Operations screen and highlight 85-gal drums, then select Groups. The Detector Group Operations screen will be displayed.
• There should be three groups listed:
Upper LEGE
Lower LEGE
SEGEs
- Highlight "Upper LEGE" then Edit.
- There should be a single detector listed: DET:LEGE5
- The "Segmented?" box should not be checked.

- Return to the Detector Group Operations screen, highlight "Upper LEGE" and select Analysis.
- On the next screen (Analysis Setup Operations) highlight the count type "\( \leq 250 \) pound drums" and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report check boxes should be checked.
- The analysis sequence file selected should be MGA.ASF.
- Processing information should be set to Normal, and View report not checked.
- Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
- On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.
- The analysis sequence file selected should be MGA.ASF.
- Processing information should be set to Normal, and View report not checked.

- Return to the Detector Group Operations screen and select the "Lower LEGE".
- There should be a single detector listed: DET:LEGE6
- The "Segmented?" box should not be checked.

- Return to the Detector Group Operations screen, highlight "Lower LEGE" and select Analysis.
• On the next screen (Analysis Setup Operations) highlight the count type "<= 250 pound drums" and select Edit.

• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.

• The analysis sequence file selected should be MGA.ASF.

• Processing information should be set to Normal, and View report not checked.

• Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.

• On the next screen (Edit Analysis Parameters) the Group Analysis/Report the check box should be checked.

• The analysis sequence file selected should be MGA.ASF.

• Processing information should be set to Normal, and View report not checked.

SEGE Detectors. 55-gal. Arrangement

• Return to the menu for Arrangement Operations, highlight 55-gal. Drums, and select Groups.

• On the next menu select "SEGEs" and press Edit.

• The detectors listed should be:
  DET: SEGE4
  DET: SEGE3
  DET: SEGE2
  DET: SEGE1

• The "Segmented?" box should be checked.

• Return to the Detector Group Operations screen and select Analysis.

• On the next screen (Analysis Setup Operations) highlight the count type "<= 250 pound drums" and select Edit.

• On the next screen (Edit Analysis Parameters) the setup should be:
  – Enable and select ASF file for non-transmission segment: SEGTRCOR.ASF
- Enable and select ASF file for transmission segment: SEGTRANS.ASF
- Enable Combine non-segmented groups: COMBMGA.ASF
- Enable Analyze shift-summed segments: SEGSUM.ASF
- Enable Merge segment NID results: COMBSEG.ASF
- Enable Combine segment shift-summed with NID results: COMBNID.ASF
- Enable Combine all results: COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

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Reviewed: [Signature] 6/19/96

- Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.
- On the next screen (Edit Analysis Parameters) the setup should be:
  - Enable and select ASF file for non-transmission segment: SEGTRCOR.ASF
  - Enable and select ASF file for transmission segment: SEGTRANS.ASF
  - EnableCombine non-segmented groups: COMBMGA.ASF
  - Enable Analyze shift-summed segments: SEGSUM.ASF
  - Enable Merge segment NID results: COMBSEG.ASF
  - Enable Combine segment shift-summed with NID results: COMBNID.ASF
  - Enable Combine all results: COMBALL.ASF
  - Do not enable Report?
  - Do not enable View report on screen?

Set Processing to Normal.

Verfied: [Signature] 6/18/96
Reviewed: [Signature] 6/19/96

SEGE Detectors, 85-gal. Arrangement

- Return to the menu for Arrangement Operations, highlight 85-gal. Overpacks, and select Groups.
- On the next menu highlight “SEGEs” and select Edit.
The detectors listed should be:
- DET: SEGE4
- DET: SEGE3
- DET: SEGE2
- DET: SEGE1

The "Segmented?" box should be checked.

Return to the Detector Group Operations screen and select Analysis.

On the next screen (Analysis Setup Operations) highlight the count type "<= 250 pound drums" and select Edit.

On the next screen (Edit Analysis Parameters) the setup should be:
- Enable and select ASF file for non-transmission segment:
  - SEGTRCOR.ASF
- Enable and select ASF file for transmission segment:
  - SEGTRANS.ASF
- Enable Combine non-segmented groups:
  - COMBMGA.ASF
- Enable Analyze shift-summed segments:
  - SEGSUM.ASF
- Enable Merge segment NID results:
  - COMBSEG.ASF
- Enable Combine segment shift-summed with NID results:
  - COMBNID.ASF
- Enable Combine all results:
  - COMBALL.ASF
- Do not enable Report?
- Do not enable View report on screen?

Set Processing to Normal.

Return to the previous screen (Analysis Setup Operations), highlight >250 pound drums, and select Edit.

On the next screen (Edit Analysis Parameters) the setup should be:
- Enable and select ASF file for non-transmission segment:
  - SEGTRCOR.ASF
- Enable and select ASF file for transmission segment:
  - SEGTRANS.ASF
- Enable Combine non-segmented groups:
  - COMBMGA.ASF
- Enable Analyze shift-summed segments:
  - SEGSUM.ASF
- Enable Merge segment NID results:
  - COMBSEG.ASF
4.4 MID Setup

- On the main menu select Utility Operations, then Editors.
- On the Editors menu select MID Editor.
- When the editor screen is displayed, select Database, then Unload from. A file name will appear (such as WRAP2). Highlight it, then select Unload.
- Select File, then Open. A new window will appear. Select the name shown (such as WRAP2), then Open.
- The screen will then display all of the detectors (one line per detector) and their electronics units, with AIM in the left column, under MCA, DET01, etc. under Input. The size value will be 4096 for each line, and there will be numbers and letters under the ADC, Amp, and HV labels.
- Highlight the first line, then select Settings, then MCA to get the AIM address.
- Repeat for lines 3 and 5 to get the other AIM addresses.
- Highlight the first line again, select Settings, then select ADC and note the ICB address.
- Return to Settings, then select Amplifier and note its address.
- Return to Settings, then select High voltage
- Repeat for the next 5 lines, getting the other detector information.
Confirm that the address numbers match those in the table below.
Detector # | Description | HVPS | Amp | ADC | GEA A Aim address
--- | --- | --- | --- | --- | ---
5 | LEGE5 | 5 | 3 | 2 | 
6 | LEGE6 | 4 | 1 | 0 | #3 079E
1 | SEGE1 | 5 | 3 | 2 | #1 07A1
2 | SEGE2 | 4 | 1 | 0 | 07A0
3 | SEGE3 | 5 | 3 | 2 | #2 0799
4 | LEGE4 | 4 | 1 | 0 | 0798

HV values, amplifier gains, and ADC parameters have already been set up for proper operation.

(The DMSS setup parameters are performed in a separate menu.)

- Now reload the MID file by first selecting Database, then Load.
- On the load file selection screen, select the name examined, then Load.
- Exit with File, then Exit.

4.5 DMSS Setup

- On the main menu select Utility Operations, then Editors.
- On the Editors menu select DMSS Setup Parameter Editor.
- On the next screen choose the 55-gal. drums.
- The next screen will be for detector selection, after which a screen allows input of the DMSS parameters for that detector. Use these two screens to set up all of the following parameters.

Detector: SEGE1 SEGE2 SEGE3 SEGE4

MSS values:
- ICB Address: 6 6 6 6
- Input number: 1 2 1 2
- check box (MSS first in memory): yes yes yes yes

Verified: C\textsuperscript{\textcopyright}Ewan 06/18/96
Reviewed: O\textsuperscript{\textcopyright}Harran 6/19/96
- Total memory 32678 32678 32678 32678
- ADC conversion gain 4096 4096 4096 4096
- Number of MSS groups 8 8 8 8
- Dwell time (microsec) 0.72 0.72 0.72 0.72

- Repeat the review of DMSS setup for the 85 gal. Container. (It should be identical.)

4.6 Certificate Files

4.6.1 Energy and efficiency calibration certificate files

- On the main menu select Utility Operations.
- On the next menu select Editors.
- On the screen select Certificate Editor.
- On the certificate file editor screen, select File, then Open, and confirm that there are certificate files such as: EU-AM-CS.CTF

These certificate files will be used in energy and efficiency calibration.

4.6.2 Transmission source certificate file

- On the main menu select Utility Operations.
- On the next menu select Editors.
- On the next menu select Transmission Source Certificate Editor
- On the next menu select Eu-152, then Edit.
- On the next screen confirm or edit the data as follows:

<table>
<thead>
<tr>
<th>Nuclide Name</th>
<th>Peak Energy</th>
<th>Half-Life (sec)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eu-152</td>
<td>121.8</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>244.69</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>344.5</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>778.9</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>964.1</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1112.1</td>
<td>4.19E8</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1408.0</td>
<td>4.19E8</td>
</tr>
</tbody>
</table>

4.7 Nuclide Library

- On the main menu select Utility Operations, the Editors, then Nuclide Library Editor.

- Open the file WRAP_GEA.NLB.

- Confirm that the nuclide names and energy lines correspond to those shown on the following library list report. (A similar report can be obtained by selecting Report in the File drop-down menu in the library editor.)

```
library listing report 1-23-96 1:24:37 pm page 1

nuclide library title: wrap-gfa library
nuclide library description: main library for wrap-gfa

<table>
<thead>
<tr>
<th>Nuclide Name</th>
<th>Half-Life (Seconds)</th>
<th>Energy (keV)</th>
<th>Energy Uncert. (keV)</th>
<th>Yield</th>
<th>Yield Uncert. (Abs.+-)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>1.663E+08</td>
<td>1173.216</td>
<td>0.000</td>
<td>100.0000000</td>
<td>0.0000000</td>
</tr>
<tr>
<td>ZR-95</td>
<td>3.383E+08</td>
<td>1332.486*</td>
<td>0.000</td>
<td>100.0000000</td>
<td>0.0000000</td>
</tr>
<tr>
<td>NB-94</td>
<td>6.4062+11</td>
<td>513.930*</td>
<td>0.000</td>
<td>99.8079387</td>
<td>0.0060000</td>
</tr>
<tr>
<td>NB-95</td>
<td>3.029E+06</td>
<td>702.627</td>
<td>0.000</td>
<td>43.70000008</td>
<td>0.8000000</td>
</tr>
<tr>
<td>ZR-95</td>
<td>5.531E+06</td>
<td>871.099*</td>
<td>0.000</td>
<td>55.2999992</td>
<td>1.1000000</td>
</tr>
</tbody>
</table>
```
### WRAP GEA Site Acceptance Test Procedure

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Activity</th>
<th>Error</th>
<th>Count</th>
<th>Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>RU-106</td>
<td>3.181E+07</td>
<td>0.000</td>
<td>9.8000002</td>
<td>0.5000000</td>
</tr>
<tr>
<td>SB-125</td>
<td>8.741E+07</td>
<td>0.000</td>
<td>1.7300000</td>
<td>0.0000000</td>
</tr>
<tr>
<td>CS-134</td>
<td>6.507E+07</td>
<td>0.000</td>
<td>29.3299999</td>
<td>0.2500000</td>
</tr>
<tr>
<td>CS-137</td>
<td>9.521E+07</td>
<td>0.000</td>
<td>10.3500004</td>
<td>0.1800000</td>
</tr>
<tr>
<td>CE-144</td>
<td>2.456E+07</td>
<td>0.000</td>
<td>17.7999992</td>
<td>0.3000000</td>
</tr>
<tr>
<td>Pr-144</td>
<td>1.037E+03</td>
<td>0.020</td>
<td>11.3199997</td>
<td>0.2000000</td>
</tr>
<tr>
<td>EU-152</td>
<td>4.207E+08</td>
<td>0.002</td>
<td>97.5999985</td>
<td>0.3000000</td>
</tr>
<tr>
<td>Eu-154</td>
<td>2.711E+08</td>
<td>0.000</td>
<td>85.4000015</td>
<td>0.4000000</td>
</tr>
<tr>
<td>TH-232</td>
<td>4.434E+17</td>
<td>0.000</td>
<td>28.3999996</td>
<td>0.7000000</td>
</tr>
<tr>
<td>U-233</td>
<td>5.024E+12</td>
<td>0.010</td>
<td>26.6000004</td>
<td>0.5000000</td>
</tr>
<tr>
<td>U-235</td>
<td>2.217E+16</td>
<td>0.000</td>
<td>12.7399998</td>
<td>0.2500000</td>
</tr>
<tr>
<td>Np-237</td>
<td>6.753E+13</td>
<td>0.000</td>
<td>20.7000008</td>
<td>0.5000000</td>
</tr>
<tr>
<td>U-238</td>
<td>1.410E+17</td>
<td>0.000</td>
<td>19.7000008</td>
<td>0.3900000</td>
</tr>
<tr>
<td>Pu-239</td>
<td>7.605E+11</td>
<td>0.000</td>
<td>35.4900017</td>
<td>0.7100000</td>
</tr>
<tr>
<td>Am-241</td>
<td>1.365E+10</td>
<td>0.000</td>
<td>29.0000000</td>
<td>3.0000000</td>
</tr>
<tr>
<td>Pu-241</td>
<td>4.544E+08</td>
<td>0.000</td>
<td>12.6000004</td>
<td>0.1000000</td>
</tr>
<tr>
<td>Am-243</td>
<td>2.329E+11</td>
<td>0.000</td>
<td>36.0000000</td>
<td>1.0000000</td>
</tr>
<tr>
<td>Cm-245</td>
<td>2.682E+11</td>
<td>0.000</td>
<td>14.1999998</td>
<td>0.6000000</td>
</tr>
</tbody>
</table>

**TOTALS:** 23 Nuclides | 46 Energy Lines

- Exit the nuclide library editor by selecting File, then Exit.

### 4.8 Mass Attenuation Coefficients

- On the main menu select Utility Operations, then Editors, then Mass Attenuation Coefficients Editor.
- Open file for Lucite.
On the next screen confirm or edit the data to that below:

These values are:

<table>
<thead>
<tr>
<th>E gamma</th>
<th>Mass absorption coefficient (for lucite)</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 keV</td>
<td>.234</td>
</tr>
<tr>
<td>50</td>
<td>.208</td>
</tr>
<tr>
<td>60</td>
<td>.193</td>
</tr>
<tr>
<td>80</td>
<td>.176</td>
</tr>
<tr>
<td>100</td>
<td>.164</td>
</tr>
<tr>
<td>150</td>
<td>.146</td>
</tr>
<tr>
<td>200</td>
<td>.133</td>
</tr>
<tr>
<td>300</td>
<td>.115</td>
</tr>
<tr>
<td>400</td>
<td>.103</td>
</tr>
<tr>
<td>500</td>
<td>.0941</td>
</tr>
<tr>
<td>600</td>
<td>.0871</td>
</tr>
<tr>
<td>800</td>
<td>.0765</td>
</tr>
<tr>
<td>1000</td>
<td>.0687</td>
</tr>
<tr>
<td>1500</td>
<td>.0559</td>
</tr>
<tr>
<td>2000</td>
<td>.0480</td>
</tr>
</tbody>
</table>

The degree of fit is 4.

4.9 Analysis Sequence Files

On the main menu select Utility Operations, then Editors, then Analysis Sequence Editor.

Select File, then Open, then confirm that the following files exist:
- MGA.ASF
- SEGTRCOR.ASF
- SEGTRANS.ASF
- COMBMGA.ASF
- SEGSUM.ASF
- COMBSEG.ASF
- COMBNID.ASF
- COMBALL.ASF

Confirm that the files are set up with the following steps and parameters by highlighting each step in turn, and using the Setup Algorithm button to see the parameters.
**MGA ASF**

Unidentified peak search
- Ch. 50 - 4096
- 5.00 significance level
- 1.5 keV tolerance

Peak area
- Ch. 50 - 4096
- fixed tail, reject zero area peaks
- 4 channel continuum
- step function
- 4 ch. ROI limits

**MGA**

Only the "Ignore fatal MGA errors" box should be checked.

**SEGTRCOR.ASF**

Unidentified peak search
- Ch. 50 - 4096
- 5.00 significance level
- 1.5 keV tolerance

Peak area
- Ch. 50 - 4096
- fixed tail, reject zero area peaks
- 4 channel continuum
- step function
- 4 ch. ROI limits

Reference peak correction (New algorithm)
- 1.5 keV tolerance

Efficiency correction
- Dual

Attenuation correction
- Min. Trans. 0.5 %
- Transmission error limit 50%
- Mass attenuation: C:\WAS\CALIB\LUCITE.MAC

NID with interference
- Ch. 50 - 4096
- Library C:\WAS\NLIB\WRAP_GEA.NLB
- 1.5 keV tolerance
- 0.3 confidence threshold
- 5.00 MDA confidence factor

**MDA**
- 5 % confidence factor
SEGTRANS.ASF

Unidentified peak search
  Ch. 50 - 4096
  5.00 significance level
  1.5 keV tolerance
Peak area
  Ch. 50 - 4096
  fixed tail
  4 channel continuum
  step function
  4 ch. ROI limits
Reference peak correction (New algorithm)
  1.5 keV tolerance

COMBMGA.ASF

MGA averager
  Pu-239 normalization nuclide

SEGSUM.ASF

Unidentified peak search
  Ch. 50 - 4096
  5.00 significance level
  1.5 keV tolerance
Peak area
  Ch. 50 - 4096
  fixed tail
  4 channel continuum
  step function
  4 ch. ROI limits
Reference peak correction (New algorithm)
  1.5 keV tolerance
Multi-curve efficiency
  Dual
Efficiency correction
  Dual
NID with interference
  Ch. 50 - 4096
  Library C:\WAS\NLIB\WRAP_GEA.NLB
  1.5 keV tolerance
  0.3 confidence threshold
  5.00 MDA confidence factor
WRAP GEA Site Acceptance Test Procedure

MDA
5% confidence factor

COMBSEG.ASF
Sum/average NID
Sum the data

NUDS
121.8 keV transmission peak energy
Eu-152 Cs-137
C: \WAS\NL\WRAP_GEA.NLB

COMBNID.ASF
Best of NID
(autosetup)

COMBALL.ASF
Best of MGA/NID
Pu239 normalization nuclide

Verified
C. E. WA 6/18/46
Reviewed
H. Rosen 6/18/46
5. Verify Setup and Parameters: GEA-Specific Functions

- Click on the icon for the GEA Setup Utility in the GEA icon view on the OS/2 desktop.
- When the logon screen appears, log in to the GEA-specific setup with the username and password supplied by the System Manager.

5.1 High Count Rate Threshold

- On the next menu, select High Count Rate Threshold.
- Confirm that a value has been entered for the dead time.
- Confirm that a value has been entered for the count time, like 10 sec.
- Confirm that a SEGE detector has been selected, such as SEGE2 or SEGE3.

5.2 Listed/Non-listed Nuclide Flags

- On the GEA Setup menu, select Listed / Non-listed Nuclides.
- Note on the screen that appears that there is a field for nuclide name, followed by a check box for listed.
- Note that in the list box below, an "**" appears in the same row as the nuclide name if the nuclide is "listed."
- Change one of the nuclides by highlighting it in the list box, changing the checkbox, and clicking on Update.
- Note that the asterisk appears or disappears, depending upon the check box status.
- Reverse the status of Listed/Non-Listed to restore to current value.
5.3 ROI Start and Stop Channels

- Select one of the detectors on the MCA view for GWAS.

The MCA View can be used to take data if desired, or just enter the ROIs. The ROIs are entered in the usual way for Genie PC, by placing the left and right cursors at the boundaries of the ROI desired, and pressing the Insert key on the keyboard.

One can jump from one ROI to another with the + or - buttons, and any ROI on which the cursors are located can be deleted with the Delete key.

- Open Datasource file C:\WAS\ROI.CNF.
- Enter several ROIs, then select File and Save.
- Select ROI Setup on the GEA setup menu.

- Open the file just saved. Then exit the option. The ROIs will be saved.

5.4 Pu Criticality Level

- On the GEA Setup menu, select Pu Criticality Level.
- Confirm that a value has been entered for the criticality level.

5.5 TMU Setup

- Select the TMU setup option on the GEA setup menu.
- Confirm that a sample error value has been entered into the field.
5.6 Automatic Operation Setup

- On the GEA Setup menu, select Counter, Arrangement and C. Type Sel.
- On the first screen, select GEA counter, then Ok.
- On the next screen, select the arrangement for the 55 gallon drum, then Ok.
- On the next screen, select <= 250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 55 gallon drum again, then Ok.
- On the next screen, select the >250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 85 gallon overpack, then Ok.
- On the next screen, select the <=250 pound drum, then Ok.
- Return to the screen for selecting arrangements and select the 85 gallon drum again, then Ok.
- On the next screen, select the >250 pound drum, then Ok.

On the GEA menu select Automatic Data File Purge.

Confirm that a number of days has been entered, such as 4.

Note: A value of 0 means no purging.

The GEA parameters are now set up.

- Confirm the setup by selecting Review Setup on the GEA menu.
• Confirm that the numbers (internal to GEA) for the arrangements are different, and that within an arrangement, the numbers for count types are different.
6. Calibration Operations

The user has the choice of manually or automatically loading and unloading a calibration drum for calibration. The procedure shown below will use manual loading and unloading. (Manual loading and unloading uses the mechanical system, but is manually controlled with individual software functions, rather than from the computer control of counting and analysis.)

Note also that when you first select Calibration Operations, you must then select one of the two arrangements, 55-gal. drums or 85-gal. overpacks. When switching between 55 and 85 gallon arrangements below, you must go back to the main menu.

6.1 Energy Calibration of SEGE and LEGE Detectors

This calibration must be performed for each SEGE detector, in either arrangement, and for each LEGE detector.

In addition, a group energy calibration must be performed for each SEGE group, once for each of the two arrangements.

Note: It is assumed in this procedure that Canberra has been allowed to provide a set of line sources for the calibration process. These sources are expected to be a mixture of Am-241, Ba-133, Cs-137 and Co-60. The procedure below is based on using these sources. If these are not available for some reason, an alternate set using Am-241 and Eu-152 will be used, perhaps with Cs-137 as well.

6.1.1 Energy Calibration Setup

Energy calibration requires that a certificate file be set up that contains the energies of the peaks to be used in the radioactive source. This has already been done for the sources provided, and is file AMBACSCO.CTF. (Am-241, Ba-133, Cs-137 and Co-60)

- Go to the main menu and select Calibration Operations.
- Select the 55-gal. Drum arrangement.
- Select Calibration Setup on the Calibration Operations menu.
- Select Energy/Shape calibration on the next menu.
Select Detector.

- On the next menu, select the SEGE1 detector.

- On the next screen enter:

```
Continuum function: Linear or Step
Channels, fixed 4
Channels, variable 1
Use variable channels Not checked
Energy cal tolerance, fixed 1.5
Energy tolerance, variable 1.5
Eff & Match, fixed 1
Eff & Match, variable 1
Use variable tolerance (FWHM) Not checked
```

Units: keV
Use low tail checked
Recal analysis sequence CALENG.ASF

ROI limits determination, left 4
ROI limits determination, right 4

The parameters are explained in the standard Genie PC documentation, and are used in the energy and efficiency calibrations and analysis. The parameters have been chosen for good results with Ge detectors for this energy range.

- Repeat these setup values for the remaining detectors SEGE2, SEGE3, and SEGE4, LEGE5 and LEGE6.

- Return to the Calibration Operations menu, then select Calibration Setup, then Energy/Shape calibration.

- On the Detector/Group screen, select Group, then SEGEs.

- Then enter or confirm the setup parameters as above.

- Return to the main menu, then select Calibration Operations again.

- Select the 85-gal overpack arrangement.

- Select Calibration Setup, then Energy/Shape calibration.
On the Detector/Group screen, select Group, then SEGEs.

Then enter or confirm the setup parameters as above.

Place the calibration source in a drum and place at the load position.

Under manual operations, load the drum, choosing the appropriate size.

Return to the main menu, then select Calibration Operations.

Select 55-gal. drum on the arrangement selection menu.

Select Calibration count on the Calibration Operations menu.

On the next screen select Energy/Shape for Calibration type

| Dispel load/unload | 4 | 7/26/96 |

On the next screen

| Preset count time     | 300 seconds |
| Disable manual load/unload | not checked |
| Platform position    | 2 |

The other fields should not be checked, and can be ignored.

Select Start. The calibration count will then be started, and when finished, will be saved to files.

On the Calibration Operations menu, select Full/Energy Shape Calibration

On the next menu select Detector.

On the next menu select SEGE1.

On the next menu select the certificate file to be used, AMBACSCO.CTF.
The next screen will show the initial lines to be used for the energy calibration, 59.5 and the 1332 keV at the high end.

- Highlight the 59.5 keV line in the list box.
- In the spectrum displayed in the lower half of the screen, place the cursor on the 59.5 keV line.
- Click on Cursor in the dialog box. The cursor channel will then be displayed in the channel field. Click on Update to move the information to the list box.
- Repeat the last three steps for the 1332 keV line.
- Now click on Ok. The calibration will then be displayed as a graph.
- If the graph line is very close to going through zero, accept it. If not, cancel and go back to the previous steps, making sure that you have the lowest strong peak and the highest strong peak.

The program will then do the full calibration with all peaks, and the next screen will then show the full set of data. If all peaks are very close to the line, accept the data. The detector is then fully calibrated for energy and shape. Detector shape parameters are viewed by clicking on the Shape button in the upper right box.

Repeat the energy calibration for SEGE2.

Repeat the energy calibration for SEGE3.

Repeat the energy calibration for SEGE4.
Return to the Calibration Operations menu and select Full Energy/Shape Calibration.

Select Group on the Detector/Group menu, then SEGEs.

Repeat the energy calibration as specified for an individual detector.

Return to the main menu, then select Calibration Operations.

Select 85-gal. overpack on the arrangement selection menu.

Select Full Energy/Shape calibration.

Select Group on the Detector/Group menu, then SEGEs.

Repeat the energy calibration as specified for an individual detector.

6.2 Energy Calibration of Low-Energy Detectors

Place one or more of the Am-Ba-Cs-Co line sources in the center of the shield (or in a low density calibration drum) so that both LEGE detectors can view the source.

The setup of gains for the amplifiers can be performed with the MCA View. Select Datasource, then Upper LEGE (det. 5).

We wish to confirm that the energy range is 0 to 307 keV (about 0.075 keV/channel in a 4096-channel spectrum). The 60.5 keV peak should be in channel 793, the 81 keV line in channel 1060, and the 276 keV line in channel 3684.
If not close to these channels, adjust the amplifier gains until this is so. Adjust the amplifier gain by selecting MCA on the menu bar, then Adjust, then Amp. Then change the gain.

Confirm similarly for the other low-energy detector, Lower LEGE (det. 6).

The setup of parameters has been done above.

**LEG E Energy Calibration Count and Calibration**

- Use the same sources as for the SEGE detectors.

- Select Calibration count on the Calibration Operations menu.

- On the next screen select Energy/Shape for Calibration type

- On the next screen
  - Preset count time 200 seconds
  - Disable manual load/unload not checked

  The other fields should not be checked, and can be ignored.

- Select Start. The calibration count will then be started, and when finished, will be saved to files.

- On the Calibration Operations menu, select Full/Energy Shape Calibration

- On the next menu select Detector.

- On the next menu select Upper LEGE.

- On the next menu select the certificate file AMBACSCO.CTF. (Higher energy lines than 307 keV can be ignored.)

- Enter a description, if desired, then select OK.

- The next screen will show the initial lines to be used for the energy calibration, 69.5 keV at the low end and the 276 keV in the middle (at the high end of the LEGE).
- Highlight the 59.5 keV line in the list box.

- In the spectrum displayed in the lower half of the screen, place the cursor on the 59.5 keV line.

- Click on Cursor in the dialog box. The start and end channels will then be filled in the list box. Click on Update to accept the information.

- Repeat the last three steps for the 276.4 keV line.

- Now click on Ok. The calibration will then be displayed as a graph.

- If the graph line is very close to going through zero, accept it. If not, cancel and go back to the previous steps, making sure that you have the lowest strong peak and the highest strong peak.

- The program will then do the full calibration with all peaks (if there are more), and the next screen will then show the full set of data. If all peaks are very close to the line, accept the data. The detector is then fully calibrated for energy and shape. Detector shape parameters are viewed by clicking on the Shape button in the upper right box.

Note: For the LEGE detectors, make sure that the final calibration is first order only. This is required by the MGA program.
6.3 Reference Peak Calibration

Note: No calibration setup required before performing a count. Reference peak calibration is for the SEGE detectors and SEGE groups, not the LEGE.

Start with no source in the station. The door may be open.

- On the main menu select Calibration Operations, then 55-gal. Drum, then Calibration Count.
- On the next screen select Reference Peak Calibration.
- On the next screen enter 300 seconds. The container type, collimator position and platform positions do not matter since it is only a detector electronics function.
- Check Disable Load/Unload
- Select Start and allow the count to start and complete.
- On the main menu select Calibration Operations, then Reference Peak Calibration.
- On the next menu select Detector, then SEGE1.
- On the next screen press Select Peak.
- The next screen displayed lists the peaks found. Select the pulser peak and press Ok.
- Back on the screen for pulser, source, etc., there will now be peak energy, rate and rate error values.
- The pulser rate should be a little less than 50 Hz.
- Set the pulser/source designation to pulser, and set the half-life to zero.
- Set the Accept by pressing Ok.
• Repeat the calibration for each of the other SEGE detectors, SEGE2, SEGE3, SEGE4.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</thead>
<tbody>
<tr>
<td>7/28/96</td>
<td>7/28/96</td>
</tr>
</tbody>
</table>

• Return to the detector/group menu and select group, then SEGEs.

• Repeat the calibration for the group (in 55-gal. drum arrangement).

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</thead>
<tbody>
<tr>
<td>7/28/96</td>
<td>7/28/96</td>
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</tbody>
</table>

• Now go to Calibration Approval on the Calibration Operations menu.

• Select Reference Peak. A list of the calibrations performed will appear.

• Select and approve each one.

• When asked if you want to set the calibration as the default, answer Yes.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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<tbody>
<tr>
<td>7/28/96</td>
<td>7/28/96</td>
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</table>

• Return to the main menu, then select Calibration Operations, then 85-gal. Overpack.

• Select Reference Peak Calibration, then group, then SEGEs.

• Repeat the calibration for the group.

<table>
<thead>
<tr>
<th>Verified</th>
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<tr>
<td>7/28/96</td>
<td>7/28/96</td>
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</table>

• Now go to Calibration Approval on the Calibration Operations menu.

• Select Reference Peak. A list of the calibrations performed will appear.
Select and approve each one.

When asked if you want to set the calibration as the default, answer Yes.
6.4 Transmission Calibration

- Load an empty 55 gallon drum into the station.
- On the main menu select Calibration Operations, then 55-gal. drum.
- On the Calibration Operations menu select Calibration Setup, then Transmission
- Set the tolerance to 1 or 1.5 keV.
- Return to the Calibration Operations menu and select Calibration Count.
- On the next menu select Transmission calibration.
- Take a count for 200 seconds, at platform position 2, with absorber out (collimator position 0). Do not check Use Sample Database.

- When the count is finished, return to the Calibration Operations menu and select Transmission Source Calibration.
- On the detector menu, select SEGEl.
- The next screen to be shown requires selection of the transmission source certificate. This has been set up, and is EU152.

- Press Ok to start the transmission calibration.

- The transmission results will be displayed. Confirm that there are results for the peaks listed below, and that the peak areas are approximately in the percentages listed.

<table>
<thead>
<tr>
<th>Energy (keV)</th>
<th>Area (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>122</td>
<td>28.4</td>
</tr>
<tr>
<td>244</td>
<td>7.5</td>
</tr>
<tr>
<td>345</td>
<td>26.6</td>
</tr>
<tr>
<td>779</td>
<td>13.0</td>
</tr>
<tr>
<td>964</td>
<td>14.5</td>
</tr>
<tr>
<td>1112</td>
<td>13.6</td>
</tr>
<tr>
<td>1408</td>
<td>20.8</td>
</tr>
</tbody>
</table>

  28.4% (this will be lower because of absorption in the drum walls)

- Select Ok if the results are consistent with the percentages above.

- Back at the detector menu, the calibration just done will be indicated by an asterisk at the left of the detector. Then select SEGE2, then transmission certificate, then accept the results.

- Repeat for SEGE3 and SEGE4.

- Return to the Calibration Operations menu and select Calibration Approval.

- Select Transmission. The next screen will list the transmission calibrations just made, for each detector.
• Approve the calibration for each SEGE detector, and select it as the default calibration on the next screen.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>7/28/96</td>
</tr>
<tr>
<td></td>
<td>7/28/96</td>
</tr>
</tbody>
</table>

• Repeat the calibration process for the 55 gallon drum with absorber in place (collimator position 1):
  • Make transmission count for platform position 2, collimator position 1.
  • Select detector SEGE1.
  • Select Transmission Calibration, certificate, and Ok, and accept the results, if the peaks exist as listed above, and if the percentages are similar (but lower for the lower energies).
  • Repeat for SEGE2, SEGE3, SEGE4.
  • Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.
  • Select this calibration as the default each time.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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<tbody>
<tr>
<td></td>
<td>7/28/96</td>
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<tr>
<td></td>
<td>7/28/96</td>
</tr>
</tbody>
</table>

• Repeat the calibration count and calculation process for an empty 85 gallon overpack with absorber out. (The setup remains the same.)
  • Return to the main menu, then select Calibration Operations, then 85-gal. Overpack, the Transmission calibration.
  • Make transmission count for platform position 2, collimator position 0.
  • Select Transmission Calibration, certificate, check the peak results, and select Ok.
  • Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.
  • Select this calibration as the default.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>7/28/96</td>
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<tr>
<td></td>
<td>7/28/96</td>
</tr>
</tbody>
</table>

• Repeat the process for the 85 gallon drum with absorber in place.
  • Make transmission count for platform position 2, collimator position 1.
  • Select Transmission Calibration, certificate, check the peak results, and select Ok.
Select Calibration Approval, Transmission Calibration, and approve the one just made for each SEGE.

Select this calibration as the default.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>[Signature]</td>
<td>[Signature]</td>
</tr>
<tr>
<td>7/25/96</td>
<td>7/25/96</td>
</tr>
</tbody>
</table>
6.5 Segment Efficiency Calibration

Efficiency calibration will be done only for the group of SEGE detectors. (The LeGE detectors only measure relative isotopic composition for Pu isotopes.)

The segment efficiency calibration follows the usual SGS practice of measuring the response in the smooth section of the drum (platform position 2, in this case) and using the efficiency for that segment in all segments viewed by that detector.

The efficiency calibration requires that a certificate file be set up with the calibration source energies and intensities. For the segment efficiency, the certificate file must have the source intensity given by the sum of the source activities, divided by the number of segments used. Since there are 10 segments for the 55-gal. drum and 11 for the 85-gal. drum, two different certificate files are used. These files are named something like (the exact names will be provided at the SAT):

- 10SEGEFF.CTF for the 55-gal. drum
- 11SEGEFF.CTF for the 85-gal. overpack.

By dividing the total source intensity by the number of segments, when performing the segment analysis, the sum of the segment results can be added in order to get the total activity for the drum.

The calibration process involves data acquisition and analysis for line sources, which are used to approximate a uniform distribution of radiation throughout the drum by placing them at specific radial positions.

Calibration must be performed for both 55 and 85 gallon drums, and for the two cases of with and without absorber. For the 85-gallon overpack, it is planned to use the line sources in a 55-gallon drum inside of the 85-gallon overpack.

A drum with a foam matrix (density of about 0.014) is equivalent to an empty drum, and can be used if an empty drum with the correct source positioning tubes is not available.

- Place the calibration source set in the foam matrix drum and load into the station.
- Go to the Manual Operations menu, then select Load/Unload/Transport.
- Select Prepare for Measurement. This will close the door and start the platform rotating.
Select Calibration Operations on the main menu, then 55-gal. drum.
Select Calibration Setup on the Calibration Operations menu.
Select Efficiency Calibration on the next menu.
On the next menu select SEGE for Standard electrode Ge detectors.

On the next screen enter:
Use Eff Crossover Not checked
Sequence: CALEFF.ASF

Repeat the selection of CALEFF.ASF for both LEGE detectors (even though it will not be used).

Return to the main menu, then select Calibration Operations, then 85-gal. Overpack, then Calibration Setup.

On the next menu select SEGE for Standard electrode Ge detectors.

On the next screen enter:
Use Eff Crossover Not checked
Sequence: CALEFF.ASF

Repeat the selection of CALEFF.ASF for both LEGE detectors (even though it will not be used).

Return to the main menu and select Calibration Operations, then 55-gal. drum.
Select Calibration Count on the Calibration Operations menu.

On the next screen select Efficiency for Calibration type

On the next screen
Preset count time 300 seconds
Collimator position 0 (no absorber)
Disable manual load/unload Not checked

The other fields should not be checked, and can be ignored.
Select Start. The calibration count will then be started, and when finished, will be saved to files. On the sample information screen that appears, enter and ID number that is unique, and enter the proper density.

Segment Efficiency Calibration Calculation

- On the Calibration Operations menu select Efficiency calibration

- On the next screen, press Find, then select the count to be used by highlighting the count, checking the box for Select, pressing change, then pressing Ok.

- On the next screen select the SEGE4 for platform position 2.

- On the next screen select the appropriate certificate file.

- After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.

- If the graph looks reasonable, select Ok. The graph should be a smooth curve very close to all of the points, with a maximum value between 81 and 256 keV. The Gamma Waste Assay Software User manual shows examples of efficiency curves in the calibration section.

- Back on the detector group selection screen, select platform position 2 for each of the other SEGE detectors, then get the plot and select Ok.

- Repeat the calibration process of count and calculation for the 55 gallon light foam drum with the absorber in place (collimator position 1):
  - Select count, then efficiency calibration, then SEGE4 for platform position 2.
  - Select Efficiency calibration, then certificate file as needed.
  - Make sure that the summed spectrum and all SEGE detectors are done.
• Repeat the process of count and calculation for the 85 gallon drum:
  • Select count, then efficiency calibration.
  • Select Efficiency calibration, then certificate file as needed.
  • Make sure that the summed spectrum and all SEGE detectors are done.

• Repeat the calibration process of count and calculation for the 85 gallon drum, with the absorber in place (collimator position 1):
  • Select count, then efficiency calibration.
  • Select Efficiency calibration, then certificate file as needed.
  • Make sure that the summed spectrum and all SEGE detectors are done.
6.6 Calibration Approval for Segment Efficiency

An efficiency calibration must be approved and selected as default before it can be used. For the segment efficiencies, it is also required to perform the approval in such a way that the efficiency for position 2 is used for each of the positions, on a detector-by-detector basis.

- On the Calibration Operations menu, select Calibration Approval.
- On the next menu, select Efficiency Calibration.
- On the next screen you will get the un-segmented, summed segments and segments selection. Select Summed Segments.
- The next screen will list all unapproved calibrations.
- Delete any calibrations not desired.
- Approve the calibration just made for the sum of the segments.
- On the next screen, when asked if this should be the default calibration, select Yes, with "matching container" checked.

Note: If a valid calibration has already been made, do not approve this latest one, but delete it.

- Now perform the approval for each of the detectors, for platform position 2.
- On the non-segmented, etc. selection screen, select Segments.
- The platform position is indicated in the last number of the file extension, which is Sdp. (d = detector number, p = platform position number)
- Select the segment efficiency calibration for detector 1, position 2.
- On the next screen, do not check “matching only” for the platform position.
- Repeat for detector 2, position 2.
- Repeat for detector 3, position 2.
- Repeat for detector 4, position 2.

- Repeat this process for the 55 gallon drum with absorber in.

- Return to the main menu, then select Calibration Operations, then 85-gal pack, then repeat this process for the 85 gallon drum with absorber out.

- Repeat this process for the 85 gallon drum with absorber in.
Summed Spectrum Efficiency Calibration

We will calibrate the spectrum formed from the sum of the segment spectra by using the multiple density efficiency calibration. This process determines the actual efficiency by using the average density of the drum to interpolate between efficiencies measured at several different densities. A set of 55-gallon calibration drums of four different densities has been provided in order to make this efficiency calibration.

This summed spectrum analysis is used to detect weaker intensity radiation that may be more apparent than in the individual segment spectra.

The efficiency calibration requires that a certificate file be set up with the calibration source energies and intensities. This has been done already, and is the same file AMBACSCO.CTF already used for energy calibration.

The calibration process involves data acquisition and analysis for four different drums, each with a different average density. It is important to know which drum is which throughout the process, and to label the data correctly. It is best to use the drums in a known sequence, such as light to heavy, to avoid confusion.

We will use four different drums:

<table>
<thead>
<tr>
<th>Description</th>
<th>Approx. Density</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) foam</td>
<td>0.013</td>
</tr>
<tr>
<td>2) soft board</td>
<td>0.45</td>
</tr>
<tr>
<td>3) hard board</td>
<td>0.672</td>
</tr>
<tr>
<td>4) sand</td>
<td>1.577</td>
</tr>
</tbody>
</table>

6.7.1 Calibration Setup

- Select Calibration Operations on the main menu.
- Select 55-gal. drum arrangement.
- Select Calibration Setup on the Calibration Operations menu.
- Select Efficiency Calibration on the next menu.
- On the next menu select SEGEs.
- On the next screen enter:
  - Use Eff Crossover Sequence: Not checked
    CALEFF.ASF
6.7.2 55-gallon drums without absorber

First drum
- Place the calibration source set in the drum of density 0.01 and load into the station.
- Select Calibration Count on the Calibration Operations menu.
- On the next screen select Efficiency for Calibration type
- On the next screen
  - Preset count time: 300 seconds
  - Disable manual load/unload: Checked
  - Select collimator geometry position: 0
  - The other fields should not be checked, and can be ignored.
- Select Start. The calibration count will then be started, and then a screen for sample information will be presented.
- Enter in the correct information, including the density.
- When the count is finished, it will be saved to files.

Second drum
Repeat the last section for the drum of approx. density 0.4.

Third drum
Repeat the last section for the drum of approx. density 0.7.
Fourth drum

Repeat the last section for a drum of approx. density 1.7, but use a longer count time, of 600 seconds.

Efficiency Calibration Calculation

We will now calculate the efficiency for all four drums in sequence, then combine the results into a multi-curve efficiency. The multi-curve efficiency is indicated by a density of 999.

First drum

- On the Calibration Operations menu select Efficiency calibration

- The next screen is a logbook search screen. Select only Calib in the counts type of drop down box, then press Find.

- A list of calibration counts will be displayed.

- Select the first drum data collected (density about 0.01) by highlighting the line, checking the box for Select (*), then pressing Change.

- Then select Ok to go to the next screen.

- On the next screen select the certificate file, AMBACSCO.CTF.

- After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.

- If the graph looks reasonable, select Ok. If it does not, repeat the calibration count with a longer count time.

  The graph should be a smooth curve very close to all of the points, with a maximum value between 81 and 256 keV. The Gamma Waste Assay Software User manual shows examples of efficiency curves in the calibration section.
Select the fourth drum data collected (density about 1.7) by highlighting the line, checking the box for Select (*), then pressing Change.

Then select Ok to go to the next screen.

On the next screen select the certificate file, AMBACSCO.CTF.

After selecting OK, the calibration will be performed, and the graph of efficiency vs energy displayed.

**Multi-Curve Efficiency**

- Return to the Calibration Operations menu and select Add to Efficiency Calibration Points.
- On the next screen select Summed Segments.
- On the next screen select Unapproved.
- The next screen displays all of the unapproved calibration Summed Segments files, and lists the date and time, density, and detector group.
- Select the 0.01 density data and Geo. 0 and press Ok.
- On the next screen check Matching Container Type, then Ok.
- On the next screen select Unapproved, then Ok.
- The next screen again displays the list of data for date and time, density, etc.
- Select the second drum calibrated (0.4 density), then Ok.
- The program will then display a graph of the two curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer Yes.

- On the next screen select Unapproved.
- The next screen will display the list of calibrations by date and time, density, etc.
- Select the third drum calibrated (0.7 density), then Ok.
- The program will then display a graph of the three curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer Yes.

- On the next screen select Unapproved.
- The next screen will display the list of calibrations by date and time, density, etc.
- Select the third drum calibrated (1.7 density), then Ok.
- The program will then display a graph of the four curves.
- Press Ok, and then a dialog box will ask if you want to add another density record. Answer No.
- You will then exit the Add Density option.
6.7.3 55-gallon Drums with Absorber

- Repeat the previous section, but selecting collimator/geometry position 1 (Geo. 1) for absorber in place.

6.7.4 85-gallon Overpack without Absorber

- Exit the Calibration Operations section, then re-enter, selecting 85-gallon overpack arrangement.

- Place the 55-gallon drum calibration drums inside of an 85-gallon empty overpack.

- Repeat the previous section, without absorber. Be careful to label the calibrations properly.

6.7.5 85-Gallon Overpack with Absorber

- Repeat the previous section, with absorber.

6.8 Calibration Approval for Summed Segment Spectra

An efficiency calibration must be approved before it can be used.

- Return to the main menu, then select Calibration Operations, then 55-gal. Drum arrangement.
On the Calibration Operations menu, select Calibration Approval.

On the next menu, select Efficiency Calibration.

On the next screen select Summed Segments.

The next screen will list all unapproved calibrations.

Highlight one of the multi-curve density calibrations just made (density=999 and geo 0), then press Approve.

The next screen will prompt for setting the default. Leave the check boxes checked (matching container), and press Ok.

You will be returned to the unapproved calibration list. The one you just approved will no longer be present.

Highlight the other multi-curve density (density=999, geo = 1), and press Ok.

You will be returnd to the unapproved calibration list. Neither density=999 calibration will be present.

Return to the Calibration Operations menu. (The individual densities do not need to be approved.)

We will now confirm that the calibration can be used. Go to Calibration Operations on the main menu, then Report/Plot Efficiency Calibration.

Select Plot Efficiency Calibration on the next screen.

Select Summed Segments on the next screen.

Select Default Efficiency calibration on the next screen.

Select the calibration for density 999, and either geo = 0 or 1.

On the next screen select:
  Type: Dual
  Scale: Linear
  Effic. Vs. Energy for all Densities
    Energy 1
    Density 0.01

and press Ok.
The efficiency curve will be plotted, with four separate curves. Examine the four curves to see if they are reasonable. Each density curve should be separate from the other densities, with no crossing of the lines. The lower density curves should be higher (have greater efficiency values) than the higher density curves. An example of a four-density multi-curve is shown in section 10.14 of the Genie PC Waste Assay Software User manual.

- Return to the efficiency selection screen and repeat, selecting the other geometry.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</thead>
<tbody>
<tr>
<td>Mike Mark</td>
<td>9/30/96</td>
</tr>
<tr>
<td>7/30/96</td>
<td>7/30/96</td>
</tr>
</tbody>
</table>

- Return to the main menu, then select Calibration Operations again, then 85-gal. Overpack.

- Now repeat the approval and plotting as just above for the 55-gal. drums.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike Mark</td>
<td>9/30/96</td>
</tr>
<tr>
<td>7/30/96</td>
<td>7/30/96</td>
</tr>
</tbody>
</table>
7. Measurement in Local Mode

Manual operations consist of individual steps that can be performed for a measurement, such as loading a drum, turning on the HVPS, collecting the data, and analyzing the data. We will perform most of the possible operations, using a 55-gallon drum.

7.1 Start a Count

Manual Load of a Drum

- Place a low-density 55-gallon drum at the load position.
- On the arrangement selection screen, select 55-gallon drum.
- On the next screen select 55-gallon drum, then Load.
- Note that the drum is moved to the center of the station, and the door closed.

Perform a Count

- Next return to the Manual Operations menu, then select Start a Count.
- On the next screen for count type, select <= 250 pounds or >250 pounds.
- On the next screen, confirm or enter the data:
  
  Count time
  - With transmission: 30 seconds
  - Without transmission: 110 seconds
  - Use Sample database: Not checked
  - Use Bar code reader: Not checked
  - Collimator/geometry position: 0

- The system will then start counting for all detectors defined in the Assay 55 gallon drum count type. At the end of the count, all data will be saved to files.

Manual Unload of a Drum

Select 55-gallon drum on the container type screen.

Select Unload on the next menu.

Note that the door opens, and that the drum is returned to the conveyor.

7.2 Analyze Existing Count

On the Manual Operations menu, select Analyze Existing Count.

On the next screen, press Find, then select the count just taken by highlighting it, then pressing Select, then Change. An asterisk will appear beside the TB. Press Ok.

On the next screen, press Analyze Entire Count. The analysis will be performed.

Display the report by opening an OS/2 window and entering:
> CD WAS
> DISPREP MORE

The report will be displayed on the screen.

Review the report for completeness, and for activities that correspond to those in the drum assayed.

7.3 Turn On/Off HVPS

Select Turn On/Off HVPS on the Manual Operations menu.

On the next screen, select Off, then Ok.

Note that the LEDs on the HV supplies start “dropping down” by gradually turning off the upper LEDs.
After all HVPSs are off, repeat the process, but select On.

Note that all of the LEDs turn on at increasing higher positions until the full voltage has been reached.

7.4 Manual Load / Unload

We have already done a light 55-gallon drum. We will now do a heavy 55-gallon drum and light and heavy 85-gallon overpacks.

- Place a high-density (up to 1000 pound maximum weight, per specification), 55-gallon waste drum at the starting load point.
- On the next screen select the 55-gallon drum.
- On the next screen select Load.
- Note that the drum is moved into the shield, and the door closed.
- On the next screen select Unload.
- Select the 55-gallon drum.
- Note that the door opens, and the drum moved to the unload point.

Repeat the load and unload process for a low-density 85-gallon overpack, as follows:

- Return to the main menu, then select Manual Operations.
- On the arrangement selection screen select 85-gal. overpack.
- On the container selection screen select 85-gal. overpack.
- On the next screen select Load.
- Return to the Load/Unload/Transport screen and select Unload.
- Select the 85-gal. overpack.
- Note that the container is unloaded.

- Repeat the load and unload process for a heavy 85-gallon overpack, close to 1000 pounds (maximum value for the specification).
- Return to the main menu, then select Manual Operations.
- On the arrangement selection screen select 85-gal. overpack.
- On the container selection screen select 85-gal. overpack.
- On the next screen select Load.
- Return to the Load/Unload/Transport screen and select Unload.
- Select the 85-gal. overpack.
- Note that the container is unloaded.
8. Routine Counts

- Place sources in one of the calibration drums, and place the drum at the load point.

- Select Routine Counts on the main menu.

- Select 55 gal. drum on the next menu.

- On the next screen, enter or accept:
  - Transm. count time: 30 seconds
  - Use sample database: Not checked
  - Use barcode reader: Not checked
  - Disable Load/Unload: Not checked

  Then select Start.

- The drum will then be loaded, data collected, then analyzed.

- The drum will then be unloaded.

- Display the report by opening an OS/2 window and entering:
  - > CD IWAS
  - > DISPREP | MORE

- The report will be displayed on the screen.

- Examine the report to see that the activity measured is close to the activity of the source(s).
9. Test of Minimum Transmission

This test is to verify that if the drum absorption is greater than 95% for a peak in the transmission source (and that is selected in the transmission source certificate) the transmission is set to 0.5%.

- Set up the test by going to the main menu and selecting Utilities, then Counter Maintenance, then Arrangement, then 55-gallon drum, then Group, then SEGEs, then Analysis.

- For the report option, enable the report, change the analysis sequence file selected to V_TRANS.ASF. (This will show the transmission results on the screen.) If a printer is available, select P_TRANS.ASF for the analysis sequence file. (This will print the results.)

- Select Ok, then return to the main menu.

- Now load the 55-gallon calibration drum with density of about 0.7, (particle board) by placing it at the load point, then going to Manual Operations and selecting Load/Unload/Transport.

- Now perform a routine measurement, with Disable Load/Unload checked.

- When the count and analysis is finished, examine the report. Note that for the low energy transmission source lines, the report has a section for each segment and results that look something like:

```
Analysis Warnings:
Minimum transmission used.
--- Transmission Correction ---

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Energy</th>
<th>Transmission</th>
</tr>
</thead>
<tbody>
<tr>
<td>Eu-152</td>
<td>121.80</td>
<td>0.005 +/- 0.0025</td>
</tr>
<tr>
<td>Eu-152</td>
<td>244.50</td>
<td>0.005 +/- 0.0025</td>
</tr>
<tr>
<td>Eu-152</td>
<td>344.50</td>
<td>0.036 +/- 0.0013</td>
</tr>
<tr>
<td>Eu-152</td>
<td>778.00</td>
<td>0.062 +/- 0.0078</td>
</tr>
<tr>
<td>Eu-152</td>
<td>964.00</td>
<td>0.073 +/- 0.0086</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1112.00</td>
<td>0.077 +/- 0.0098</td>
</tr>
<tr>
<td>Eu-152</td>
<td>1408.00</td>
<td>0.126 +/- 0.0125</td>
</tr>
</tbody>
</table>
```

- Note that the low energy lines have minimum transmission values of 0.005.
Note that this minimum value is an editable parameter in the transmission correction engine.

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</table>

- Now restore the analysis to no report (remove the check from the report box in the Analysis section for the SEGEs group and restore check from V in Report on Screen.
10. Sensitivity Testing

10.1 Pu-239 Sensitivity

Load a drum with the appropriate level of Pu-239 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering

> CD IWAS
> DISPREP | MORE

Determine that Pu-239 activity is reported.

View the SEGE2 data on the screen and note whether either of the peaks at 129 and 414 keV have a net peak area that is at least three times the one sigma background (in the region under the peak).

10.2 Sensitivity

Load a drum with the appropriate level of U-235 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering

> CD IWAS
> DISPREP | MORE

Determine that U-235 activity is reported.

View the SEGE2 data on the screen and note whether the peak at 186 keV has a net peak area that is at least three times the one sigma background (in the region under the peak).
10.3 Cs-137 and Co-60 Sensitivity

Load a drum with the appropriate level of Co-60 and Cs-137 and the proper density.

Perform a routine count, with Disable Load/Unload checked.

Display the report by opening an OS/2 window and entering

> CD WAS
> DISPREP | MORE

Determine that Cs-137 and Co-60 activity is reported.

View the SEGE2 data on the screen and note whether the peaks at 661, 1173 and 1332 keV have a net peak area that is at least three times the one sigma background (in the region under the peak).
11. TMU Setup and Test

TMU is determined by added the “TMU Error” in the GEA-specific setup to the statistical error determined in the analysis.

- Click on the GEA Setup icon, then select TMU setup on the menu.
- Enter a value of 0%.
- Make a routine measurement of some source and note the activity and uncertainty.
- Return to the GEA TMU setup, and set the value to 10%.
- Make a routine measurement of the same source, and now note the activity and uncertainty.
- Confirm that the TMU % error is added in quadrature to the original error.
12. Test of Remote (Automatic) Operation

For these tests it is assumed that the PCS and SIE are running, and the GEA system has been powered on.

Note: When used on GEA system B, the Subsystem indicated will be B, not A (third record of the message).

12.1 Status Messages

12.1.1 GEA Initialization

If the SIE and PCS have been started before the GEA system is running, then as the GEA is initialized, three status messages will be sent to the PCS. These are:

GEAPCS / SGEA / A / 00190010 / 0 / Initialization in process
GEAPCS / SGEA / A / 00090010 / 0 / Initialization in process
GEAPCS / SGEA / A / 00090010 / 0 / Initialization in process

12.1.2 GEA in Manual (Local) Mode

- On the PCS request status.
- The message should be:

GEAPCS / SGEA / A / 00090010 / 0 / System ready to process drums

- Confirm that the message format is correct.
- Set the GEA into manual mode by pressing Exit in the upper right window.
- A logon screen will appear.
- On the PCS request status.
- The message should be:


- Now logon by entering a valid username and password. The main GWAS menu will appear in the upper left.
- On the PCS request status.
- The message should be:

- Return to automatic mode by going to the main menu in manual mode, and selecting the first option, Automatic Counting.

12.2 Drum Measurement

We will go through an entire drum measurement sequence, including getting status messages automatically, and requesting status messages.

- On the SIE send a message for assaying a 55 gallon drum of less than 250 pounds; with drum status of "PROC".

  SIE message records are:
  1. SIEGEA
  2. DGEA
  3. (drum ID)
  4. 55 or 85
  5. Net weight (Kg)
  6. % Pu-239
  7. Drum status. Possible status values are:
     PROC
     CERT
     VERF_HI
     VERF_LO
     BACK

- On the PCS send "Request to drop off drum" (RDOD) message.

  Note: These last two commands can be issued in either order.

- Note that the GEA system upper left screen has message boxes indicating the status of the system and the operation in progress, and that the screen in the upper right allowing access to manual mode has disappeared.

- The GEA system will send a message back to the PCS that it is ready to accept drum. The PCS will receive:

  GEAPCS / RAD / A (Ready to accept drum)
• At this point the station conveyor will turn on. Turn on the transfer conveyor manually, the drum will move into the station. Turn off the transfer conveyor when the drum has left it.

• The GEA will send a message to the PCS when the drum is in the assay position.

  `GEAPCS / DPS / A` (Drum presence sensed in station)

• On the PCS request the status. Depending upon how long after the RDOD message was sent, you will get one of the following messages at the PCS (you can get status before DPS message received by PCS):

  `GEAPCS / SGEA / A / 00190020 / 0 / Drum loading or unloading`

  `GEAPCS / SGEA / A / 00000020 / 0 / Data acquisition in progress`

  (In this case the 19 has been cleared since read once. The 2 remains because data acquisition is still in progress.)

• When the measurement analysis has been completed, the GEA sends to the PCS a status message for task finished:

  `GEAPCS / SGEA / A / 00000040 / 0 / Task finished`

• You then need to unload the drum by sending PCS command ready to pick up drum - RPUD.

• The unload will start by lowering the platform to unload position, stopping rotation, and opening the door.

• Request status immediately after the RPUD command. The PCS will receive:

  `GEAPCS / SGEA / A / 00000040 / 0 / Drum loading or unloading`

• Request status again and again until you get the following:

  `GEAPCS / SGEA / A / 00000010 / 0 / System ready to process drums`

• When the report message is ready, it will be sent to the SIE.

• Confirm that the report message is in the proper format, and that the activity is correct.

• The report message is also saved in a file on the GEA system.

• On the GEA system open an OS/2 window.

• Run the command C:\WAS\DISPREP | MORE to see the report.
• (Print the report with the commands C:\WAS\DISPREP > file.lis and PRINT file.lis)
• Review the results to confirm that the system is operating properly.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</table>

• Repeat the process for a 55 gallon drum of greater than 250 pounds.
• The process will be identical, except that the absorber will be placed in front of the detector. This can be observed by noting the rotation of the absorber motion shaft.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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</table>

• If the 85 gallon overpacks have been calibrated, repeat the process for 85 gallon overpacks, less than or equal to 250 pounds.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
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<tr>
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</table>

12.3 Test of Absorber Use

This test will demonstrate that for count rates above a user-specified minimum, the absorber will be placed between the drum and the detectors. (In the GWAS software this absorber is defined as a collimator position.)

Note: The system must have been calibrated for drums with the absorber in place.

• Place a radioactive source in a 55 gallon drum and load into the cell.
WRAP GEA Site Acceptance Test Procedure

- Use the MCA View in GWAS or in Spectroscopy Assistant in the Utility Operations and measure the dead time on the ADC for the detector specified in GEA-specific setup.
- Set the dead time limit in the GEA setup to less than the dead time measured.
- Repeat a measurement. Note that the absorber goes into place by watching the absorber shaft turn.
- Compare the results with the activity expected.

Note: Absorber in means that a different calibration is used.

12.4 Test of SIE Message Drum Status

12.4.1 SIE Message with Drum Status CERT

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of CERT.

SIE message records are:

1. SIEGEA
2. DGEA
3. (drum ID)
4. 55
5. Net weight (Kg)
6. % Pu-239
7. Drum status. Possible status values are:
   PROC
   CERT
   VERF_HI
   VERF_LO
   BACK

- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.
12.4.2 SIE Message with Drum Status CERT

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of CERT.

SIE message records are:
1 SIEGEA
2 DGEA
3 (drum ID)
4 55
5 Net weight (Kg)
6 % Pu-239
7 Drum status. Possible status values are:
   PROC
   CERT
   VERF_HI
   VERF_LO
   BACK

- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.3 SIE Message with Drum Status VERF_HI

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of VERF_HI.
- Issue the PCS messages necessary to load a drum and start the measurement.
When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.4 SIE Message with Drum Status VERF_LO

- Prepare a 55-gallon drum with known activity sources.
- Send an SIE message for a 55 gallon drum with drum status of VERF_LO.
- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

12.4.5 SIE Message with Drum Status BACK

- Prepare a 55-gallon drum without any sources.
- Send an SIE message for a 55 gallon drum with drum status of BACK.
- Issue the PCS messages necessary to load a drum and start the measurement.
- When the measurement is complete, confirm that the SIE received the message and it is in proper format.

Note for this page: GEA does not distinguish between CERT, PROC, VERF_LO, VERF_HI, or BACK drums.
13. Test of Pu Criticality Message

- Load a drum with enough plutonium to find a measurable amount. (The specification for the GEA system is about 1 gram of Pu-239.)

- Perform an automatic measurement of the drum, and note the amount of Pu-239 reported.

- Go to the OS/2 desktop and click on the GEA Setup icon.

- Logon and select the option for Pu mass criticality level.

- Set the Pu-239 criticality mass level to less than the amount measured.

- Perform a measurement again, with the same drum and amount of Pu.

- Display the report by opening an OS/2 window and entering:
  - `> CD WAS`
  - `> DISPREP | MORE`

- The report will be displayed on the screen.

- Confirm that the message at the SIE is as required.
14. Test of Plutonium Isotopic Ratios

- Obtain a drum with plutonium of known isotopic ratios, including at least Pu-239 and Pu-241, with a quantity of more than 1 gram total Pu. The drum should have a density of 0.2 g/cc or less.

- Perform a routine measurement of this drum.

- Display the report and compare the relative isotopic abundances reported to the known isotopic ratios. Display the report with the following commands:

- Display the report by opening an OS/2 window and entering:
  > CD \WAS
  > DISPREP | MORE

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Wt. % Pu-238</th>
<th>Ratio to Pu-239</th>
<th>Ratio to Pu-241</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pu-238</td>
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<td>Am-241</td>
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15. Repeatability Measurements

Repeatability measurements must meet the requirement of two-thirds of the measurements being within 5% of the mean. This test will include loading and unloading. Six measurements will be made in each of four cases:

1) Low-density 55-gallon drum
2) High-density 55-gallon drum
3) Low-density 85-gallon overpack
4) High-density 85-gallon overpack

15.1 Repeatability Measurement with Low-Density 55-gallon Drum

First load the system with a low-density 55-gallon drum with some radioactive sources.

• Make an automatic measurement of the drum activity.

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
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</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WASIDISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
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</table>
- Make an automatic measurement of the drum activity. (#3)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WASIDISPREP).

- Record the activity results obtained:

<table>
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<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
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</table>
- Make an automatic measurement of the drum activity. (#4)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
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<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
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</table>
- Make an automatic measurement of the drum activity. (#5)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
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<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
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</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
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</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.

Verified: [Signature]
Reviewed: [Signature]
15.2 Repeatability Measurement with High-Density 55-gallon Drum

First load the system with a low-density 55-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^{60}$Co</td>
<td>7.12</td>
<td>± 0.18</td>
</tr>
<tr>
<td>$^{133}$Ba</td>
<td>23.72</td>
<td>± 0.41</td>
</tr>
<tr>
<td>$^{137}$Cs</td>
<td>5.60</td>
<td>± 0.21</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity.(#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>6.90</td>
<td>± 0.17</td>
</tr>
<tr>
<td>Ba 133</td>
<td>22.90</td>
<td>± 0.46</td>
</tr>
<tr>
<td>Cs 137</td>
<td>5.56</td>
<td>± 0.22</td>
</tr>
</tbody>
</table>

**Sand Drum #2**
- Make an automatic measurement of the drum activity. (#3)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>7.09</td>
<td>.18</td>
</tr>
<tr>
<td>Cs 137</td>
<td>24.20</td>
<td>.47</td>
</tr>
<tr>
<td>Cs 137</td>
<td>5.69</td>
<td>.22</td>
</tr>
<tr>
<td></td>
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</tbody>
</table>
Make an automatic measurement of the drum activity. (#4)

Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>5.70</td>
<td>± 0.14</td>
</tr>
<tr>
<td>Ba 133</td>
<td>24.14</td>
<td>± 0.47</td>
</tr>
<tr>
<td>Cs 137</td>
<td>5.34</td>
<td>± 0.21</td>
</tr>
</tbody>
</table>
• Make an automatic measurement of the drum activity. (#5)

• Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

• Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co 60</td>
<td>7.07</td>
<td>± 0.18</td>
</tr>
<tr>
<td>Ba 133</td>
<td>24.18</td>
<td>± 0.47</td>
</tr>
<tr>
<td>Cs 137</td>
<td>5.41</td>
<td>± 0.21</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Co 60</td>
<td>7.10</td>
<td>± 0.18</td>
</tr>
<tr>
<td>Ba 133</td>
<td>23.67</td>
<td>± 0.45</td>
</tr>
<tr>
<td>Cs 137</td>
<td>5.62</td>
<td>± 0.21</td>
</tr>
</tbody>
</table>
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.83</td>
<td>6.49</td>
<td>7.17</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Bg-133</td>
<td>3.80</td>
<td>2.61</td>
<td>4.99</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cs-137</td>
<td>5.54</td>
<td>5.26</td>
<td>5.81</td>
<td>6</td>
<td>0</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>M. Miller 7/30/96</td>
<td>P. Johnson 7/23/96</td>
</tr>
</tbody>
</table>
15.3 Repeatability Measurement with Low-Density 85-gallon Overpack

First load the system with a low-density 85-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ba-133</td>
<td>30</td>
<td>1</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#2)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Be-133</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
WRAP GEA Site Acceptance Test Procedure

- Make an automatic measurement of the drum activity. (#3)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ba-133</td>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7</td>
<td></td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#4)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Ba-133</td>
<td>37</td>
<td>1</td>
</tr>
<tr>
<td>Cs-137</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#5)
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Ba-133</td>
<td>36</td>
<td>1</td>
</tr>
<tr>
<td>Cs-137</td>
<td>7</td>
<td>0</td>
</tr>
</tbody>
</table>

---

105
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.
15.4 Repeatability Measurement with High-Density 85-gallon Overpack

First load the system with a low-density 85-gallon drum with some radioactive sources.

- Make an automatic measurement of the drum activity.
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>5.80</td>
<td>0.16</td>
</tr>
<tr>
<td>Ba-133</td>
<td>22.76</td>
<td>0.50</td>
</tr>
<tr>
<td>Cs-137</td>
<td>1.90</td>
<td>0.20</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Make an automatic measurement of the drum activity. (#2)

Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.61</td>
<td>0.17</td>
</tr>
<tr>
<td>Ba-133</td>
<td>22.79</td>
<td>0.52</td>
</tr>
<tr>
<td>Cs-137</td>
<td>4.22</td>
<td>0.18</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#3)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>5.78</td>
<td>0.16</td>
</tr>
<tr>
<td>Ba-133</td>
<td>22.34</td>
<td>0.51</td>
</tr>
<tr>
<td>Cs-137</td>
<td>5.14</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*Note: The table entries are placeholders and should be replaced with actual values.*
- Make an automatic measurement of the drum activity. (#4)
- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).
- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>6.62</td>
<td>0.17</td>
</tr>
<tr>
<td>B-133</td>
<td>22.71</td>
<td>0.51</td>
</tr>
<tr>
<td>Cs-137</td>
<td>5.15</td>
<td>0.21</td>
</tr>
</tbody>
</table>
- Make an automatic measurement of the drum activity. (#5)

- Read the report values on the GEA system (in an OS/2 window with the program C:\WAS\DISPREP).

- Record the activity results obtained:

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>MDA / Activity</th>
<th>Uncertainty</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-60</td>
<td>15.69</td>
<td>0.16</td>
</tr>
<tr>
<td>Ba-133</td>
<td>23.68</td>
<td>0.53</td>
</tr>
<tr>
<td>Cs-137</td>
<td>4.99</td>
<td>0.20</td>
</tr>
</tbody>
</table>

Note: Low value due to minimum transmission being used — only 10% back from the source, and very small.
Average the results for each nuclide, and list below.

<table>
<thead>
<tr>
<th>Nuclide</th>
<th>Mean Value</th>
<th>Mean - 5%</th>
<th>Mean + 5%</th>
<th># within 5%</th>
<th># outside 5%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co60</td>
<td>6.14</td>
<td>5.83</td>
<td>6.45</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Ba133</td>
<td>22.86</td>
<td>21.71</td>
<td>24.00</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Cs137</td>
<td>4.85</td>
<td>4.69</td>
<td>5.09</td>
<td>3</td>
<td>3</td>
</tr>
</tbody>
</table>

Confirm that for each nuclide present, that there are no more than 2 measurements outside of ±5% of the mean value.
16. Abort and Error Conditions

16.1 Abort of Measurement during Automatic Operation

When a measurement is in progress, there will occasionally be a message box with an Abort button. While this is displayed, the measurement can be aborted. The abort message issued when this message box is not displayed will be saved in the message queue, and will be processed when the next valid abort period occurs.

- Send an Abort command at different stages of the measurement.
- Confirm that abort occurs.

16.2 Software Error During Automatic Measurement

- Have the project engineer set up the system to fail during analysis, such as bad setup of analysis operations.
- Perform an automatic measurement, and note the status when the failure occurs.

16.3 Software Error During Manual Measurement

- Continue with the system still set up to fail during analysis, such as bad setup of analysis operations.
- Perform a manual measurement, and note the error message when the failure occurs.
16.4 Mechanical Failure During Automatic Measurement

- Start with the drum unloaded from the station.
- Place some material in the path so that a drum cannot be fully loaded.
- Start an automatic measurement, and note that a status is reported for mechanical difficulty in the load process.
- Remove the obstruction and restore the system.

16.5 Mechanical Failure During Manual Measurement

- Start with the drum unloaded from the station.
- Place some material in the path so that a drum cannot be fully loaded.
- Start a manual measurement, and note the error reported for mechanical difficulty in the load process.
- Remove the obstruction and restore the system.
17. Test of Safety Conditions

17.1 Transmission Source

- Go to Manual Operations on the main menu.
- Check that the door is open, as if a drum has been unloaded. If it is not open, unload the drum.
- Select Other Controller Functions.
- Select Open transmission source shutter.
- Note that an error occurs, and that there is no noise indicating the shutter opening.

- With the door still open, go to Calibration Operations.
- Select count, then Transmission.
- On the next screen check Disable Load/Unload. Enter a count time of 100 seconds. (The other settings do not matter.) Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.

- With the door still open, start a count in Manual Operations.
- Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.

- With the door still open, start a count in Routine Operations, with Disable Load/Unload checked.
- Note that the count will proceed, but when the transmission source shutter is to open, an error is given, and that no shutter opening occurs.
17.2 Door Tape Switch

Manual Operations
- Start with the door open after a drum unload.
- Go to Manual Operations, and select Load/Unload/Transport
- Perform a Load operation, and as the door starts to shut, hit the tape switch.
- Note that the door motion stops, and an error message is displayed on the screen.
- Turn power back on to the PLC.
- Acknowledge the error, then return to the manual operations menu. (If you acknowledge the error before turning power back on, a new error message will be generated.) The PLC will be initialized.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EWM 6/20/96</td>
<td>7/23/91</td>
</tr>
</tbody>
</table>

Automatic Operations
- Perform an automatic measurement of a drum, starting with loading a drum.
- As the door starts to shut, hit the tape switch.
- Note that the door motion stops since power to the PLC will be turned off.
- When the PC next sends a command to the PLC, an error message is displayed on the screen, and a status message is sent to the PCS.

Note: If a motion is occurring when the tape switch is hit, the error message and PCS status message will occur at that time. If there is no motion, other than rotation, then the error message will occur at the next command to the PLC.

- Turn power back on to the PLC.
- Acknowledge the error. The PLC will be initialized.
- Now exit to manual mode, then logon to the system and go to Manual Operations
- Now restore the system, by unloading the drum.

<table>
<thead>
<tr>
<th>Verified</th>
<th>Reviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>EWM 8/26/96</td>
<td>8/26/91</td>
</tr>
</tbody>
</table>

17.3 Emergency Stop
This is equivalent to the tape switch, but has a different error code in the status message.

- Perform a routine count, including drum loading.
- At some point in the process, press either one of the emergency stop buttons.
- Note that the system stops, and an error message is displayed.
- Turn PLC power back on.
- Acknowledge the error.
- Then go to Manual Operations and unload the drum so that it is ready for the next count.

- Perform an automatic measurement of a drum.
- At some point in the process, press either one of the emergency stop buttons.
- Note that the system stops because there is no power to the PLC.
- When the GEA PC next sends a command to the PLC, an error message is displayed on the screen, and a status message is sent to the PCS.
- Acknowledge the error.
- Now exit to manual mode, then logon to the system and go to Manual Operations
- Unload the drum.
18. Maintenance Functions

18.1 Liquid Nitrogen Fill Sequence

- Select Manual Operations on the main menu.
- Select Start LN2 Fill.
- A screen will be displayed asking for confirmation. Select Yes.
- The LN2 filling will start, and will continue until complete. (The filling is performed automatically on a clock cycle so that manual filling is not required in normal operation.)

18.2 Add or Change of Username or Password

- Select User Management on the main menu.
- Select Edit Password File on the User Management menu.
- On the next screen highlight one of the usernames, and press Edit Security Settings.
- On the next screen note privileges and password options.
- If desired, go back one screen and create a new username and password.
- Then log out of the software.
- Then log on with the new username and password to confirm that it has been accepted.
<table>
<thead>
<tr>
<th>Name</th>
<th>MSIN</th>
<th>Attach. With All Attach.</th>
<th>Text Only</th>
<th>Attach./ Appendix Only</th>
<th>EDT/ECN Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL Watson</td>
<td>T2-54</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>JB Payne</td>
<td>T4-02</td>
<td>X</td>
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<td></td>
<td>X</td>
</tr>
<tr>
<td>KJ Leist CE Wills</td>
<td>T4-52</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>RJ Bottenus</td>
<td>T4-52</td>
<td>X</td>
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<td></td>
<td>X</td>
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<tr>
<td>JR McGee</td>
<td>T4-02</td>
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