GEORGIA POWER COMPANY

HATCH NUCLEAR PLANT

PROCEDURE

Stabilized Assay Meter, SAM-2
PROCEDURE TITLE

HNP-8142
PROCEDURE NUMBER

Lab
RESPONSIBLE SECTION

SAFETY RELATED (X) NON-SAFETY RELATED ( )

REV.	DESCRIPTION	APPROVED DEPT. HEAD	APPROVED PLANT MANAGER	DATE
2	Page 4, 5, 7, 8, 10	W H Rogers	[signature]	4/20/82

WE

PROCEDURE REVISION REQUEST

PROCEDURE NO. HNP- 8142

Revision No. 21

REQUESTED BY		DEPARTMENT HEAD APPROVAL	
Name:	Date:	Signature:	Date:
R. ANDERSON	4-15-82	W.F. Rogers	4-17-82

REVISION CHANGES MODE OF OPERATION OR INTENT AS DESCRIBED IN FSAR:
( ) Yes (✓) No

CHANGE INVOLVES:
( ) An unreviewed Safety Question ( ) Tech.Specs. (✓) Neither
(See back for Safety Evaluation if required).

Safety Related ( ) Non-Safety Related (✓)

Safety/Non-safety Status Change ( ) Yes (✓) No

Attach marked up copy of procedure to this form.

REASON FOR REQUEST: TO CORRECT THE MISTAKES IN THE OPERATION SECTION OF THE PROCEDURE. / REVISION NUMBER CHANGE FROM 1 TO 2. ALL PAGES
PAGE 4 SECTION 6. NUMBER 12 b. CHANGE 0.65 TO 0.99 EFFICIENCY
PAGE 4 NOTE NUMBER 3 CHANGED 0.65 TO 0.99 TO CORRECT EFFICIENCY
PAGE 7 SECTION I. ADDED NUMBER 6 SETTING CH1 SWITCHES
PAGE 7 SECTION I. CHANGED 6 TO 7, 7 TO 8, 8 TO 9, 10 TO 11,
11 TO 12, 12 TO 13, 13 TO 14, 14 TO 15, 16 TO 16
PAGE 7 SECTION I. NUMBER 11 ADDED PARAGRAPH. ADJUST CH1 UNTIL IT EQUALS THE BACKGROUND COUNT FOUND IN CH 2. THE DIFFERENCE BETWEEN CH 1 & CH 2 SHOULD NOT EXCEED 5% IF POSSIBLE, RECORD THE CH2 SETTING ON DATA SHEET 3.
PROCEDURE DATA PACKAGE, R-TYPE CHANGE R01 TO R02 PAGE 11 & 14
DATA PACKAGE 1, DATA SHEET 1 CHANGE .65 TO .99 TO CORRECT EFFICIENCY

PRB RECOMMENDS APPROVAL: (✓) Yes ( ) No — PRB Secretary

12-59 — PRB Number

4-20-82 — Date

REFERENCE ONLY

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APPROVAL
See Title Page
DATE
See Title Page

E. I. HATCH NUCLEAR PLANT

Georgia Power

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MW

STABILIZED ASSAY METER, SAM-2

OPERATION AND CALIBRATION

A. PURPOSE

To establish a standard technique for the operation and calibration of the Eberline Stabilized Assay Meter, Model SAM-2; and provide a method of operation to determine I-131 concentrations in samples.

B. SAFETY

1. Observe safety rules outlined in Georgia Power Company SAFETY, Section "O."
2. Observe radiation protection procedures when calibrating the instrument with radioactive sources.

C. REFERENCES

1. Stabilized Assay Meter Model SAM-2 Technical Manual.
2. Eberline Instrument Checkout Procedures.

D. TEST EQUIPMENT

1. Electrostatic Voltmeter
2. 100 meg ohm load
3. Mini-pulser, Model MP-1
4. Calibrated Ba-133 source

E. DESCRIPTION OF INSTRUMENT

1. The SAM-2/RD-22 combination provides a portable gamma spectrometer that has been set up to be used in emergencies for analysis of low volume air samples for I-131 activity.

NO Space

It provides dual channel analyzer with scaler and ratemeter readout of either channel or scaler readout of the sum or difference of the two channels.

manual set

2. Stabilization is obtained from Am^{241} doping in the RD-22 detector scintillation crystal, which yields pulses that are counted and used to control the high voltage applied to the detector. This maintains a constant gain throughout the entire system.

3. A rear panel switch disables the stabilization circuit so the instrument can be used as a conventional scaler-ratemeter-analyzer with other types of detectors.

4. The instrument may be powered either from A.C. line or an external battery pack.

F. DESCRIPTION OF CONTROLS AND CONNECTORS

1. External Controls

a. DETECTOR: Connection to detector; MHV series coaxial.

b. H.V. ADJUST: Ten turn calibrated dial for setting and changing high voltage when operating in unstabilized mode. Functions as a high voltage limit control when in the stabilized mode.

c. THRESHOLD: Ten turn calibrated dials for setting and changing baseline sensitivity for each channel.

d. WINDOW: Ten turn calibrated dials for setting and changing range of pulse heights to be counted for each channel.

e. IN-OUT: Switches to select gross counting (OUT) or PHA (IN) for each channel.

f. +, OFF, -: Switches to select additive, subtractive or non-counting mode for each channel.

g. TIMED-STOP-MAN: Switch to select counting mode.

h. RESET-START: Switch to reset all appropriate circuitry to zero and start a counting sequence.

i. COUNT TIME IN MINUTES: Switches to select desired counting time.

j. RANGE SWITCH: Selects range of rate meter of 500, 5000, 50,000, or 500,000 counts per minute (CPM).

k. CH1, CH2: Switch to select which channel is displayed on rate meter.

l. RESET: Returns meter reading rapidly to zero when depressed.

m. RESPONSE: Controls response time of the meter.

n. POWER: Switch to supply power to instrument (rear panel).

o. BATTERY: Connector for plugging in external battery (rear panel).

p. STABILIZER: Switch selects stabilized or unstabilized operation (rear panel).

q. DISPLAY ON-OFF: Switch disables digital display to conserve battery.

r. 115-230: Switch selects 115 or 230 VAC operation (underneath chassis).

s. AMP OUT: BNC connector which provides an output for connection to a multichannel analyzer.

2. Internal Controls

a. GAIN (Channel 1 Amplifier Board): Control for adjusting gain of amplifier.

b. TIME (Timer Board): Control to calibrate time base when operating with external battery.

c. RATE METER CALIBRATION (Rate Meter Board): Controls to calibrate meter reading.

d. SENSITIVITY (Stabilizer Board): Controls stabilizer setpoint.

G. OPERATION OF INSTRUMENT

1. Verify that the RD-22 detector is properly connected to the SAM-2 detector connector.

2. Connect SAM-2/RD-22 to power supply and turn POWER switch ON (rear panel).

3. Operate STABILIZER switch to ON (rear panel) and set CH1 switches to "IN" and "+."

4. Set CH1 THRESHOLD and H.V. ADJUST to settings determined from last calibration. See label on top of instrument.

5. Set CH1 WINDOW to ".72"

6. Turn CH2 THRESHOLD to "4.0" and place CH2 WINDOW to setting determined on Data Package 3 (Data Sheet 3).

7. Place CH2 switches to "IN" and "-" for background subtraction.

8. Set Display ON-OFF switch to "ON".

9. Set desired count time and TIME-STOP-MAN switch to TIME.

10. Place the sample, enclosed in plastic, in the proper geometry to the detector and press the RESET-START switch. Note the shelf number on Data Package 1 (Data Sheet 1).

11. When counting is complete, the value in the display is "net" counts for the Iodine activity.

NOTE

If negative counts are obtained when counting a sample, CH2 switches must be set to "OUT" and "OFF" causing gross counts to be observed in the display. Recount sample and then substract background found on Data Package 3 (Data Sheet 3) manually to obtain net counts.

12. Using Data Package 1 (Data Sheet 1), calculate the Iodine concentration of the counted sample using the following formulas:

a. Silver Zeolite Cartridges:

$$\text{Iodine Activity (uci/cc)} = \frac{(\text{NET CPM})\ (4.5 \times E\text{-}10)}{(\text{Volume in Liters})(.95)(\text{D.E.})}$$

b. Charcoal Cartridges:

$$\text{Iodine Activity (uci/cc)} = \frac{(\text{NET CPM})\ (4.5 \times E\text{-}10)}{(\text{Volume in Liters})(.99)(\text{D.E.})}$$

NOTE

1. 4.5×10^{-10} = conversion factor to get from disintegrations per minute to microcuries.

2. .95 = filter media collection efficiency for silver zeolite cartridges.

3. .99 = filter media collection efficiency for charcoal cartridges

4. Volume in liters of sample = sampling time (min) x flow rate of air sample (LPM)

5. D.E. = detector efficiency at specific shelf height

6. Net CPM = Net counts per minute of sample; net counts divided by count time.

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13. Operational calibration must be performed DAILY when instrument is in use, see Section I.

H. CALIBRATION

CAUTION

High voltage exists in certain internal components, so extreme care should be used when instrument is removed from its case.

1. High Voltage Adjustment

a. Plug instrument into A.C. line and connect a 100 meg ohm load to the DETECTOR connector.

b. Connect a 3KV electrostatic voltmeter to pin A of the High Voltage Power Supply making certain the Hign Voltage Power Supply is plugged into its socket.

c. Operate POWER and STABILIZER switches to ON (rear panel) and check the high voltage output versus the high voltage settings as indicated below:

HV ADJUST	HIGH VOLTAGE
5.0	900 - 1100 volts
10.0	1400 volts or more

Record MPL number of electrostatic voltmeter used on Data Package 2 (Data Sheet 2).

d. Set the HV ADJUST control to limit the high voltage at 1500 volts. Record this setting on Data Package 2 (Data Sheet 2) and place a label on instrument bearing this HV ADJUST setting.

2. Calibration of Count Rate Meter

a. Connect an MP-1, Mini Pulser to the DETECTOR connector, setting a pulse height of approximately 300 mv and a frequency of 400 CPM. Record serial number of MP-1 on Data Package 2 (Data Sheet 2).

b. Place CH1 switches to "+" and "IN", CH2 switches to "OUT" and "OFF".

c. With the range switch on X1, adjust the X1 calibration potentiometer on the rate meter board for a reading of 400 CPM on the meter.

d. Repeat with 4000, 40,000, and 400,000 CPM on the X10, X100, and X1000 ranges respectively. Record results on Data Package 2 (Data Sheet 2).

e. Check linearity at 100, 1000, 10,000, and 100,000 CPM on the respective ranges. Do not record results, but if linearity is not ± 10% repeat steps 2a - 2c.

3. Adjustment of Linear Gain

a. Set the CH1 THRESHOLD control to 3.64 and CH1 WINDOW control to 0.1

b. Place CH2 switch to "OFF."

c. Operate the CH1 WINDOW switches to "IN" and "+" and place a Ba-133 source in proper geometry to the detector end face.

d. Adjust the GAIN control on the CH1 amplifier - PHA board until the maximum count rate is obtained. Take several 0.1 minute counts to confirm that the 364 KeV peak lies between 3.59 and 3.69 THRESHOLD setting. If there is insufficient gain to place the peak at 3.64, adjust the stabilizer SENSITIVITY control CW until the peak is below 3.64, then adjust the GAIN control CW until the peak is approximately 3.64.

4. Threshold Determination

a. Set CH1 THRESHOLD to 2.5 and CH1 WINDOW to 0.1

b. Set CH2 switch to OFF

c. Place a Ba-133 source in proper geometry to the detector and face.

d. Set count time to 1.0 and TIMED-STOP-MAN switch to TIMED.

e. Do a series of counts advancing the THRESHOLD by increments of 0.1, up to a THRESHOLD of 4.0. Record results on Data Package 2 (Data Sheet 2) and plot data graphically on Data Package 2 (Data Sheet 2a). Plot the threshold settings on the X-axis and counts per minute (CPM) on the Y-axis.

f. Determine the peak THRESHOLD setting from this curve and then using a WINDOW setting of 0.72, calculate the optimum THRESHOLD setting by subtracting one half of the WINDOW setting from the peak THRESHOLD setting.

g. Place a label showing the optimum THRESHOLD setting and the WINDOW setting of 0.72 on top of the instrument for later reference. Record the optimum THRESHOLD setting on Data Package 2 (Data Sheet 2).

5. Detector Resolution Determination

a. Detector resolution can also be determined by using the curve drawn from the data in step 4e.

b. Determine the peak THRESHOLD setting from this curve and record on Data Package 2 (Data Sheet 2).

c. Determine the THRESHOLD setting at one half the peak count at a THRESHOLD setting greater than 3.69 and record on Data Package 2 (Data Sheet 2).

d. Figure the detector resolution as follows:

$$\% \text{ RES} = \frac{2(\text{High setting for 1/2 peak} - \text{peak setting})}{\text{Peak Setting}} \times 100$$

e. The resolution should be 15% or less. Record on Data Package 2 (Data Sheet 2).

I. DAILY OPERATIONAL CALIBRATION

1. Verify that the RD-22 detector is properly connected to the SAM-2 DETECTOR connector.

2. Connect SAM-2/RD-22 to power supply and turn POWER switch ON (rear panel).

3. Operate STABILIZER switch to ON (rear panel) and set CH1 switches to "IN" and "+."

4. Set CH1 THRESHOLD and HV ADJUST to settings determined from last calibration. See label on top of instrument.

5. Place CH1 WINDOW to ".72".

6. Set CH1 switches to "IN" and "+", and CH2 switches to "OUT" and "OFF".

7. Set Display ON-OFF switch to "ON".

8. Set count time to 1.0 minute and TIMED-STOP-MAN switch to TIMED.

9. Record a 1.0 minute count of CH1 background at these settings on Data Package 3 (Data Sheet 3).

10. Set CH1 switches to "OUT" and "OFF", and place the CH2 switches to "IN" and "+."

11. Place the CH2 THRESHOLD TO 4.0 and adjust the CH2 window until it equals the background count found in CH1 (The difference between CH1 & CH2 should not exceed 5% if possible.) Record the CH2 window setting on Data Package 3 (Data Sheet 3).

12. Set CH1 switches to "IN" and "+" and CH2 switches to "IN" and "-"

13. Place a Ba-133 source in proper geometry to the detector on Shelf # 3 and count for 5 minutes. Counts observed in the display window represents the NET counts of the source with the background subtracted. Record in counts per minute on Data Package 3 (Data Sheet 3).

NOTE

If negative counts are obtained when counting a sample, CH2 switches must be set to "OUT" and "OFF" causing gross counts to be observed in the display. Recount sample and then substract background found on Data Package 3 (Data Sheet 3) manually to obtain net counts.

14. Divide the NET counts per minute of the source by the known disintegrations per minute of the source and multiply by 1.19 to get the efficiency of the detector (D.E.).

NOTE

The 1.19 factor accounts for the difference in yield of the Ba-133 and the I-131 gammas.

15. Repeat steps 11 and 12 with shelves 4 and 5 to obtain a detector efficiency for each of the three shelves.

16. Complete Data Package 3 (Data Sheet 3) on a daily basis, only when SAM-2/RD-22 is in use.

PROCEDURE DATA PACKAGE

DOCUMENT NO: HNP-8142-1

SERIAL NO: R02-

MPL NO: _____

RTYPE: G15.14

XREF: _____

TOTAL SHEETS: 2

FREQUENCY: AS REQUIRED

COMPLETED BY: _____

DATE COMPLETED: _____

I HAVE REVIEWED THIS DATA PACKAGE FOR COMPLETENESS AND AGAINST ACCEPTANCE CRITERIA IN ACCORDANCE WITH HNP-830.

ACCEPTANCE _____ UNACCEPTABLE _____

REVIEWED BY: _____

DATE REVIEWED: _____

REMARKS: _____

FIGURE 1
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DATA PACKAGE 1
DATA SHEET 1
PORTABLE AIR SAMPLE LOG

DATE: ____________ NO.: ____________

COLLECTION DATA									
SMPL NO.	SAMPLE LOCATION SAMPLE POINT	AIR SMPL	TIME ON	(CST) OFF	SAMPLE TIME (MIN)	FLOW RATE LPM	VOLUME IN LITERS	COLLECTED BY	REMARKS
COUNTING DATA	SHELF NO.	TIME (CST)	TOTAL COUNT	MIN CTD	NET CPM	EFF.	ACTIVITY (uCi/cc)	DECAY ACTIVITY 4 HR 24 HR	INITIALS
GROSS IODINE									

COLLECTION DATA									
SMPL NO.	SAMPLE LOCATION SAMPLE POINT	AIR SMPL	TIME ON	(CST) OFF	SAMPLE TIME (MIN)	FLOW RATE LPM	VOLUME IN LITERS	COLLECTED BY	REMARKS
COUNTING DATA	SHELF NO.	TIME (CST)	TOTAL COUNT	MIN CTD	NET CPM	EFF.	ACTIVITY (uCi/cc)	DECAY ACTIVITY 4 HR 24 HR	INITIALS
GROSS IODINE									

COLLECTION DATA									
SMPL NO.	SAMPLE LOCATION SAMPLE POINT	AIR SMPL	TIME ON	(CST) OFF	SAMPLE TIME (MIN)	FLOW RATE LPM	VOLUME IN LITERS	COLLECTED BY	REMARKS
COUNTING DATA	SHELF NO.	TIME (CST)	TOTAL COUNT	MIN CTD	NET CPM	EFF.	ACTIVITY (uCi/cc)	DECAY ACTIVITY 4 HR 24 HR	INITIALS
GROSS IODINE									

IODINE ACTIVITY: 1) SILVER ZEOLITE = $\frac{(\text{NET CPM})(4.5 \times 10^{-10})}{(\text{VOLUME IN LITERS})(.95)(\text{D.E.})}$

2) CHARCOAL CARTRIDGE = $\frac{(\text{NET CPM})(4.5 \times 10^{-10})}{(\text{VOLUME IN LITERS})(.93)(\text{D.E.})}$

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HP-8142 R02

REFERENCE ONLY

FIGURE 1
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manual set

PROCEDURE DATA PACKAGE

DOCUMENT NO: HNP-8142-2

SERIAL NO: R02-

MPL NO: _____

RTYPE: G15.14

XREF: _____

TOTAL SHEETS: 3

FREQUENCY: Quarterly

COMPLETED BY: _____

DATE COMPLETED: _____

I HAVE REVIEWED THIS DATA PACKAGE FOR COMPLETENESS AND AGAINST ACCEPTANCE CRITERIA IN ACCORDANCE WITH HNP-830.

ACCEPTANCE ____ UNACCEPTABLE ____

REVIEWED BY: _____

DATE REVIEWED: _____

REMARKS: _____

FIGURE 2
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DATA PACKAGE 2
DATA SHEET 2

INSTRUMENT: GAM-2
MPL NO.: _____

LOCATION: _____

CALIB. SOURCE	ACTUAL COUNT RATE CPM	DATE: CALIB BY: AS FOUND CPM	AS LEFT CPM
MP-1	400		
SN	4000		
	40000		
	400000		

THRESHOLD	COUNTS
2.4	
2.5	
2.7	
2.8	
2.9	
3.0	
3.1	
3.2	
3.3	
3.4	
3.5	
3.6	
3.7	
3.8	
3.9	
4.0	

Peak THRESHOLD setting = _____

High THRESHOLD setting for 1/2 peak = _____

$$\% \text{ RESOLUTION} = \frac{2(\text{High setting for 1/2 peak} - \text{Peak setting})}{\text{Peak Setting}} \times 100$$

% RESOLUTION = _____

Optimum THRESHOLD setting = _____

WINDOW setting = _____

HV ADJUST setting = _____

MPL Number of electrostatic voltmeter _____

FIGURE 2
Page 2 of 3

DATA PACKAGE 2 (CON'T)
(Data Sheet 2A)

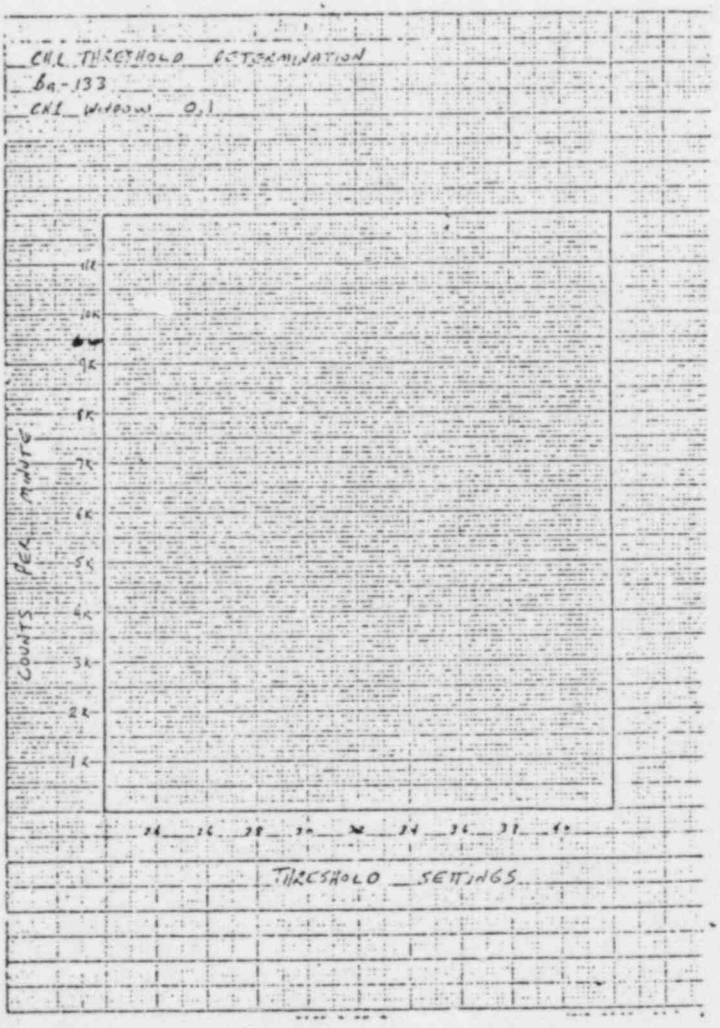

FIGURE 2
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E. I. HATCH NUCLEAR PLANT

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PROCEDURE DATA PACKAGE

DOCUMENT NO: HNP-8142-3

SERIAL NO: R02-

MPL NO: _____

RTYPE: G15.14

XREF: _____

TOTAL SHEETS: 2

FREQUENCY: AS REQUIRED

COMPLETED BY: _____

DATE COMPLETED: _____

I HAVE REVIEWED THIS DATA PACKAGE FOR COMPLETENESS AND AGAINST ACCEPTANCE CRITERIA IN ACCORDANCE WITH HNP-830.

ACCEPTANCE ____ UNACCEPTABLE ____

REVIEWED BY: _____

DATE REVIEWED: _____

REMARKS: _____

FIGURE 3
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manual set

DATA PACKAGE 3
DATA SHEET 3
SAM-2 DAILY CALIBRATION

SOURCE: _____ SERIAL NO.: _____ MONTH_____19__

ACTIVITY_____DPM INSTRUMENT MPL NO.: 021-N

(1) DETECTOR EFFICIENCY (D.E.) = Net Counts per minute x 1.19
Disintegration/minute

DAY	DATE	CH2 WINDOW SETTING	BKG COUNTS /MIN	SOURCE NET CPM	D.E. SHELF 3	D.E. SHELF 4	D.E. SHELF 5	REMARKS	COMPLETED BY
	1								
	2								
	3								
	4								
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
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	26								
	27								
	28								
	29								
	30								
	31								

FIGURE 3
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