NRC

? 1001

.igure 1001-8

Three Mile Island Nuclear Station

Special Operating Procedure

SIDE 1

SOP No. 2-67
(From SOP Log Index)

NOTE: Instructions and guidelines in AP 1001 must be followed when completing this form.

Unit No. 2

Date

1. Title ATMOS. RAD. MON. CALIB.

2. Purpose (include purpose of SOP) To calibrate and repair selected atmospheric radiation monitors

3. Attach procedure to this form written according to the following format.

A. Limitations and Precautions
   1. Nuclear Safety
   2. Environmental Safety
   3. Personnel Safety
   4. Equipment Protection

B. Prerequisites

C. Procedure

Attached

Generated by V.P. Orlandi   Date 4/6/79

5. Duration of SOP - Shall be no longer than 90 days from the effective date of the SOP or (a) or (b) below — whichever occurs first.

(a) SOP will be cancelled by incorporation into existing or new permanent procedure submitted by ______ ☐

(b) SOP is not valid after ______ ☐
(fill in circumstances which will result in SOP being cancelled)

N/A

6. (a) Is the procedure Nuclear Safety Related?
If "yes", complete Nuclear Safety Evaluation. (Side 2 of this Form) . . . . Yes ☐ No ☐

(b) Does the procedure affect Environmental Protection?
If "yes", complete Environmental Evaluation. (Side 2 of this Form) . . . . Yes ☐ No ☐

(c) Does the procedure affect radiation exposure to personnel? . . . . Yes ☐ No ☐

N/A

NOTE: If all answers are "no", the change may be approved by the Shift Supervisor. If any questions are answered "yes", the change must be approved by the Unit Superintendent.

7. Review and Approval

Approved – Shift Supervisor [signature] 4/6/79
Date

NRC [signature] Reviewed – List members of PORC contacted W.C. [signature] 4/6/79
Date

N.A. [signature]   V.P. Orlandi [signature]   R.P. Warren 4/6/79
Date

L.D. [signature]   G.A. Kunder 4/6/79
Date

AIAKA [signature] Approved - Unit Superintendent [signature] Miller 4/6/79
Date

8. SOP is Cancelled

______ Shift Supervisor/Shift Foreman   ______ Date

131 310

TMI-83 Rev. 8/77

"EVALUATION"

AP-1001 | Three Mile Island Nuclear Station | SIDE 2

Figure 1001-8 | Nuclear Safety/Environmental Impact Evaluation | SOP No. _____

1. Title _____

2. Nuclear Safety Evaluation

Does this SOP:

*(a) increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety? . . . . . yes☐ no☐

*(b) create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report? . . . . . yes☐ no☐

*(c) reduce the margin of safety as defined in the basis for any technical specification? . . . . . yes☐ no☐

Details of Evaluation (Explain why answers to above questions are "no". Attach additional pages if required.)

Evaluation By _____ Date _____

3. Environmental Impact Evaluation

Does this SOP:

(a) possibly involve a significant environmental impact? . . . . . yes☐ no☐

*(b) have a significant adverse effect on the environment? . . . . . yes☐ no☐

*(c) involve a significant environmental matter or question not previously reviewed and evaluated by the N.R.C. . . . . yes☐ no☐

Details of Evaluation

Evaluation By _____ Date _____

*NOTE: If these questions are "yes", the change must receive N.R.C. approval.

4. Review (PORC review of evaluation is required only when requested by the Station Superintendent/Unit Superintendent. If this review is made, the PORC must consist of two off-site members.)

1. _____

2. _____ Off-Site Members | _____ PORC Chairman Signature | _____ Date

5. Approval

_____ Station Superintendent/Unit Superintendent | _____ Date

131 511

"TEMPORARY CHANGE"

AP 1001
Figure 1001 - 5

Three Mile Island Nuclear Station
Temporary Change Notice (TCN)

SIDE 1

TCN NO. 2-79-051
(From TCN Log Index)

Unit No. 2

Date 3-26-79

NOTE: Instructions and guidelines in AP 1001 must be followed when completing this form.

1. Procedure 2 GP2-R2 Atmospheric Rad. Mon. Calib.
No. Title

2. Change (Include page numbers, paragraph numbers, and exact wording of change.)
Replace TCN 2-79-741
See attached page 31-0

3. Reason for Change:
This is a non-applicable section, within the TMI-2 baseline data

4. Recommended by [signature] 3-26-79
Date

5. [signature] 3-26-79
Supervisor's Signature Date

6. Duration of TCN - No longer than ninety days from effective date of TCN or as in (a) or (b) below whichever occurs first.

(a) TCN will be cancelled by a procedure revision issued as a result of a Procedure Change Request to be submitted by JAB (Submit PCR as soon as possible) ☒
Supervisor Submitting TCN

(b) TCN is not valid after _____ ☐
(fill in circumstances which will result in TCN being cancelled)

7. (a) Is the procedure on the Nuclear Safety Related Procedure List? (Sec. AP 1001 – Appendix B)
If "Yes", complete Nuclear Safety Evaluation. (Side 2 of this Form) Yes ☒ No ☐

(b) Is the procedure on the Environmental Impact Procedure List? (Sec. AP 1001 – Appendix B)
If "Yes", complete Environmental Evaluation. (Side 2 of this Form) Yes ☐ No ☒

(c) Does the change effect the intent of the original procedure? Yes ☐ No ☒

NOTE: If all answers are "no" the change may be approved by the Shift Supervisor. If question (c) is answered "yes", the change must be reviewed by the PORC and approval by the Station/Unit Superintendent prior to implementation. If the answer to question (c) is "no" the change may be approved by two members of the plant management staff at least one of whom holds a senior reactor operators license on the unit affected in accordance with paragraph 3.6.4.2 of AP 1001.

8. Review and Approval

Block (c) "yes"

Approved _____ Shift Supervisor/Foreman _____ Date

Reviewed _____ _____

Members _____ _____

Of PORC _____ _____

Contacted _____ PORC Members _____ Date

Approved _____ Unit Superintendent _____ Date

Block (c) "no"

Approved [signature] SRO License _____ Date

[signature] Member Plant Mgt. Staff 3-26-79 Date

Reviewed _____ Chairman of PORC _____ Date

Approved _____ Unit Superintendent _____ Date

NOTE The block (c) "Yes" review and approval chain may be followed at anytime.

9. Approval
Manager, Generation Quality Assurance [signature] Date _____

NOTE M.G.Q.A. approval required only on certain Administrative Procedures listed in Enclosure 7 of AP 1001

10. TCN is Cancelled _____ Shift Supervisor/Shift Foreman _____ Date

131 312

TMI 50 Rev 8 77

"EVALUATION"

AP 1001

Figure 1001-4

Three Mile Island Nuclear Station

SIDE 2

Nuclear Safety/Environmental Impact Evaluation

1. Procedure 2612-R2 (No.) ATM- Rad. Mon. (Title) 2-79-031 (Temporary Change Notice No.)

2. Nuclear Safety Evaluation

Does the attached procedure change:

* (a) increase the probability of occurrence or the consequences of an accident or malfunction of equipment important to safety? . . . . . yes ☐ no ☑
* (b) create the possibility for an accident or malfunction of a different type than any evaluated previously in the safety analysis report? . . . . . yes ☐ no ☑
* (c) reduce the margin of safety as defined in the basis for any technical specification? . . . . . yes ☐ no ☑

Details of Evaluation (Explain why answers to above questions are "no". Attach additional pages if required.)

Change is made to delete step which is not applicable to TMI-2. This step has no effect on the ability of the monitor. Therefore change does not affect a, b, or c above.

Evaluation By [signature] JAB Date 3-26-79

3. Environmental Impact Evaluation

Does the attached procedure change:

(a) possibly involve a significant environmental impact? . . . . . yes ☐ no ☐
(if 3(a) is "yes", answer questions (b) and (c) and fill in "Details of Evaluation" below. If "no", state why by filling in the "Details of Evaluation" below) . . . . . yes ☐ no ☐
* (b) have a significant adverse effect on the environment? . . . . . yes ☐ no ☐
* (c) involve a significant environmental matter or question not previously reviewed and evaluated by the N.R.C. . . . . . yes ☐ no ☐

Details of Evaluation (Attach additional pages if required)

Evaluation By ____________ Date ________

4. Unit Superintendent requests PORC review ☐ Check if YES.

5. Approval

Evaluation Accompanying PCR

____________ Unit Superintendent ________ Date

Evaluation Accompanying TCN

Approval [signature] SRO Licensee 3/26/79 Date

Reviewed [signature] Member of Plant Staff 3-26-79 Date

Approval ____________ Unit Superintendent ________ Date

NOTE The Evaluation "Accompanying a PCR" evaluation and approval chain may be followed at anytime.

131 313

PROCEDURE STEP NO.	CHANNEL HP-R IODINE	AS FOUND	AS LEFT
	The corrected source reading (133 Ba) reduced 7% of optimized is the "as left" data in step 6.2.2.3		
6.2.4.1	Original source reading (133 Ba) Gross mode Analyzed mode - optimized less 7% Original source reading Date	____CPM ____CPM DAY/MO/YR	
6.2.4.2	(t) Decay time in MOS.	____MOS	
6.2.4.3	Expected source reading (133 Ba) Gross mode Analyzed mode - optimized less 7% -15% tolerance +15% tolerance	____CPM ____CPM ____CPM ____CPM	
6.2.5.1	Corrected scaler source reading (step 6.1.3.1) within 15% of expected (analyzed mode - optimized less 7% value)	Yes____ No____	Yes____
	Cs^{137} must be greater than 5% of the Ba^{133} and less than 15% of Ba. 5% ^{133}Ba < ^{137}Cs scaler reading <15% ^{133}Ba 5% Ba^{133}= 15% Ba^{133}= delete	____CPM ____CPM Yes____ No____	Yes____

131 314

Revision 0
2612-R2
11/1/77

THREE MILE ISLAND NUCLEAR STATION
UNIT #2 SURVEILLANCE PROCEDURE 2612-R2

ATMOSPHERIC RADIATION MONITORS CALIBRATION

WORKING COPY

Table of Effective Pages

Page	Date	Revision	Page	Date	Revision	Page	Date	Revision
1.0	11/1/77	0	26.0	11/1/77	0	51.0	11/1/77	0
2.0	11/1/77	0	27.0	11/1/77	0	52.0	11/1/77	0
3.0	11/1/77	0	28.0	11/1/77	0	53.0	11/1/77	0
4.0	11/1/77	0	29.0	11/1/77	0	54.0	11/1/77	0
5.0	11/1/77	0	30.0	11/1/77	0	55.0		
6.0	11/1/77	0	31.0	11/1/77	0	56.0		
7.0	11/1/77	0	32.0	11/1/77	0	57.0		
8.0	11/1/77	0	33.0	11/1/77	0	58.0		
9.0	11/1/77	0	34.0	11/1/77	0	59.0		
10.0	11/1/77	0	35.0	11/1/77	0	60.0		
11.0	11/1/77	0	36.0	11/1/77	0	61.0		
12.0	11/1/77	0	37.0	11/1/77	0	62.0		
13.0	11/1/77	0	38.0	11/1/77	0	63.0		
14.0	11/1/77	0	39.0	11/1/77	0	64.0		
15.0	11/1/77	0	40.0	11/1/77	0	65.0		
16.0	11/1/77	0	41.0	11/1/77	0	66.0		
17.0	11/1/77	0	42.0	11/1/77	0	67.0		
18.0	11/1/77	0	43.0	11/1/77	0	68.0		
19.0	11/1/77	0	44.0	11/1/77	0	69.0		
20.0	11/1/77	0	45.0	11/1/77	0	70.0		
21.0	11/1/77	0	46.0	11/1/77	0	71.0		
22.0	11/1/77	0	47.0	11/1/77	0	72.0		
23.0	11/1/77	0	48.0	11/1/77	0	73.0		
24.0	11/1/77	0	49.0	11/1/77	0	74.0		
25.0	11/1/77	0	50.0	11/1/77	0	75.0		

Unit 1 Staff Recommends Approval

Approval NA Date —
Cognizant Dept. Head

Unit 2 Staff Recommends Approval

Approval NA Date —
Cognizant Dept. Head

Unit 1 PORC Recommends Approval

NA Date —
Chairman of PORC

Unit 2 PORC Recommends Approval

J. J. Seelinger Date 9/26/77
Chairman of PORC

Unit 1 Superintendent Approval

NA Date —

Unit 2 Superintendent Approval

[signature] Date 11-1-77

Manager Generation Quality Assurance Approval NA Date —

THREE MILE ISLAND NUCLEAR STATION

UNIT #2 SURVEILLANCE PROCEDURE 2612-R2

ATMOSPHERIC RADIATION MONITORS CALIBRATION

1.0 PURPOSE

To provide the steps necessary for uniform calibration of all the atmospheric radiation monitors, which are not covered in the Technical Specifications for Unit #2.

2.0 SURVEILLANCE FREQUENCY

2.1 Frequency - at least once per 18 months (R)

3.0 LIMITS AND PRECAUTIONS

3.1 Prior to placing the RMS defeat in defeat, permission must be granted by the Shift Supervisor/Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

3.2 The instrument employee shall review the interlocks and control functions with the Shift Supervisor/Foreman. The Shift Supervisor/Foreman shall consider the potential effect on Unit operation.

3.3 Comply with AP1002 and AP1003.

3.4 All test equipment shall be traceable to the National Bureau of Standards and be within its current calibration period per AP1022.

3.5 Attached
3.6 Attached

4.0 LOCATION OF SYSTEM/ASSEMBLIES

See Table 1.

5.0 EQUIPMENT REQUIRED

5.1 Pulse Generator (Hew left Packard Model 8005A or equivalent).

5.2 ^{137}Cs (No. 177) Button Source.

5.3 ^{133}Ba (No. 177) Button Source.

131 316

3.5 The following atmospheric monitors are to be worked by this procedure:

HPR-220 Iodine
VAR-748 Gas

These monitors have no interlocks

The detectors for both of these monitors are accessible (220 - Control room ventilation; 748 - condenser vacuum pump discharge). The entire channel will be worked.

3.6 Notify the Shift Supervisor / Foreman prior to beginning work, and after work is complete. Readings will be erroneous while this work is in progress.

3.7 These two systems are potentially contaminated. Notify health physics prior to breaking into these systems.

5.4 Scaler (Hewlett Packard Model 5201L or equivalent).

5.5 Oscilloscope (Tektronic Model 466 or equivalent).

5.6 10:1 Scope Probe.

5.7 Digital Voltmeter Fluke 8600 or equivalent.

6.0 PROCEDURE

6.1 Calibration check of Atmospheric Monitor Particulate Channel.

NOTES: (1) Perform the following steps making no adjustments unless specifically required by the procedure steps. Record data on "As Found" Data Sheet 1.

(2) Perform the following steps to reduce the background level on the appropriate monitor prior to calibration.

1. Leave the sampler air pump running.
2. Close the sampler inlet isolation valve.
3. Slowly open the cover on the particulate sampler. Verify with tissue paper or other means that the air flow is into the sampler prior to opening the cover a significant amount.
4. With the cover open, continue to run the sampler air pump for five minutes.
5. Close the sampler outlet valve and quickly turn off the sampler air pump.
6. Calibrate appropriate monitor per section 6.1, 6.2, and 6.3.

7. Upon completing this procedure, return the monitor to normal by first closing the particulate sampler cover and then opening the sampler isolation valves and starting the monitor vacuum pump.

(3) Mark the individual channel recorder trace to indicate where the "Abnormal" levels were imposed during this calibration.

6.1.1 Background Radiation Readings.

6.1.1.1 Obtain a copy of Data Sheet 1 and record channel number under calibration.

6.1.1.2 Attach the scaler (Section 5.4) to the binary of the log ratemeter board (between R13 and R16 or R18 and R14). Attach the ground lead to the ratemeter chassis.

6.1.1.3 Place the readout module function selector switch in the "OPER" position.

6.1.1.4 Measure the background level with a 10 minute run on the scaler. Multiply the measured binary counts by 2 and divide by 10 minutes to obtain the background scaler CPM. Read the radiation level for the monitor being calibrated from the ratemeter module and the appropriate point on the recorder located on Panel 12 and record these values along with the background scaler CPM in step 6.1.1.4 on Data Sheet 1.

NOTE: The recorders for HP-R-223 and HP-R-224 are local only.

6.1.2 Button Source Readings.

6.1.2.1 With the lid off the moving filter paper particulate monitor sampler, remove the lead shielding blocks and capstan assembly from the monitor. Attach the ^{137}Cs (No. 177) button source, in the source holder, to the detector.

NOTE: The detector is not taken out of the sampler.

6.1.2.2 Allow the indicated radiation level on the recorder and ratemeter module to stabilize. Then record the radiation level indicated for the monitor being calibrated from the ratemeter module indicator and from the appropriate point on the recorder in step 6.1.2.2 on Data Sheet 1.

6.1.2.3 Take a two minute scaler run and record the scaler CPM, with the button source on the detector in step 6.1.2.3.

6.1.2.4 Remove the ^{137}Cs (No. 177) button source holder, containing the button source, from the detector.

6.1.2.5 Carefully install the capstan assembly in the sampler, the lead shielding blocks and insure that the filter paper is around the capstan.

6.1.2.6 Install the lid on the particulate sampler and latch into place.

6.1.3 Background Correction of Radiation Source Readings.

6.1.3.1 Subtract the background readings obtained in step 6.1.1.4 from the associated button source readings obtained in steps 6.1.2.2 and 6.1.2.3. Enter these results in the "Corrected Source Readings" in step 6.1.3.1 on Date Sheet 1.

6.1.4 Calculation of Expected Source Readings.

6.1.4.1 Obtain the "Original Source Reading" and the date of the "Original Source Reading" for the ^{137}Cs (No. 177) button

source from the Isotopic Calibration section of MTX-123, and record this data on Data Sheet 1.

NOTE: Reference - Victoreen Technical Manual for Unit #2.

6.1.4.2 Calculate "t" to the nearest month. "t" is the time elapsed between the "Original Source Reading" (CPM) date and the date of the source data taken for this calibration.

6.1.4.3 Calculate the expected source reading using Table 1. Enter the expected source reading on Data Sheet 1. Calculate ± 15% tolerance and enter this on Data Sheet 1.

6.1.5 Comparison of Corrected Source Readings (Actual) and the Excepted Source Readings.

6.1.5.1 Compare the "Corrected Source Readings" with the "Expected Source Reading". The scaler value of the "Corrected Source Reading" should be within ± 15% of the "Expected Source Reading" value. Record this in step 6.1.5.1 of Data Sheet 1.

6.1.5.2 Compare the value obtained from the "Corrected Source Reading" of the ratemeter with the value of the "Corrected Source Reading" of the scaler. The "Corrected Source Reading" for the scaler should be within one minor division of the ratemeter value of the "Corrected Source Reading". Record this in step 6.1.5.2 of Data Sheet 1.

NOTE: A minor division on the ratemeter is the distance between any "8" on the indicator and the next higher mark.

6.1.5.3 Compare the value obtained from the "Corrected Source Reading" of the recorder with the value of the "Corrected Source Readings" of the scaler. The reading should be within one minor division of the recorder scale. Record on Data Sheet 1.

131 321

NOTE: A minor division of the recorder is the distance between any "9" on the scale and the next higher mark.

6.1.5.4 If the readings do not compare within the tolerances allowed, document this as a deficiency on an "E/O" sheet.

NOTE: If any deficiencies are noted, they will be corrected per section 6.1.8 of this procedure.

6.1.6 Verification of "Alert" and "High" Alarm Setpoints.

6.1.6.1 Enter the required "Alert" and "High" alarm setpoints in step 6.1.6.1 of Data Sheet 1.

NOTE: The alarm setpoints must be obtained from 2105-1.12.

6.1.6.2 Open the signal and 16V links at the rear of Panel 12 for the monitor being calibrated.

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor.

CAUTION: Adjust the pulse repetition rate of the Signal Generator (Section 5.1) to zero prior to connecting it to the ratemeter.

6.1.6.3 Connect the pulse generator to the signal input connector and adjust the pulse generator for a negative polarity with a 1.0 volt amplitude, zero repetition rate, and a 1.0u sec. pulse width.

6.1.6.4 Slowly increase the pulse repetition rate until the "Alert" alarm light energizes. Record the ratemeter reading at which the "Alert" alarm was tripped in step 6.1.6.4 on Data Sheet 1. Acknowledge all the associated alarms.

6.1.6.5 Continue to slowly increase the pulse repetition rate until the "High" alarm light energizes. Record the ratemeter reading at which the "High" alarm was tripped in steo 6.1.6.5 on Data Sheet 1.

6.1.6.6 Compare the tripped "Alert" and "High" alarm trip setpoints with the required setpoints which were entered in step 6.1.6.1 on Data Sheet 1. The observed setpoint should equal the required setpoint. The tolerance on these setpoints is plus zero, minus one minor division of the ratemeter scale. See NOTE in step 6.1.5.2 of this procedure.

6.1.6.7 Disconnect and remove the pulse generator, then reconnect the detector signal and 16V links.

6.1.6.8 Place the function selector switch on the readout module for the monitor being calibrated in the "CAL" position. Note on Data Sheet 1 if the Ratemeter stops at the Cal. mark.

6.1.6.8.1 Depress the "Alert" alarm pushbutton and record the "indicated setpoint" ratemeter reading in step 6.1.6.8.1 on Data Sheet 1. Release the "Alert" alarm pushbutton. Compare this reading with the ratemeter reading at which the "Alert" alarm tripped in step 6.1.6.4. The value obtained in this step must agree with the value obtained in step 6.1.6.4. The tolerance is minus zero plus one minor division of the ratemeter scale; see NOTE in step 6.1.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on "E/D" sheet.

6.1.6.8.2 Depress the "High" alarm pushbutton and record the "indicated setpoint" ratemeter reading in step 6.1.6.8.2 on Data Sheet 1. Release the "High" alarm pushbutton. Compare this reading with the ratemeter reading at which the "High" alarm tripped in step 6.1.6.5. The value obtained in this step must agree with the value obtained in step 6.1.6.5. The tolerance is minus zero, plus one minor division of the ratemeter scale; see NOTE in step 6.1.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on an "E/D" Sheet.

6.1.6.9 Return the function selector switch to the "OPER" position.

6.1.7 Determination of Check Source Readings.

6.1.7.1 Record original CS Reading (obtained from MTX123) on Data Sheet 1. Depress the "CS" pushbutton. After the reading has stabilized, determine the number of counts per minute that the reading increased above background. Record the value in step 6.1.7.1 on Data Sheet 1.

6.1.7.2 Return the RMS Interlock Defeat Switch if applicable from the DEFEAT to the NORMAL position on Panel 12.

6.1.8 Deficiency Corrections.

NOTE: If any deficiencies were found, they must be corrected using the calibration procedures of Appendix A, using the applicable sections described below.

6.1.8.1 If the scaler CPM does not agree with the required CPM within the tolerance specified, perform Section A.1 through A.6.

6.1.8.2 If the recorder or the panel meter does not agree with the scaler CPM within the tolerance specified, or if the Ratemeter did not stop on the Cal. mark perform section A.8.

6.1.8 3 If the "Alert" and "High" alarm test results are out of tolerance, perform Section A.9.

6.1.8.4 If any adjustments were made, repeat sections 6.1.1 through 6.1.8. Record the final values on Data Sheet 1 marked "As Left". Provide copies of these Data Sheets and "E/D" sheets, for the deficiencies found on the monitor being calibrated, to the H.P. Supervisor and to the I&C Engineer.

6.2 Calibration Check of Atmospheric Monitor Iodine Channel.

NOTES: (1) Perform the following steps making no adjustments unless specifically required by the procedure steps. Record data on "As Found" Data Sheet 2.

(2) Mark the individual channel recorder trace to indicate where the "Abnormal" levels were imposed during this calibration.

(3) Place the RMS Interlock Defeat Switch, if applicable, from NORMAL to DEFEAT per 4.1.

6.2.1 Background Radiation Readings.

6.2.1.1 Obtain a copy of Data Sheet 2.

6.2.1.2 Attach the scaler (section 5.4) to the binary of the log ratemeter board (between R13 and R16 or R18 and R14). Attach the ground lead to the ratemeter chassis.

6.2.1.3 Verify that the toggle switch on the analzer circuit board is in the analyze mode, (toggle switch up).

6.2.1.4 Place the readout module function selector switch in the "OPER" position.

6.2.1.5 Measure the background level with a 10 minute run on the scaler. Multiply the measured binary counts by 2 and divide by 10 minutes to obtain the background scaler CPM. Read the radiation level for the monitor being calibrated from the ratemeter module and the appropriate point on the recorder located on Panel 12 and record these values along with the background scaler CPM in step 6.2.1.5 on Data Sheet 2.

NOTE: Data Sheet has space to record reading in the "gross counts mode. This is only necessary if the source "as found" readings are out of spec. and monitor must be recalibrated.

6.2.2. Button Source Readings.

6.2.2.1 Remove the filter holder from the sampler and attach the ^{133}Ba (No. 177) button source to the Detector using the special source holder. Replace the filter holder. Insure the button is tight against the Detector by pushing the center of the source holder in firmly with a blunt device.

6.2.2.2 Allow the indicated radiation level on the recorder and ratemeter module to stabilize. Then record the radiation level for the monitor being calibrated from the ratemeter module indicator and from the appropriate point on the recorder in step 6.2.2.2 on Data Sheet 2.

6.2.2.3 Take a two minute scaler run and record the scaler CPM with the button source on the detector in step 6.2.2.3.

NOTE: Data Sheet has space to record reading in the "gross counts mode. This is only necessary if the source "as found" readings are out of spec. and monitor must be recalibrated.

6.2.2.4 Remove the ^{133}Ba (No. 177) button source from the Detector.

6.2.2.5 Attach the ^{137}Cs (No. 177) button source to the Detector using the special source holder. Replace the filter holder.

6.2.2.6 Allow the indicated radiation level on the recorder and ratemeter module to stabilize. Then record the radiation level for the monitor being calibrated from the ratemeter module indicator and from the appropriate point on the recorder in step 6.2.2.6 on Data Sheet 2.

6.2.2.7 Take a two minute scaler run and record the scaler CPM with the button source on the detector in step 6.2.2.7.

6.2.2.8 Remove the ^{137}Cs (No. 177) button source from the Detector. Replace the filter holder.

6.2.3 Background Correction of Radiation Source Readings.

6.2.3.1 Subtract the background readings obtained in step 6.2.1.5 from the associated button source readings obtained in steps 6.2.2.2 and 6.2.2.3. Enter these results in the "Corrected Source Readings" in step 6.2.3.1 on Data Sheet 2.

NOTE: Data Sheet has space to record reading in the "gross counts mode. This is only necessary if the source "as found" readings are out of spec. and monitor must be recalibrated.

6.2.4 Calculation of Expected Source Readings.

6.2.4.1 Obtain the "Original Source Reading" and the date of the "Original Source Reading" for the ^{133}Ba (No. 177) button source from the Isotopic Calibration Test Report section of the MTX123, and record this data on Data Sheet 2. Two values are called for on Data Sheet 2 Gross mode - this will only be

131 327

required if monitor must be recalibrated. Analyzed mode (optimized less 7%) - this is the final reading that appears on the Isotopic Calibration sheet.

NOTE: Reference - Victoreen Technical Manual for Unit #2.

6.2.4.2 Calculate "t" to the nearest month. "t" is the time elapsed between the "Original Source Reading" (CPM) date and the date of the source taken for this calibration.

6.2.4.3 Calculate expected source reading by multiplying the "original source reading" times the decay factor from Table 1. Enter expected source reading on Data Sheet 2. Calculate tolerance and record on Data Sheet 2.

6.2.5 Comparison of Corrected Source Readings (Actual) and the Excepted Source Readings.

6.2.5.1 Comparison of actual and expected source readings.

a. Compare the "corrected" scaler source reading for ^{133}Ba (No. 177) with the "expected" source reading. The "corrected" source reading should be within $\pm$ 15% of the "expected" reading. Decay-correct ^{137}Cs (No. 177) "corrected" source reading to date of original calibration indicated on the Isotopic Calibration Test Report section of MTX123 (Divide ^{137}Cs result from 6.2.2.6 by decay factor Table No. 1). The decay-corrected ^{137}Cs (No. 177) scaler reading must be greater than 5% and less than 15% of the ^{133}Ba (No. 177) Original Source Reading from 6.2.2.3.

6.2.5.2 Compare the value obtained from the "Corrected Source Reading" of the ratemeter with the value of the "Corrected Source Reading" of the scaler. The "Corrected Source Reading" of the

scaler should be within one minor division of the "Corrected Source Reading" of the ratemeter. Record this in step 6.2.5.1 of Data Sheet 2.

NOTE: A minor division on the ratemeter is the distance between any "8" on the indicator and the next higher mark.

6.2.5.3 Compare the value obtained from the "Corrected Source Reading" of the recorder with the value of the "Corrected Source Readings" of the Scaler. The reading should be within one minor division of the recorder scale. Record in step 6.2.5.3 of Data Sheet 2.

NOTE: A minor division on the recorder is the distance between any "9" on the scale and the next higher mark.

6.2.5.4 If the readings do not compare within the tolerances allowed, document this as a dificiency on an "E/D" sheet.

NOTE: If any deficiencies are noted, they will be corrected per section 6.2.8 of this procedure.

6.2.6 Verification of "Alert" and "High" Alarm Setpoints.

6.2.6.1 Enter the required "Alert" and "High" alarm setpoints in step 6.2.6.1 of Data Sheet 2.

NOTE: The alarm setpoints must be obtained from 2105-1.12.

6.2.6.2 Open the signal and 16V links at the rear of Panel 12 for the monitor being calibrated.

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor, TB6 Terminal 22, 23 and 24.

CAUTION: Adjust the pulse repetition rate of the Signal Generator (Section 5.1) to zero prior to connecting it to the ratemeter.

6.2.6.3 Connect the pulse generator to the signal input connector and adjust the pulse generator for a negative polarity with a 1.0 volt amplitude, zero repetition rate, and a 1.0u sec. pulse width.

6.2.6.4 Slowly increase the pulse repetition rate until the "Alert" alarm light energizes. Record the ratemeter reading at which the "Alert" alarm was tripped in step 6.2.6.4 on Data Sheet 2. Acknowledge all the associated alarms.

6.2.6.5 Continue to slowly increase the pulse repetition rate until the "High" alarm light energizes. Record the ratemeter reading at which the "High" alarm was tripped in step 6.2.6.5 on Data Sheet 2.

6.2.6.6 Compare the "tripped" "Alert" and "High" alarm trip setpoints with the required setpoints which were entered in step 6.2.6.1 on Data Sheet 2. The observed setpoint should equal the required setpoint. The tolerance on these setpoints is plus zero, minus one minor division of the ratemeter scale. See NOTE in step 6.2.5.2 of this procedure.

6.2.6.7 Disconnect and remove the pulse generator, then reconnect the detector signal and 16V links.

6.2.6.8 Place the function selector switch on the readout module for the monitor being calibrated in the "CAL" position. Note on Data Sheet 2 if the Ratemeter stops on the cal. mark.

6.2.6.8.1 Depress the "Alert" alarm pushbutton and record the "indicated" ratemeter reading in step 6.2.6.8.1 on Data Sheet 2. Release the "Alert" alarm pushbutton. Compare this reading with the ratemeter reading at which the "Alert" alarm tripped in step 6.2.6.4. The value obtained in this step must agree with the value obtained in step 6.2.6.4. The tolerance is minus zero plus one minor division of the ratemeter scale; see NOTE in step 6.2.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on "E/O" sheet.

6.2.6.8.2 Depress the "High" alarm pushbutton and record the "indicated" ratemeter reading in step 6.2.6.8.2 on Data Sheet 2. Release the "High" alarm pushbutton. Compare this reading with the ratemeter reading at which the "High" alarm tripped in step 6.2.6.5. The value obtained in this step must agree with the value obtained in step 6.2.6.5. The tolerance is minus zero plus one minor division of the ratemeter scale; see NOTE in step 6.2.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on an "E/O" Sheet.

6.2.6.9 Return the function selector switch to the "OPER" position.

6.2.7 Determination of Check Source Readings.
Record Original CS reading (obtained from MTX123) on Data Sheet 2.

6.2.7.1 Depress the "CS" pushbutton. After the reading has stabilized, determine the number of counts per minute that the reading increased above background. Record the value in step 6.2.7.1

131 331

6.2.7.2 Return the RMS Interlock Defeat Switch if applicable from the DEFEAT to the NORMAL position on Panel 12.

6.2.8 Deficiency Corrections.

NOTE: If any deficiencies were found, they must be corrected using the calibration procedures of Appendix A, using the applicable sections described below.

6.2.8.1 If the scaler CPM does not agree with the required CPM within the tolerance specified, perform Section A.1 through A.7.

6.2.8.2 If the recorder or the panel meter does not agree with the scaler CPM within the tolerance specified, or if the Ratemeter did not stop on the cal. mark perform section A.8.

6.2.8 3 If the "Alert" and "High" alarm test results are out of tolerance, perform Section A.8.

6.2.8.4 If any adjustments were made, repeat sections 6.1.1 through 6.1.8.

NOTE: A complete recalibration must be performed if any adjustments are made to effect the H.V. or analyzer window. If this is necessary the Gross Mode information must be filled in on the Data Sheet 2.

Record the final values on Data Sheet 2 marked "As Left". Provide copies of these Data Sheets and "E/O" sheets, for the deficiencies found on the monitor being calibrated, to the H.P. Supervisor and to the I&C Engineer.

6.3 Calibration Check of Atmospheric Monitor Gaseous Channel.

NOTES: (1) Perform the following steps making no adjustments unless specifically required by the procedure steps. Record data on "As Found" Data Sheet 3.

(2) Mark the individual channel recorder trace to indicate where the "Abnormal" levels were imposed during this calibration.

(3) Place the RMS Interlock Defeat Switch, if applicable, rom NORMAL to DEFEAT per 4.1.

6.3.1 Background Radiation Readings.

6.3.1.1 Obtain a copy of Data Sheet 3.

6.3.1.2 Attach the scaler (section 5.4) to the binary of the log ratemeter board (between R13 and R16 or R18 and R14). Attach the ground lead to the ratemeter chassis.

6.3.1.3 Place the readout module function selector switch in the "OPER" position.

6.3.1.4 Measure the background level with a 10 minute run on the scaler. Multiply the measured binary counts by 2 and divide by 10 minutes to obtain the background scaler CPM. Read the radiation level for the monitor being calibrated from the ratemeter module and the appropriate point on the recorder located on Panel 12 and record these values along with the background scaler CPM in step 6.3.1.4 on Data Sheet 3.

NOTE: The recorders for HP-R-223 and HP-R-224 are local only.

6.3.2 Button Source Readings.

6.3.2.1 Remove the detector from the sampler and attach the ^{137}Cs (No. 177) button source, in the source holder, to the detector using the

→ following procedure:

1. Close the sampler isolation valve associated with the vacuum pump discharge. Leave the isolation valve assoc. with the vacuum pump suction open.
2. Break the air seal at the detector.
3. Allow the monitor to purge for 1 minute.
4. Close the isolation valve associated with the vacuum pump suction.
5. Remove the detector.

17.0

6.3.2.2 Replace the detector in the well and close the outer shield door.

6.3.2.3 Allow the indicated radiation level on the recorder and ratemeter module to stabilize. Then record the radiation level for the monitor being calibrated from the ratemeter module indicator and from the appropriate point on the recorder in step 6.3.2.2 on Data Sheet 3.

6.3.2.4 Take a two minute scaler run and record the scaler CPM with the button source on the detector in step 6.3.2.3.

6.3.2.5 Remove the Detector and button source holder from the sampler.

6.3.2.6 Remove the button source holder containing the ^{137}Cs (No. 177) button source from the detector.

6.3.2.7 Re-install the detector in the sampler and close and tighten shield door.

6.3.3 Background Correction of Radiation Source Readings.

6.3.3.1 Subtract the background readings obtained in step 6.3.1.4 from the associated button source readings obtained in steps 6.3.2.2 and 6.3.2.3. Enter these results in the "Corrected Source Readings" in step 6.3.3.1 on Data Sheet 3.

6.3.4 Calculation of Expected Source Readings.

6.3.4.1 Obtain the "Original Source Reading" and the date of the "Original Source Reading" for the ^{137}Cs (No. 177) button source from the Isotopic Calibration section of the MTX-123, and record this data on Data Sheet 3.

NOTE: Reference - Victoreen Technical Manual for Unit #2.

6.3.4.2 Calculate "t" to the nearest month. "t" is the time elapsed between the "Original Source Reading" (CPM) date and the date of the source taken for this calibration.

6.3.4.3 Calculate the expected source reading using Table 1. Enter the expected source reading on Data Sheet 3. Calculate the ± 15% tolerance and enter this on Data Sheet 3.

6.3.5 Comparison of Corrected Source Readings (Actual) and the Excepted Source Readings.

6.3.5.1 Compare the "Corrected Source Readings" with the "Expected Source Reading". The scaler value of the "Corrected Source Reading" should be within ± 15% of the "Expected Source Reading" value. Record this in step 6.3.5.1 of Data Sheet 3.

6.3.5.2 Compare the value obtained from the "Corrected Source Reading" of the ratemeter with the value of the "Corrected Source Reading" of the scaler. The "Corrected Source Reading" for the scaler should be within one minor division of the ratemeter. Record this in step 6.3.5.2 of Data Sheet 3.

NOTE: A minor division on the ratemeter is the distance between any "8" on the indicator and the next higher mark.

6.3.5.3 Compare the value obtained from the "Corrected Source Reading" of the recorder with the value of the "Corrected Source Readings" of the scaler. The reading should be within one minor division of the recorder scale. Record on Data Sheet 3.

NOTE: A minor division of the recorder is the distance between any "9" on the scale and the next higher mark.

6.3.5.4 If the readings do not compare within the tolerances allowed, document this as a deficiency on an "E/D" sheet.

NOTE: If any deficiencies are noted, they will be corrected per section 6.3.8 of this procedure.

6.3.6 Verification of "Alert" and "High" Alarm Setpoints.

6.3.6.1 Enter the required "Alert" and "High" alarm setpoints in step 6.3.6.1 of Data Sheet 3.

NOTE: The alarm setpoints must be obtained from 2105-1.12.

6.3.6.2 Open the signal and 16V links at the rear of Panel 12 for the monitor being calibrated.

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor, TB7 term. 22, 23 and 24.

CAUTION: Adjust the pulse repetition rate of the Signal Generator (Section 5.1) to zero prior to connecting it to the ratemeter.

6.3.6.3 Connect the pulse generator to the signal input connector and adjust the pulse generator for a negative polarity with a 1.0 volt amplitude, zero repetition rate, and a 1.0u sec. pulse width.

6.3.6.4 Slowly increase the pulse repetition rate until the "Alert" alarm light energizes. Record the ratemeter reading at which the "Alert" alarm was tripped in step 6.3.6.4 on Data Sheet 3. Reset all the associated alarms.

6.3.6.5 Continue to slowly increase the pulse repetition rate until the "High" alarm light energizes. Record the ratemeter reading at which the "High" alarm was tripped in step 6.3.6.5 on Data Sheet 3.

6.3.6.6 Compare the tripped "Alert" and "High" alarm trip setpoints with the required setpoints which were entered in step 6.3.6.1 on Data Sheet 3. The observed setpoint should equal the required setpoint. The tolerance on these setpoints is plus zero, minus one minor division of the ratemeter scale. See NOTE in step 6.3.5.2 of this procedure.

6.3.6.7 Disconnect and remove the pulse generator, then reconnect the detector signal and 16V links.

6.3.6.8 Place the function selector switch on the readout module for the monitor being calibrated in the "CAL" position. Note on Data Sheet 3 if the Ratemeter stop on the Cal. mark.

6.3.6.8.1 Depress the "Alert" alarm pushbutton and record the "indicated setpoint" ratemeter reading in step 6.3.6.3.1 on Data Sheet 3. Release the "Alert" alarm pushbutton. Compare this reading with the ratemeter reading at which the "Alert" alarm tripped in step 6.3.6.4. The value obtained in this step must agree with the value obtained in step 6.3.6.4. The tolerance is minus zero, plus one minor division of the ratemeter scale; see NOTE in step 6.3.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on "E/D" sheet.

6.3.6.8.2 Depress the "High" alarm pushbutton and record the "indicated setpoint" ratemeter reading in step 6.3.6.8.2 on Data Sheet 3. Release the "High" alarm pushbutton. Compare this reading with the ratemeter reading at which the "High" alarm tripped

with the value obtained in step 6.3.6.5. The tolerance is minus 0, plus one minor division of the ratemeter scale; see NOTE in step 6.3.5.2 of this procedure. If the setpoint is not within the tolerance allowed, document this as a deficiency on an "E/D" Sheet.

6.3.6.9 Return the function selector switch to the "OPER" position.

6.3.7 Determination of Check Source Readings.

6.3.7.1 Depress the "CS" pushbutton. After the reading has stabilized, determine the number of counts per minute that the reading increased above background. Record the value in step 6.3.7.1 on Data Sheet 3.

6.3.7.2 Return the RMS Interlock Defeat Switch if applicable from the DEFEAT to the NORMAL position on Panel 12.

6.3.8 Deficiency Corrections.

NOTE: If any deficiencies were found, they must be corrected using the calibration procedures of Appendix A, using the applicable sections described below.

6.3.8.1 If the scaler CPM does not agree with the required CPM within the tolerance specified, perform Section A.1 through A.6.

6.3.8.2 If the recorder or the panel meter does not agree with the scaler CPM within the tolerance specified, or if the Ratemeter did not stop on the Cal. mark, perform section A.8.

6.3.8 3 If the "Alert" and "High" alarm test results are out of tolerance, perform Section A.9.

6.3.8.4 If any adjustments were made, repeat sections 6.1.1 through 6.1.8. Record the final values on Data Sheet 3 marked "As Left". Provide copies of these Data Sheets and "E/O" sheets, for the deficiencies found on the monitor being calibrated, to the H.P. Supervisor and to the I&C Engineer.

7.0 ACCEPTANCE CRITERIA

7.1 Acceptance criteria as noted on Data Sheets.

DATA SHEET 1

RADIATION MONITORING SYSTEM ATMOSPHERIC MONITOR CALIBRATION

WARNING: Prior to placing the RMS interlock defeat switch, if applicable, in defeat, permission must be granted by the Shift Supervisor/Shift Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

PROCEDURE STEP NO.	CHANNEL HP-R_____ PARTICULATE	AS FOUND	AS LEFT
6.1.1.4	Background - Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Ratemeter Reading	____CPM	____CPM
6.1.2.3	Source Reading (^{137}Cs) Scaler Reading	____CPM	____CPM
6.1.2.2	Recorder Reading	____CPM	____CPM
6.1.2.2	Ratemeter Reading	____CPM	____CPM
6.1.3.1	Correct Source Reading (^{137}Cs)		
	Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Patemeter Reading	____CPM	____CPM
6.1.4.1	Original Source Reading (^{137}Cs)	____CPM	_____
	Date	Day/Mo/Yr / /	_____
6.1.4.2	(t) Decay Time in mos.	____MOS	_____
6.1.4.3	Expected Source Reading (^{137}Cs)	____CPM	_____
	-15% Tolerance	____CPM	_____
	+15% Tolerance	____CPM	_____
6.1.5.1	Corrected Scaler Source Reading	Yes____	Yes____
	within 15% of Expected	No____	

131 340

PROCEDURE STEP NO.	CHANNEL HP-R_____ PARTICULATE	AS FOUND	AS LEFT
6.1.5.2	Panel Meter within one minor division of Scaler	Yes____ No____	Yes____
6.1.5.3	Recorder within one minor division of Scaler	Yes____ No____	Yes____
	If yes was indicated in step 6.1.5.1; 6.1.5.2 + 6.1.5.3 no adjustments will be necessary to the source calibration and the above "as left" column will be left blank. If no was indicated in any of the steps adjustment must be made per procedure and the "as left" column must be filled in.		
6.1.6.1	Required setpoints: Alert High	____CPM ____CPM	____ ____
6.1.6.4	Tripped alert setpoint	____CPM	____CPM
6.1.6.5	Tripped high setpoint	____CPM	____CPM
6.1.6.6	The observe setpoint must be within the required by plus zero, minus one minor division Tripped stpt ≥ Required + zero (-) minor div.	Alert: Yes____ No____ High: Yes____ No____	Alert: Yes____ High: Yes____
6.1.6.8	Ratemeter indicates in the cal. mark.	Yes____ No____	Yes____

PROCEDURE STEP NO.	CHANNEL HP-R_____ PARTICULATE	AS FOUND	AS LEFT
6.1.6.8.1	"Indicated" alert setpoint The "indicated" alert setpoint must be within the tripped by plus one, minus zero Indicated ≥ tripped by: +/minor div. -0/minor div.	CPM Yes____ No____	CPM Yes____
6.1.6.8.2	"Indicated" High setpoint The "indicated" High setpoint must be within the observed by plus one, minus zero Indicated ≥ tripped by: +/minor div. -0/minor div.	____CPM Yes____ No____	____CPM Yes____
	If yes was indicated in steps 6.1.6.6, 6.1.6.8.1 + 6.1.6.8.2 no adjustments will be necessary to the alarm setting and the above "as left" column will be left blank. If no was indicated in any of the steps adjustments must be made per procedure and the "as left" column must be filled out.		
6.1.7.1	Original check source reading If background is more than 2 times the original check source reading then this step is NA. CPM indicated when CS button depressed Increase in background reading due to check source	____CPM ____CPM ____CPM Yes____ No____ NA____	____CPM Yes____ NA____

131 342

PROCEDURE STEP NO.	CHANNEL HP-R_____ PARTICULATE	AS FOUND	AS LEFT
	Mark Recorder trace with time, date, procedure number and initials.	Yes____	Yes____
	ATTACH a new calibration sticker	Yes____ No____	Yes____
	Place "Old calibration sticker here" or a explanation why you didn't. Such as: Lost, contaminated. 		
	The above blocks must have numbers where CPM is requested if applicable and initials of performer where Yes/No is requested. Acceptance criteria: All Yes/No blanks in the "as found" column marked Yes and No "as left" data needed or all "as left" data Yes/No blocks marked Yes except for 6.1.7.1 where NA is acceptable.		

131 343

DATA SHEET 1 (cont'd)

Test equipment used:

Model _____ S.N. _____ Date Cal. due _____

_____ _____ _____

_____ _____ _____

_____ _____ _____

Performed by _____

Date _____

Approved by _____

Date _____

DATA SHEET 2

RADIATION MONITORING SYSTEM ATMOSPHERIC MONITOR CALIBRATION

WARNING: Prior to placing the RMS interlock defeat switch, if applicable, in defeat, permission must be granted by the Shift Supervisor/Shift Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

PROCEDURE STEP NO.	CHANNEL FP-R_____ PARTICULATE	AS FOUND	AS LEFT
6.2.1.5	Background - Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Ratemeter Reading	____CPM	____CPM
	Background in gross mode if "as found" is out of spec. - Scaler	X	____CPM
	Recorder	X	____CPM
	Ratemeter	X	____CPM
6.2.2.3	Source Reading - (133 Ba) Scaler	____CPM	____CPM
	Recorder	____CPM	____CPM
	Ratemeter	____CPM	____CPM
	Source Reading - (133 Ba) "Gross Mode" - only if "as found" is out of spec. Scaler	X	____CPM
	Recorder	X	____CPM
	Ratemeter	X	____CPM
	Source Reading - (133 Ba) "Optimized" - only required if "as found" is out of spec. Scaler	X	____CPM
	Record	X	____CPM
	Ratemeter	X	____CPM

345

PROCEDURE STEP NO.	CHANNEL HP-R_____ IODINE		AS FOUND	AS LEFT
	Source Reading - (133 Ba) reduced 7% of optimized - required only if "as found" is out of spec.	Scaler		____CPM
		Recorder		____CPM
		Ratemeter		____CPM
6.2.2.7	Source reading - (137 Cs)	Scaler	____CPM	____CPM
		Recorder	____CPM	____CPM
		Ratemeter	____CPM	____CPM
6.2.3.1	Corrected source reading - (133 Ba)			
		Scaler	____CPM	____CPM
		Recorder	____CPM	____CPM
		Ratemeter	____CPM	____CPM
	Corrected source reading - (133 Ba) - Gross mode. This is only required if "as found" was O.O.S. and a recalibration is necessary.	Scaler		____CPM
		Recorder		____CPM
		Ratemeter		____CPM
	Corrected source reading - (133 Ba) - "optimized". This is only required if "as found" was O.O.S. and a recalibration is necessary.	Scaler		____CPM
		Recorder		____CPM
		Ratemeter		____CPM

131 346

PROCEDURE STEP NO.	CHANNEL HP-R IODINE	AS FOUND	AS LEFT
	The corrected source reading (133 Ba) reduced 7% of optimized is the "as left" data in step 6.2.2.3		
6.2.4.1	Original source reading (133 Ba)		
	Gross mode	____CPM	
	Analyzed mode - optimized less 7%	____CPM	
	Original source reading Date	DAY/MO/YR	
6.2.4.2	(t) Decay time in MOS.	____MOS	
6.2.4.3	Expected source reading (133 Ba)		
	Gross mode	____CPM	
	Analyzed mode - optimized less 7%	____CPM	
	-15% tolerance	____CPM	
	+15% tolerance	____CPM	
6.2.5.1	Corrected scaler source reading (step 6.1.3.1) within 15% of expected (analyzed mode - optimized less 7% value)	Yes____ No____	Yes____
	Cs^{137} must be greater than 5% of the Ba^{133} and less than 15% of Ba. 5% ^{133}Ba < ^{137}Cs scaler reading <15% ^{133}Ba		
	5% Ba^{133}=	____CPM	
	15% Ba^{133}=	____CPM	
		Yes____ No____	Yes____

See TCN 2-79-091 mdb

131 347

PROCEDURE STEP NO.	CHANNEL HP-R_____ IODINE	AS FOUND	AS LEFT
6.2.5.2	Panel meter within one minor division of scaler	Yes____ No____	Yes____
6.2.5.3	Recorder within one minor division of scaler	Yes____ No____	Yes____
	If yes was indicated in step 6.2.5.1, 6.2.5.2 + 6.2.5.3 no adjustment will be necessary to the source calibration and the above "as left" column will be left blank. If step 6.2.5.1 is No then a recalibration must be done per procedure and the "gross data" must be filled in on the "as left" section.		
	If step 6.2.5.2 and 6.2.5.3 were No it is not a source calibration problem but was high voltage a electronic problem between unit and adjusted the "gross data" will not be necessary unless you adjust the H.V. Pot on the ratemeter during repair. Initial that No H.V. adjustment was necessary. If H.V. was adjusted recalibrate unit per procedure.	Yes____ No____	
6.2.6.7	Required setpoints Alert High	____CPM ____CPM	

PROCEDURE STEP NO.	CHANNEL HP-R_____ IODINE	AS FOUND	AS LEFT
6.2.6.4	"Tripped" alert setpoint	____CPM	____CPM
6.2.6.5	"Tripped" high setpoint	____CPM	____CPM
6.2.6.6	The tripped setpoints must be within the required by plus zero, minus one minor division. Tripped ≤ required by + zero (-)one minor division	Alert: Yes____ No____ High: Yes____ No____ Yes____ No____	Alert: Yes____ High: Yes____ Yes____
6.2.6.8.1	"Indicated" alert setpoint The "indicated" alert setpoint must be within the observed by plus one minor division, minus zero. Indicated ≥ tripped by +1 minor div. Indicated high setpoint -0.	____CPM Yes____ No____	____CPM Yes____
6.2.6.8.2	"Indicated" high setpoint must be within the observed by plus one minor division, minus zero. Indicated ≥ tripped by +1 minor div. -0	____CPM Yes____ No____	____CPM Yes____

PROCEDURE STEP NO.	CHANNEL FP-R_____ IODINE	AS FOUND	AS LEFT
	If yes was indicated in steps 6.2.6.6, 6.2.6.8.1 and 6.2.6.8.2 no adjustments will be necessary to the alarm setting and the above "as left" column will be left blank. If no was indicated in any of the steps adjustments must be made per procedure and the "as left" column must be filled in.		
6.2.7.1	Original check source reading If background is more than 2 times the original, check source reading then this step is NA. CPM indicated when CS button depressed Observed increase in background reading due to check source.	____CPM ____CPM Yes____ No____ NA____	 Yes____ NA____
	Mark recorder trace with time, date, procedure number and initials.	Yes____	Yes____
	ATTACH a new calibration sticker.	Yes____ No____	Yes____
	Place "Old calibration sticker here" or a explanation why you didn't. Such as: Lost or contaminated.		

The above blocks must have numbers where CPM is requested if applicable and initials of performer where Yes/No is requested.

ACCEPTANCE CRITERIA:

All Yes/No blank in the "as found" column marked Yes (except to adjustment of H.V. this must be No), and No "as left" data needed or all "as left" data Yes/No blocks marked Yes except for 6.1.7.1 where NA is acceptable.

TEST EQUIPMENT USED:

Model	S.N.	Date Cal. due
_____	_____	_____
_____	_____	_____
_____	_____	_____
_____	_____	_____

Performed by _____

Date _____

Approved by _____

Date _____

131 351

DATA SHEET 3

RADIATION MONITORING SYSTEM ATMOSPHERIC MONITOR CALIBRATION

WARNING: Prior to placing the RMS interlock defeat switch, if applicable, in defeat, permission must be granted by the Shift Supervisor/Shift Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

PROCEDURE STEP NO.	CHANNEL HP-R_____ GAS	AS FOUND	AS LEFT
6.3.1.4	Background - Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Ratemeter Reading	____CPM	____CPM
6.3.2.4	Source Reading (^{137}Cs) Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Ratemeter Reading	____CPM	____CPM
6.3.3.1	Correct Source Reading (^{137}Cs)		
	Scaler Reading	____CPM	____CPM
	Recorder Reading	____CPM	____CPM
	Ratemeter Reading	____CPM	____CPM
6.3.4.1	Original Source Reading (^{137}Cs)	____CPM	X
	Date	Day/Mo/Yr __/__/__	X
6.3.4.2	(t) Decay Time in mos.	____MOS	X
6.3.4.3	Expected Source Reading (^{137}Cs)	____CPM	X
	-15% Tolerance	____CPM	X
	+15% Tolerance	____CPM	X
6.3.5.1	Corrected Scaler Bounce Reading within 15% of Expected	Yes____ No____	Yes____

PROCEDURE STEP NO.	CHANNEL HP-R_____ GAS	AS FOUND	AS LEFT
6.3.5.2	Panel Meter within one minor division of Scaler	Yes____ No____	Yes____
6.3.5.3	Recorder within one minor division of Scaler	Yes____ No____	Yes____
	If yes was indicated in step 6.1.5.1; 6.1.5.2 + 6.1.5.3 no adjustments will be necessary to the source calibration and the above "as left" column will be left blank. If no was indicated in any of the steps adjustment must be made per procedure and the "as left" column must be filled in.		
6.3.6.1	Required setpoints: Alert High	____CPM ____CPM	
6.3.6.4	Tripped alert setpoint	____CPM	____CPM
6.3.6.5	Tripped high setpoint	____CPM	____CPM
6.3.6.6	The observe setpoint must be within the required by plus zero, minus one minor division Tripped stpt ≥ Required + zero (-) minor div.	Alert: Yes____ No____ High: Yes____ No____	Alert: Yes____ High: Yes____
6.1.6.8	Ratemeter indicates in the cal. mark.	Yes____ No____	Yes____

PROCEDURE STEP NO.	CHANNEL HP-R_____ GAS	AS FOUND	AS LEFT
6.3.6.8.1	"Indicated" alert setpoint The "indicated" alert setpoint must be within the tripped by plus one, minus zero Indicated ≥ tripped by: +/minor div. -0/minor div.	_____CPM Yes_____ No_____	____CPM Yes____
6.3.6.8.2	"Indicated" High setpoint The "indicated" High setpoint must be within the observed by plus one, minus zero Indicated ≥ tripped by: +/minor div. -0/minor div.	_____CPM Yes_____ No_____	____CPM Yes____
	If yes was indicated in steps 6.1.6.6, 6.1.6.8.1 + 6.1.6.8.2 no adjustments will be necessary to the alarm setting and the above "as left" column will be left blank. If no was indicated in any of the steps adjustments must be made per procedure and the "as left" column must be filled out.		
6.3.7.1	Original check source reading If background is more than 2 times the original check source reading then this step is NA. CPM indicated when Cs button depressed Increase in background reading due to check source	_____CPM _____CPM Yes_____ No_____ NA_____	____CPM Yes____ NA_____

PROCEDURE STEP NO.	CHANNEL HP-R_____ GAS	AS FOUND	AS LEFT
	Mark Recorder trace with time, date, procedure number and initials.	Yes____	Yes____
	ATTACH a new calibration sticker	Yes____ No____	Yes____
	Place "Old calibration sticker here" or a explanation why you didn't. Such as: Lost, contaminated. 		
	The above blocks must have numbers where CPM is requested if applicable and initials of performer where Yes/No is requested. Acceptance criteria: All Yes/No blanks in the "as found" column marked Yes and No "as left" data needed or all "as left" data Yes/No blocks marked Yes except for 6.1.7.1 where NA is acceptable.		

Test equipment used:

Model	S.N.	Date Cal. due

Performed by _____

Date _____

Approved by _____

Date _____

TABLE NO. 1

UNIVERSAL DECAY TABLE

NOTE: The following table gives the fraction of activity of a nuclide remaining, from 0.001 half-life to 1.000 half-life.

To use this table:

1. Divide elapsed time by the half-life ($^{t}/_{T_{\frac{1}{2}}}$). Time must be in the same units.
2. With the answer obtained in Step 1, enter appropriate row along the side and the column at the top. The number obtained is the fraction of original activity remaining.
3. Multiply the original activity by this figure to obtain the present activity (or the amount remaining).

NOTE: The half-life of ^{133}Ba is 126 months.

Decay ^{133}Ba to the nearest month only.

Example: If a ^{133}Ba source was cross calibrated on 4/72, what would the decay factor be on 9/74 (it has decay 29 months).

$$\frac{29}{126} = 126\overline{)29.000} = 0.230$$

0.2301
25.2
3.80
3.78
.02

Checking the Universal Decay Table, one would multiply the original activity of the ^{133}Ba source on 4/72 by 0.85266 to obtain the activity value on 9/74.

131 357

	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
00	.00000	.99769	.99862	.99793	.99723	.99645	.99526	.99516	.99446	.99379
.010	.99309	.99238	.99172	.99103	.99034	.98965	.98898	.98828	.98759	.98689
.020	.98623	.98554	.98487	.98419	.98350	.98243	.98214	.98146	.98076	.98010
.030	.97942	.97874	.97807	.97740	.97671	.97603	.97517	.97446	.97399	.97332
.040	.97262	.97218	.97122	.97055	.96997	.96930	.96820	.96795	.96725	.96662
.050	.96594	.96527	.96461	.96393	.96326	.96260	.96190	.96125	.96053	.95994
.060	.95923	.95862	.95793	.95723	.95661	.95596	.95529	.95452	.95395	.95331
.070	.95264	.95198	[illegible]	.95067	.95000	.94935	.94870	.94800	.94733	.94673
.080	.94597	.94532	.94467	.94392	.94329	.94261	.94195	.94130	.94063	.94000
.090	.93936	.93868	.93802	.93753	.93693	.93623	.93564	.93499	.93434	.93370
.100	.93304	.93240	.93175	.93112	.93046	.92982	.92906	.92853	.92787	.92725
.110	.92660	.92594	.92532	.92468	.92403	.92340	.92276	.92216	.92152	.92085
.120	.92017	.91956	.91893	.91826	.91766	.91702	.91639	.91575	.91511	.91443
.130	.91377	.91321	.91255	.91196	.91132	.91069	.91000	.90939	.90861	.90817
.140	.90747	.90691	.90629	.90566	.90502	.90440	.90378	.90314	.90250	.90190
.150	.90127	.90064	.90002	.89901	.89840	.89816	.89754	.89690	.89627	.89565
.160	.89504	.89442	.89381	.89319	.89257	.89195	.89133	.89071	.89003	.88940
.170	.88883	.88823	.88763	.88702	.88650	.88579	.88518	.88456	.88393	.88334
.180	.88272	.88211	.88150	.88089	.88030	.87967	.87905	.87835	.87782	.87724
.190	.87663	.87603	.87542	.87481	.87420	.87360	.87300	.87216	.87172	.87112
.200	.87057	.86997	.86937	.86877	.86816	.86756	.86697	.86636	.86576	.86517
.210	.86456	.86396	.86337	.86277	.86217	.86157	.86092	.86037	.85978	.85919
.220	.85859	.85800	.85741	.85681	.85621	.85579	.85503	.85443	.85384	.85325
.230	.85265	.85207	.85148	.85097	.85030	.84975	.84914	.84853	.84794	.84735
.240	.84677	.84619	.84561	.84502	.84443	.84384	.84326	.84265	.84210	.84152
.250	.84092	.84034	.83976	.83913	.83860	.83802	.83744	.83685	.83628	.83570
.260	.83511	.83454	.83396	.83339	.83283	.83223	.83200	.83165	.83050	.82987
.270	.82935	.82873	.82820	.82763	.82703	.82648	.82591	.82533	.82476	.82419
.280	.82362	.82313	.82248	.82191	.82135	.82077	.82021	.81962	.81907	.81850
.290	.81792	.81736	.81681	.81624	.81567	.81511	.81454	.81397	.81341	.81300
.300	.81228	.81172	.81116	.81060	.81004	.80948	.80892	.80819	.80779	.80722
.310	.80667	.80609	.80555	.80500	.80444	.80389	.80333	.80277	.80222	.80166
.320	.80110	.80055	.80000	.79944	.79883	.79834	.79779	.79731	.79663	.79613
.330	.79557	.79502	.79447	.79393	.79337	.79282	.79227	.79172	.79113	.79063
.340	.79007	.78953	.78899	.78844	.78789	.78735	.78681	.78625	.78571	.78517
.350	.78462	.78402	.78354	.78300	.78245	.78191	.78137	.78082	.78023	.77974
.360	.77920	.77866	.77812	.77758	.77704	.77645	.77597	.77543	.77489	.77435
.370	.77383	[illegible]	.77275	[illegible]	.77163	.77115	.77062	.77007	.76953	.76901
.380	.76848	.76795	.76742	.76689	.76635	.76582	.76529	.76476	.76423	.76370
.390	.76317	.76272	[illegible]	.76159	.76106	.76053	.76001	.75948	.75895	.75843
.400	.75790	.75737	[illegible]	.75633	.75580	.75528	.75476	.75423	.75371	.75319
.410	.75266	.75215	.75163	.75111	.75053	[illegible]	.74955	.74902	.74855	.74799
.420	.74747	.74695	.74644	.74592	.74540	.74483	.74437	.74385	.74334	.74282
.430	.74231	.74179	.74125	.74077	.74025	.73974	.73923	.73871	.73820	.73769
.440	.73718	.73667	.73616	.73563	.73514	.73463	.73413	.73361	.73311	.73260
.450	.73209	.73158	.73108	.73057	.73006	.72956	.72906	.72854	.72804	.72754
.460	.72703	.72653	.72603	.72545	.72503	.72452	.72402	.72351	.72302	.72252
.470	.72201	.72151	.72102	.72052	.72001	.71952	.71902	.71852	.71802	.71752
.480	.71702	.71652	.71604	.71554	.71504	.71455	.71405	.71355	.71306	.71257
.490	.71207	.71158	.71109	.71060	.71010	.70961	.70912	.70863	.70814	.70765
.500	.70715	.70666	.70618	.70569	.70520	.70471	.70423	.70373	.70325	.70276

131 558

ACTIVITY REMAINING FOR t/T, FROM .01 TO 1.00

	.000	.001	.002	.003	.004	.005	.006	.007	.008	.009
.10	.70227	.70178	.70130	.70082	.70033	.69984	.69936	.69887	.69839	.69791
.520	.69742	.69694	.69646	.69598	.69549	.69501	.69453	.69404	.69356	.69309
.530	.69261	.69213	.69165	.69117	.69069	.69021	.68973	.68925	.68877	.68829
.540	.68796	.68735	.68687	.68640	.68593	.68545	.68497	.68450	.68405	.68348
.550	.68307	.68260	.68213	.68166	.68118	.68071	.68024	.67976	.67913	.67832
.560	.67835	.67782	.67742	.67695	.67646	.67601	.67554	.67507	.67461	.67414
.570	.67367	.67320	.67274	.67227	.67181	.67134	.67088	.67041	.66995	.66948
.580	.66902	.66856	.66810	.66764	.66718	.66671	.66624	.66578	.66532	.66486
.590	.66440	.66394	.66348	.66302	.66256	.66210	.66164	.66118	.66053	.66027
.600	.65981	.65935	.65890	.65846	.65798	.65753	.65707	.65661	.65616	.65571
.610	.65525	.65480	.65435	.65390	.65344	.65299	.65244	.65203	.65160	.65113
.620	.65073	.65028	.64983	.64938	.64892	.64848	.64803	.64758	.64713	.64668
.630	.64623	.64578	.64534	.64489	.64440	.64400	.64356	.64310	.64270	.64222
.640	.64178	.64133	.64089	.64044	.64000	.63955	.63911	.63866	.63822	.63778
.650	.63734	.63690	.63646	.63602	.63558	.63514	.63470	.63426	.63382	.63338
.660	.63294	.63250	.63206	.63163	.63118	.63075	.63032	.62987	.62944	.62900
.670	.62856	.62813	.62770	.62727	.62683	.62639	.62595	.62552	.62509	.62465
.680	.62422	.62379	.62336	.62293	.62250	.62207	.62164	.62120	.62077	.62035
.690	.61991	.61948	.61906	.61863	.61820	.61777	.61735	.61691	.61649	.61606
.700	.61563	.61520	.61478	.61436	.61393	.61350	.61308	.61265	.61223	.61181
.710	.61138	.61096	.61054	.61012	.60969	.60927	.60885	.60842	.60800	.60758
.720	.60716	.60674	.60632	.60592	.60548	.60506	.60464	.60422	.60380	.60339
.730	.60296	.60255	.60213	.60172	.60130	.60088	.60047	.60005	.59963	.59922
.740	.59880	.59838	.59797	.59756	.59717	.59673	.59632	.59590	.59549	.59508
.50	.59466	.59426	.59385	.59344	.59302	.59261	.59220	.59179	.59144	.59097
.760	.59056	.59015	.58974	.58934	.58892	.58852	.58811	.58770	.58730	.58690
.770	.58649	.58608	.58567	.58527	.58485	.58447	.58405	.58364	.58324	.58284
.780	.58243	.58202	.58161	.58122	.58082	.58042	.58002	.57961	.57921	.57880
.790	.57841	.57801	.57761	.57721	.57681	.57641	.57601	.57561	.57519	.57478
.800	.57441	.57402	.57362	.57317	.57282	.57243	.57204	.57163	.57124	.57085
.810	.57045	.57005	.56966	.56904	.56836	.56847	.56808	.56768	.56729	.56690
.820	.56645	.56611	.56572	.56533	.56494	.56455	.56416	.56377	.56338	.56298
.830	.56259	.56220	.56182	.56143	.56101	.56065	.56026	.56037	.56049	.56010
.840	.55899	.55832	.55794	.55755	.55716	.55673	.55640	.55601	.55562	.55524
.850	.55485	.55447	.55408	.55370	.55332	.55293	.55255	.55217	.55179	.55140
.860	.55102	.55064	.55026	.54988	.54950	.54912	.54874	.54842	.54797	.54758
.870	.54721	.54683	.54645	.54605	.54569	.54532	.54495	.54457	.54419	.54382
.880	.54344	.54306	.54269	.54231	.54193	.54156	.54118	.54081	.54043	.54006
.890	.53968	.53931	.53894	.53856	.53819	.53782	.53745	.53702	.53670	.53632
.900	.53595	.53558	.53520	.53485	.53447	.53410	.53373	.53335	.53299	.53262
.910	.53225	.53188	.53152	.53115	.53078	.53043	.52995	.52968	.52931	.52895
.920	.52858	.52821	.52785	.52748	.52711	.52675	.52638	.52600	.52564	.52528
.930	.52491	.52456	.52420	.52384	.52347	.52311	.52275	.52239	.52203	.52168
.940	.52130	.52094	.52058	.52022	.51986	.51950	.51916	.51878	.51842	.51808
.950	.51770	.51734	.51698	.51661	.51627	.51591	.51556	.51520	.51484	.51448
.960	.51402	.51377	.51342	.51306	.51270	.51235	.51200	.51164	.51129	.51093
.970	.51057	.51027	.50987	.50952	.50916	.50881	.50846	.50810	.50775	.50740
.80	.50705	.50670	.50635	.50600	.50565	.50530	.50495	.50460	.50426	.50390
.90	.50355	.50320	.50285	.50250	.50216	.50181	.50141	.50111	.50077	.50042
1.000	.50000	.49973	.49938	.49904	.49869	.49833	.49800	.49765	.49731	.49696

131 359

APPENDIX A

ATMOSPHERIC MONITOR CALIBRATION

WARNING: Prior to placing the RMS interlock defeat switch, if applicable in defeat, permission must be granted by the Shift Supervisor/Shift Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

A.1.0 TEST SETUP.

1.1 Inform Shift Supervisor of work to be accomplished.

1.2 Obtain and warm-up equipment, Fast rise oscilloscope, pulse generator (low output impedance), DVM and scaler are needed.

1.3 Turn applicable Bypass Switch to DEFEAT.

1.4 Turn ratemeter function switch to OPER.

1.5 Slide ratemeter from Panel 12 far enough to make internal connections.

NOTE: ratemeter for HP-R-223 and HP-R-224 is local only.

1.6 For Iodine channels, place toggle switch S6 in the ANALYZE position. Green Failure Light should be ON.

A.2.0 DISCRIMINATOR VOLTAGE ADJUSTMENT

2.1 Open 16V link and signal link to the detector (located at rear of Panel 12)

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor. Part TB5 term 22, 23 and 24, Iodine TB6 term 22, 23 and 24, Gas TB7 term 22, 23 and 24.

2.2 For Iodine channels, place toggle switch on the analyzer board in the GROSS position.

131 360.

2.3 Connect oscilloscope ground lead to ratemeter chassis. Connect signal lead to ratemeter function switch (front deck, terminal No. 12).

2.4 Connect pulse generator ground lead to ratemeter chassis. Connect signal lead to ratemeter function switch blue wire. Set up the pulse generator as follows:

Repetition rate - Approximately 10,000 pps.

Polarity - negative pulse.

Pulse Width - 1 u sec.

Amplitude - refer to applicable Calibration Data Sheet in the Victoreen Technical Manual, "ISOTOPIC CALIBRATION TEST REPORT". This voltage is identified as "CLIP".

NOTE: Set this voltage as accurately as possible using the oscilloscope.

2.5 Adjust Discriminator Adjust potentiometer R3 on the log ratemeter board until the ratemeter just begins to count.

2.6 Disconnect pulse generator and oscilloscope and reconnect 16V and signal links for the detector.

A.3.0 BACKGROUND MEASUREMENT

3.1 Connect scaler input, using high impedance probe (Section 5.5) to binary of log ratemeter board (842 - 1 - 30) between R13 and R16 or between R18 and R14. Connect scaler ground lead to ratemeter chassis.

3.2 Reset scaler to zero and count for 10 minutes. Multiply binary counts obtained by 2 and divide by 10 to obtain CPM. Record this value for later use.

131 361

A.4.0 CALIBRATION SOURCE MEASUREMENT

4.1 Determine the calibration source to be used as follows:

HP-R___ P - ^{137}Cs (No. 177)

HP-R___ I - ^{133}Ba (No. 177)

HP-R___ G - ^{137}Cs (No. 177)

4.2 Refer to "CAL. SOURCE DATA" section of the Victoreen Technical Manual. Connect calibration source per applicable illustration.

4.3 Reset scaler to zero and count for 2 minutes. Record CPM for later use.

A.5.0 CALCULATION OF EXPECTED AND REQUIRED CPM.

5.1 Refer to "ISOTOPIC CALIBRATION TEST REPORT" section of the Victoreen Technical Manual. Use the applicable Calibration Data Sheet to determine original * CPM for the calibration source in the sampler and original * date. (For Iodine channels, use "Gross Counting Position" data).

*The original does not have to be Victoreen original data if the detector has been repaired on site. The original is the data sheet covered per I-22.1 which will also be kept in the Victoreen Manual.

NOTE: Determine decay time to the nearest month and use Table No. 1 to determine current "expected" CPM. Add the background counts obtained in Section A.3.0 to determine "required" CPM. Record "expected" and "required" CPM for later use.

A.6.0 HIGH VOLTAGE CORRECTION.

6.1 Alternately adjust high voltage (using High Voltage Adjust Potentiometer R115 on the Power Supply Board) and take 0.2 minute scaler runs until measured CPM readings are repeatable

132 001

with ± 3% of the "required" CPM from Section A.5.0. Take a 2 minute scaler run to verify results.

CAUTION: DO NOT EXCEED 1400 VDC.

6.2 Remove calibration source and take a 10 minute background run to ensure that H.V. adjustments have not altered background CPM enough to invalidate the ± 3% agreement.

A.7.0 ANALYZER BOARD ADJUSTMENT (IODINE CHANNELS ONLY).

7.1 Adjust the analyzer board in accordance with Appendix. B.

A.8.0 LOG RATEMETER BOARD CALIBRATION.

8.1 Insure function switch is in the oper. position. Open 16V and signal links at rear of Panel 12.

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor.

8.2 For Iodine Channels, ensure S6 is in the GROSS position.

8.3 Adjust the Zero Set Potentiometer R36 until the panel meter reads approximately 1/4" below the 10 CPM mark.

8.4 Connect pulse generator ground lead to ratemeter chassis. Connect signal lead to function switch blue wire.

8.5 Connect oscilloscope ground lead to ratemeter chassis. Connect signal lead to function switch. Connect a DVM on the lowest range to read 0 to 1V to F102 (this is output protection fuse for the recorder output). This fuse is label F2 on a small board hanging on the left side of the ratemeter.

8.6 Set Pulse Generator as follows:

Repetition Rate: 10^5 CPM

Amplitude: 1 volt

Pulse Width: 1 u sec.

Pulse Polarity: Negative (-)

NOTE: The scaler should be used to ensure proper setting of the pulse generator throughout this section. Connect ground lead to ratemeter chassis. Connect signal lead to function blue wire.

8.7 Adjust the output control R38 until the meter reads 10^5 CPM.

8.8 Adjust the pulse generator repetition rate to 10^2 CPM.

8.9 Slightly adjust the zero control R36 until the meter reads 10^2 CPM. Adjust R132 for a .2 VDC $\pm$ .02 reading on the DVM.

8.10 Adjust the pulse generator repetition rate to 10^6 CPM.

8.11 Adjust C19, 10^5 CPM control until the meter reads 10^6. Adjust R128 for 1VDC $\pm$.02 reading on the DVM. Due to the interaction it may be necessary to switch between 10^2, 10^5 and 10^6 several times, adjusting their respective controls until the optimum span is achieved.

8.12 Decade all ranges from 10 through 10^6 to insure proper spanning. DVM should also span correctly between 0 to 1VDC $\pm$.02VDC.

8.13 Adjust the pulse generator for a one (1) KHz pulse repetition rate and check Log Ratemeter for proper operation, the reading should fall on the black 'CAL' mark a $6X10^4$ CPM.

8.14 Connect oscilloscope to the junction of R39 and R40, which is the output of the calibration oscillation.

8.15 Adjust calibration frequency control R45 for 1 msec between pulses.

8.16 Turn the function switch to the "Cal." position. The meter indication should be on the "Cal." mark of the scale.

A.9.0 ALARM BOARD CALIBRATION

Insure function switch is inoperable.

9.1 Set R205 and R214 to the extreme clockwise position.

9.2 Switch to off and connect an adjustable power supply as follows:

9.2.1 Positive lead to ground and negative lead to C10-R21 junction.

9.2.2 Connect two jumpers from the negative lead, one to the C-12-R22 junction and one to the C14-R23 junction.

9.2.3 Switch to operate and adjust the output of the power supply to read 10 (lowest black mark) on the OVM.

9.3 Adjust R234 until both alarms (High and Alert) energize, then slowly back off until one or both just de-energize.

NOTE: HP-R-223 + 224 have manual reset and this step must be done with an auto. reset function. Either hold the reset button in or remove jumper C and F on the alarm board.

9.4 Set R205 and R214 to the extreme counter-clockwise position.

9.5 Remove the DC power supply and install the pulse generator on function switch. Set the Pulse Generator for:

Repetition Rate:	10^5 CPM
Amplitude:	1 volt
Pulse Polarity:	Negative (-)
Pulse Width:	1 μ sec.

9.6 Decrease in a clockwise direction the settings of R205 (High) and R214 (Alert) alarm set-point controls until alarms energize.

9.7 Decrease the repetition rate of the signal generator slightly to de-energize the alarm(s) then slowly increase, noting that the alarm(s) energize at precisely 10^5 CPM on the meter scale.

9.8 Set the signal generator for a count rate below the alarm set-point to de-energize the alarms.

9.9 Switch the Function Selector to the "CAL" position.

9.10 Depress the front panel pushbutton for the HIGH and ALERT alarms alternately, and adjust R209 (High) and R229 (Alert) alarm meter calibration control for a meter reading of exactly 10^5 CPM on the scale.

9.11 Due to sligh loading effects, it may be necessary to repeat Steps 5 through 10 for optimum calibration of the alarms.

9.11.1 If jumper C and F were removed in 9.3 then re-install.

9.12 To make ALARM SET POINT adjustments, proceed as follows:

a. Reset the input signal generator to zero amplitude.

b. Switch the Function Selector to the "CAL" position.

c. Depress the HIGH alarm pushbutton and adjust the High alarm set-point control (R205) until the meter indicates the desired CPM on the scale.

d. Depress the ALERT alarm pushbutton and adjust the Alert alarm set-point control (R214) until the meter indicates the desired CPM on the scale.

e. The HIGH and ALERT alarm adjustments are complete.

APPENDIX B

ADJUSTMENT OF ANALYZER CIRCUIT BOARD

(IODINE CHANNELS ONLY)

WARNING: Prior to placing the RMS interlock defeat switch if applicable in defeat, permission must be granted by the Shift Supervisor/Shift Foreman, the defeat switch key obtained from the Shift Foreman, and entry made in the Control Room Log.

B.1.0 TEST SETUP.

1.1 Disconnect detector 16V and signal links at the rear of Panel 12.

omit

NOTE: For HP-R-223 and HP-R-224 the signal and 16V links are located in the back of the monitor.

1.2 Ensure toggle switch on the analyzer board is in the GROSS position (Down).

B.2.0 PRELIMINARY WINDOW ADJUSTMENT.

2.1 Connect voltmeter between TP303 and ground on the analyzer board. Connect positive lead to ratemeter chassis. Adjust R313 for + 3.8 volts ± 0.02 volt on the meter.

2.2 Connect voltmeter between TP304 and ground. Connect positive lead to ratemeter chassis. Adjust R323 for 4.2 volts ± 0.02 volt on the meter. Remove the meter.

B.3.0 UPPER AND LOWER WINDOW ADJUSTMENT.

3.1 Place the toggle switch on the analyzer board in the analyze mode position (Up).

3.2 Connect pluse generator ground lead to ratemeter chassis and signal lead to blue wire of function switch. Set pulse generator as follows:

Repetition Rate:	Approximately 2000 pps.
Polarity (Pulse):	Negative (-).
Pulse Width:	1 u sec.
Amplitude:	less than 1 volt.

3.3 Connect oscilloscope ground lead to ratemeter chassis and signal lead to the junction of C310 and C304 or TP302 on the analyzer board.

3.4 Gradually increase the input pulse height while observing the ratemeter meter response and the output of the linear amplifier on the oscilloscope. The ratemeter meter should indicate downscale except when the input pulse height is within the 10% window of Ba^{133}. If the window width appears to be less than or greater than the desired value, or multiple windows are observed, readjust by repeating steps 8.2.1 thru 8.3.4.

8.4.0 ADJUSTMENT OF LINEAR AMPLIFIER GAIN TO CENTER ^{133}Ba PULSE IN THE WINDOW.

4.1 Reconnect the detector 16V and signal links at the rear of Panel 12.

NOTE: For HP-R-223 and HP-R-224 the detector 16V and signal links are located in the rear of the monitor.

4.2 Obtain maximum countrate on the ratemeter meter by adjusting (R334) Linear Amplifier Gain Control.

NOTE 1: The oscilloscope should be used as an aid in centering the 356 Kev ^{133}Ba pulse in the window. Of the three ^{133}Ba pulses which are produced, the 356 Kev pulse is the one with the highest voltage magnitude. Gain is adjusted so that the magnitude of this pulse is 4.0 volts at the window.

NOTE 2: While adjusting the Fine Gain Control R334, use the oscilloscope to determine which direction of rotation DECREASES the gain. This information will be used in the next step.

NOTE 3: 0.2 minute scaler runs should be used in conjunction with gain adjustments to determine when maximum CPM has been achieved.

8.5.0 ADJUSTMENT OF LINEAR AMPLIFIER GAIN TO CENTER IODINE PULSE IN THE WINDOW.

NOTE: The gain of the linear amplifier will now be readjusted so that iodine pulses will be centered in the window. Since the energy of Iodine is slightly higher than for ^{133}Ba, it will be necessary to decrease the gain settings that were made in the last step above.

5.1 Rezero the scaler and run a two minute count. Record this value for later use.

5.2 REDUCE gain slightly using control R334 (CCW on R334 reduces gain) and run another 2 minute count. Repeat this step until count rate is 7% less than that recorded for Step 5.1.

NOTE: Any change in the setting of R334 will cause a decrease in count rate. It is important that the 7%

decrease be obtained by reducing the gain and not by increasing it.

5.3 Iodine pulses are now centered in the window.