Sequoyah Nuclear Plant

TECHNICAL INSTRUCTION

TI-18

RADIATION MONITORING

Units 1 and 2

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Supervisor

PORC Review: 10/16/79
Date

Approved By: C. E. Cantrell
for Superintendent

Date Approved: 10/16/79

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Rev. No.	Date	Revised Pages	Rev. No.	Date	Revised Pages
0	7/6/76	All			
1	10/16/79	All			

The last page of this instruction is Number -61-

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PUNCHLIST

(1) Plant procedures should be changed to comply with TI-18 (IMI's, SI's 82, 83, etc.).

Warren H. Kinsey
10-16-79

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Section A

I. SCOPE

A. Purpose

This instruction serves the following purposes:

1. Establishes initial setpoints for process radiation monitors and adjustment setpoints to account for changes in background conditions.

2. Establishes initial setpoints for effluent radiation monitors and adjustment setpoints to account for batch releases and/or changes in background conditions.

3. Establishes a method to verify detector efficiencies.

4. Summarizes, for informational purposes, batch gaseous and liquid effluent release data.

B. Requirements

This technical instruction supports the surveillance programs used to satisfy technical specification requirements. Surveillance instructions reference this technical instruction for calculations of alarm/trip setpoints.

II. REFERENCES

A. General Atomic Calibration Reports

1. Required curves from these reports included in this instruction.

B. SQNP Technical Specifications

C. SQNP Final Safety Analysis Report

III DESCRIPTION

The remainder of this technical instruction is broken down into four sections and four appendices. A description of the purpose of each section and appendix follows.

A. Section B.1 lists the appropriate section C portion to use for setpoint or efficiency verification of a particular detector type. Section B.2 lists each radiation monitor at Sequoyah and the section or sections required to determine monitor setpoints.

B. Section C is used to determine each or all of the following for a particular detector type.

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III. B. Continued

1. Initial operational setpoint determination.

2. Adjusted operational setpoint determination.

   a. Monitor setpoints are initially determined by best judgement of what radiation levels will be and such that technical specifications will not be violated. After enough operation has occurred, monitor setpoints may require changes to allow for operational flexibility. However technical specifications will still be observed.

3. Periodic operational setpoint determination

   a. For certain effluent monitors, such as the shield building exhaust (RM-90-100), setpoints must be changed to suit each different type of release. For example, a release setpoint for a waste gas decay tank would be different than for a release of the containment purge air volume. Each different type of release will be controlled by an SOI and the performance of a surveillance instruction. The surveillance instruction will reference this technical instruction to calculate the release monitor setpoints.

4. Detector Efficiency Verification

   a. This technical instruction can be used to verify that a monitor is correctly responding. This is done by comparing the monitor's output to a gamma scan determination of what the monitor should read.

   b. Section C and D provides a summary sheets of gaseous and liquid releases. These summary sheets are for historical purposes only and will be retained in the Radiochemical laboratory files. NOTES: All data collected on these sheets are recorded in the appropriate surveillance instructions which become part of the plants lifetime records. Therefore, the section D summary sheets will be maintained as QA documents because of number sequence for a release (batch or continuous).

   c. Appendix A provides a list of Sequoyah's maximum allowable instantaneous release rates which were calculated in accordance with the Offsite Dose Calculation Manual (ODCM). Each limit was established on the bases of limiting dose to 500 mr/yr to the total body from noble gases and 1500 mr/yr to the thyroid from iodines and particulates.

   d. Appendix B tabulates the maximum design flowrates for each vent exhaust to be used in Section C setpoint calculations.

e. Appendix C documents the derivation of the iodine monitor (RD-35) setpoint evaluation.

f. Appendix D tabulates the FSAR and technical specifications limits required to calculate monitor setpoints in section C.

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Section B

B. SEQUOYAH RADIATION MONITOR IDENTIFICATION

B.1 TYPES OF DETECTORS

Detector	Model Number	Refer to Section
Noble Gas-β Detector	(RD-32, RD-32-01)	C.1
Noble Gas-β Detector	(RD-32-05)	C.2
Noble Gas-β Detector	(RD-32-08)	C.3
Noble Gas-β Detector	(RD-30-01)	C.4
Iodine - γ Detector	(RD-35)	C.5
Particulate-β Detector	(RD-36-01)	C.6
Liquid- γ Detector	(RD-33)	C.7
Liquid- γ Detector	(RD-33-06)	C.8

B.2 Sequoyah Nuclear Plant - Radiation Monitors

Monitor	Sample Stream	Detector Type - Refer to Section
1-RM-90-99	Condenser Vacuum Pump Exhaust, U1	C.3
2-RM-90-99	Condenser Vacuum Pump Exhaust, U2	C.3
1-RM-90-100	Shield Building Exhaust, U1	C.1, C.5 and C.6
2-RM-90-100	Shield Building Exhaust, U2	C.1, C.5 and C.6
0-RM-90-101	Auxiliary Building Exhaust	C.1, C.5 and C.6
1-RM-90-104	Reactor Coolant Letdown, U1	C.8
2-RM-90-104	Reactor Coolant Letdown, U2	C.8
1-RM-90-106	Containment Building Lower Compartment, U1	C.1, C.5 and C.6
2-RM-90-106	Containment Building Lower Compartment, U2	C.1, C.5 and C.6
1-RM-90-112	Containment Building Upper Compartment, U1	C.1, C.5 and C.6
2-RM-90-112	Containment Building Upper Compartment, U2	C.1, C.5 and C.6
0-RM-90-118	Waste Disposal Gas Effluent	C.4
1-RM-90-119	Condenser Vacuum Pump Exhaust, U1	C.1
2-RM-90-119	Condenser Vacuum Pump Exhaust, U2	C.1
1-RM-90-120	Steam Generator Blowdown Liquid Effluent, U1	C.7
2-RM-90-120	Steam Generator Blowdown Liquid Effluent, U2	C.7
1-RM-90-121	Steam Generator Blowdown Liquid Effluent, U1	C.7
2-RM-90-121	Steam Generator Blowdown Liquid Effluent, U2	C.7
0-RM-90-122	Waste Disposal Liquid Effluent	C.7
0-RM-90-123	Component Cooling System Common	C.7
1-RM-90-123	Component Cooling System, U1	C.7
2-RM-90-123	Component Cooling System, U2	C.7
1-RM-90-124	Steam Generator Blowdown, U1	C.7
2-RM-90-124	Steam Generator Blowdown, U2	C.7
0-RM-90-125	Main Control Room Intake	C.1
0-RM-90-126	Main Control Room Intake	C.1

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Section B

Monitor	Sample Stream	Detector Type - Refer to Section
1-RM-90-130	Containment Purge Exhaust, U1	C.2
2-RM-90-130	Containment Purge Exhaust, U2	C.2
1-RM-90-131	Containment Purge Exhaust, U1	C.2
2-RM-90-131	Containment Purge Exhaust, U2	C.2
0-RM-90-132	Service Building Exhaust	C.1,C.5 and C.6
0-RM-90-133	Essential Raw Cooling Water, Header A	C.7
0-RM-90-134	Essential Raw Cooling Water, Header B	C.7
0-RM-90-140	Essential Raw Cooling Water, Header A	C.7
0-RM-90-141	Essential Raw Cooling Water, Header B	C.7
1-RM-90-170	Boric Acid Evaporator Condensate, U1	C.7
2-RM-90-170	Boric Acid Evaporator Condensate, U2	C.7
0-RM-90-205	Main Control Room Emergency Intake	C.1
0-RM-90-206	Main Control Room Emergency Intake	C.1
0-RM-90-	Plant Liquid Discharge - Cooling Tower Blowdown	C.7
0-RM-90-212	Turbine Building Station Sump Discharge	C.7
0-RM-90-225	Condensate Demineralizer Discharge	C.7
0-RM-90-12	Fuel Loading Area	C.6
0-RM-90-13	Fuel Loading Area	C.6
1-RM-90-14	Unit 1 Hot Sample Room	C.6
2-RE-90-14	Unit 2 Hot Sample Room	C.6
0-RE-90-15	El. 690.0 Area	C.6
0-RE-90-16	Decontamination Room	C.6
0-RE-90-17	El. 669.0 Area	C.6
1-RE-90-62	Lower Compartment Instrument Room	C.6
2-RE-90-62	Lower Compartment Instrument Room	C.6

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Section C

Instructions and/or Worksheets for Setpoint Determination and Verification For Radiation Monitors

Section 18.C.1
RD-32,-32-01 DETECTORS

NOTE These two detectors are identical with respect to detector size. The only difference is in the amount of shielding.

Monitors:				
	1-RM-90-100(E)	1-RM-90-106(P)	1-RM-90-119(E)	0-RM-90-205(P)
	2-RM-90-100(E)	2-RM-90-106(P)	2-RM-90-119(E)	0-RM-90-206(P)
	0-RM-90-101(E)	1-RM-90-112(P)	0-RM-90-125(P)	
	0-RM-90-132(E)	2-RM-90-112(P)	0-RM-90-126(P)	

NOTE: E=Effluent P=Process

A. Setpoint Calculation

1. Obtain gaseous release rate (or concentration) limits for nuclides used to determine monitor setpoint.

2. Obtain vent flow of exhaust stream to be monitored.

3. Complete Worksheet No. 18-C.1A. Calculate setpoint count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all expected nuclides.

B. Detector Efficiency Verification

1. Obtain gaseous sample of medium per TI-16, and record the appropriate monitor's count rate at time of sampling on worksheet TI-18-C.1.B.
2. Count sample according to TI-12, Method B.5.
3. Complete Worksheet No. 18-C.1B. Calculate expected count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides. Compare with monitor count rate at time of sampling. Calculate percent deviation.

NOTE: a. Sensitivities were determined for the beta rays (with intensities greater than one percent) of anticipated nuclides. The sensitivity for each beta ray was multiplied by the beta ray's intensity, and these products were summed, yielding an overall sensitivity. Sensitivities for these and other nuclides may be determined from Figure 18-C.1 and the nuclide's beta rays and respective intensities. Information supplied by "Nuclear Decay Data for Radionuclides ocurring in routine releases from nuclear fuel cycle facilities" (August 1977, prepared by Oak Ridge National Laboratory), and General Atomics calibration reports. (March 1974).

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Worksheet No. 18-C.1A

Setpoint Calculation Worksheet
(Gas β Detector; RD-32,32-01)

Monitor ________________ Date ________ Time ________

1. Obtain Limiting Nuclide Concentrations

   a. For -90-100, -90-101, -90-119 and -90-132 obtain applicable vent exhaust limiting concentration by dividing release rate limit (section D, Appendix A) by the maximum design vent flowrate (Section D, Appendix B).

Release rate limit	Nuclide	÷	Flowrate	=	Limiting concentration
______ μCi/S	AR-41	÷	$\left(\frac{\text{\_\_\_\_\_\_ CFM x 28320 CC/CF}}{\text{60S/Min}}\right)$	=	______ μCi/cc Ar-41
______ μCi/S	KR-85			=	______ μCi/cc KR-85
______ μCi/S	KR-85m			=	______ μCi/cc KR-85m
______ μCi/S	KR-87			=	______ μCi/cc KR-87
______ μCi/S	KR-88			=	______ μCi/cc Kr-88
______ μCi/S	KR-89			=	______ μCi/cc KR-89
______ μCi/S	Xe-131M			=	______ μCi/cc Xe-131M
______ μCi/S	Xe-133			=	______ μCi/cc Xe-133
______ μCi/S	Xe-133M			=	______ μCi/cc Xe-133M
______ μCi/S	Xe-135			=	______ μCi/cc Xe-135
______ μCi/S	Xe-135M			=	______ μCi/cc Xe-135M
______ μCi/S	Xe-137			=	______ μCi/cc Xe-137
______ μCi/S	Xe-138			=	______ μCi/cc Xe-138
______ μCi/S	(Other)			=	______ μCi/cc ______ (Other)
______ μCi/S	(Other)			=	______ μCi/cc ______ (Other)

   b. Monitors -90-106 and -90-112 have a Technical Specification Limit of 8.5E-03 μCi/cc. Initial setpoint concentration will be 1/10 of this value based on Xe133. For -90-125 and -900-205 obtain limiting concentration from Appendix D

______ μCi/cc	Ar-41		
______ μCi/cc	Kr-85	______ μCi/cc	Xe-133M
______ μCi/cc	Kr-85m	______ μCi/cc	Xe-135
______ μCi/cc	Kr-87	______ μCi/cc	Xe-135M
______ μCi/cc	Kr-88	______ μCi/cc	Xe-137
______ μCi/cc	Kr-89	______ μCi/cc	Xe-138
______ μCi/cc	Xe-131M	______ μCi/cc	(Other)
______ μCi/cc	Xe-133	______ μCi/cc	(Other)

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Worksheet 18-C.1A

Monitor ____________________ Date ____________ Time __________

2. Multiply Nuclide Limiting Concentration by Detector Efficiency for Nuclide

Isotope Concentration			Monitor Efficiency - Isotope[a]		Isotope-Cal. Monitor Response
_____ μCi/cc	AR-41	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	KR-85	x	5.66E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	KR-85M	x	5.89E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	KR-87	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	KR-88	x	4.71E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	KR-89	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	XE-131M	x	3.24E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	Xe-133	x	3.50E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	XE-133M	x	4.57E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	XE-135	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	XE-135M	x	1.30E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	Xe-137	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	XE-138	x	6.00E07 CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	(______)	x	(_______) CPM/μCi/cc	=	_______ CPM
_____ μCi/cc	(______)	x	(_______) CPM/μCi/cc	=	_______ CPM

[a] Obtained From Figure 18-C.1. (Sum of isotopic energies multiplied by their respective percent abundances).

3. Total ________ CPM

4. Multiply Total (Step 3) By Appropriate Safety Factor (S.F.)

For -90-100	S.F. = 0.2	-90-119	S.F. = 0.2
-90-101	S.F. = 0.5	-90-125	S.F. = 1.0
-90-106	S.F. = 0.1	-90-205	S.F. = 1.0
-90-112	S.F. = 0.1		
-90-132	S.F. = 0.2		

NOTE: Safety factors can be changed only by the approval of the lead of cognizant chemical engineer and noted on worksheet in remarks section.

Safety Factor x Total (Value from Step 3)

______ x ______ CPM = ______ CPM

5. Background Count Rate For Monitor: _______ CPM
NOTE: Established by isolating monitor and injecting service air or air from room that radiation monitor is located into monitor. If cannot be obtained by this means use zero as the background (CPM) countrate.

6. Monitor Setpoint = (4) + (5)
_____ CPM = + _____ CPM = _____ CPM
(4) (5) (setpoint)

______________________________ ____________________
Analyst Date

______________________________ ____________________
Chem. Engr. Assoc. Date

1272 012

Worksheet 18-C.1B

Section C.1

Detector Efficiency Verification
(Gas β Detectors; RD-32, -32-01)

Monitor ________ Date ________ Time ________

1. Sample Activity Corrected to Time of Sampling. Obtain Count Rate.

Nuclide Concentration			Mon. Efficiency-Isotope[a]			Isotope - Calculated Mon. Resp.
______ μCi/cc	AR-41	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	KR-85	x	5.66E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	KR-85M	x	5.89E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	KR-87	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	KR-88	x	4.71E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	KR-89	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-131M	x	3.24E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-133	x	3.50E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-133M	x	4.57E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-135	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-135M	x	1.30E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-137	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	Xe-138	x	6.00E07	CPM/μCi/cc	=	______ CPM
______ μCi/cc	(______)	x	(______)	CPM/μCi/cc	=	______ CPM
______ μCi/cc	(______)	x	(______)	CPM/μCi/cc	=	______ CPM

[a] Obtained from Figure 18-C.1. (Sum of Isotopic energies multiplied by their respective percent abundancies.)

2. Total Calculated Monitor Response ______ CPM

3. Background Count Rate for Monitor: ______ CPM

NOTE: Established by isolating monitor and injecting service air or air from room where monitor is located into monitor. If cannot be obtained by this means then use zero as the background count rate.

4. Calculated Monitor Countrate: (2) + (3) =

______ CPM + ______ CPM = ______ CPM
(2) (3)

5. Actual monitor count rate reading at time of sample: ______ CPM

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Worksheet 18-C.1B

Section C.1

Monitor ______________ Date ___________ Time ___________

6. Calculate Percent Deviation : $\frac{(4) - (5)}{(4)}$ X 100

$$\frac{\underline{\quad}_{(4)} - \underline{\quad}_{(5)}}{\underline{\quad}_{(4)}} \text{ X } 100 = \underline{\quad}\% \text{ (b), (c)}$$

NOTES:

b. For count rates 10-500 CPM, notify Chemical Engineer Associate or Chem. Engr. for percent deviations greater than 30%. Note in remarks section.

c. For count rates greater than 500 CPM, notify chem. engr. assoc. or chem. engr. for percent deviations greater than 10%. Note in remarks section.

______________ ________ ______________________ ________
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

____

1272 014

SECTION C.2

RD-32-05 DETECTOR

Monitors: 1-RM-90-130(E) 1-RM-90-131(E)
2-RM-90-130(E) 2-RM-90-131(E)
NOTE: E = Effluent

A. Setpoint Calculation

1. Setpoint shall be a fraction of the SNP Technical Specification (initial 1/10 of 8.5E-03 μCi/cc (tech. spec. limits) for containment concentration) based on XE-133. (XE-133 assumed to account for majority of activity at time of purge.))

2. Reevaluation of radiation setpoints will be based on grab samples taken from lower containment (RM-90-106) and allowable release rate through the shield building exhaust. The reevaluation of setpoint (tech spec fraction 1/10 of allowable limit) required approval of lead or cognizant chemical engineer and when initiated noted in worksheet remarks section.

B. Detector Efficiency Verification

1. Obtain gas sample from both upper and lower compartments per TI-16, and record appropriate purge monitor's count rate at time of sampling.

2. Count sample(s) according to TI-12, method B.5. Use the most restrictive results for calculations (either upper or lower).

3. Complete Worksheet No. 18-C.2B. Calculate expected count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides. Compare with purge monitor count rate at time of sampling. Calculate percent deviation.

NOTE: (a) Sensitivities were determined for the beta rays (with intensities greater than one percent) of anticipated nuclides. The sensitivity for each ray was multiplied by the beta ray's intensity, and these products were summed, yielding an overall sensitivity. Sensitivities for these and other nuclides may be determined from Figure 18-C2 and the nuclide's beta rays and respective intensities. Information supplied by "Nuclear Decay Data for Radionuclides occuring in routing releases from Nuclear Fuel Cycle Facilities" (August 1977, prepared by Oak Ridge National Laboratory), and General Atomics Calibration Reports E-115-721, April 1979).

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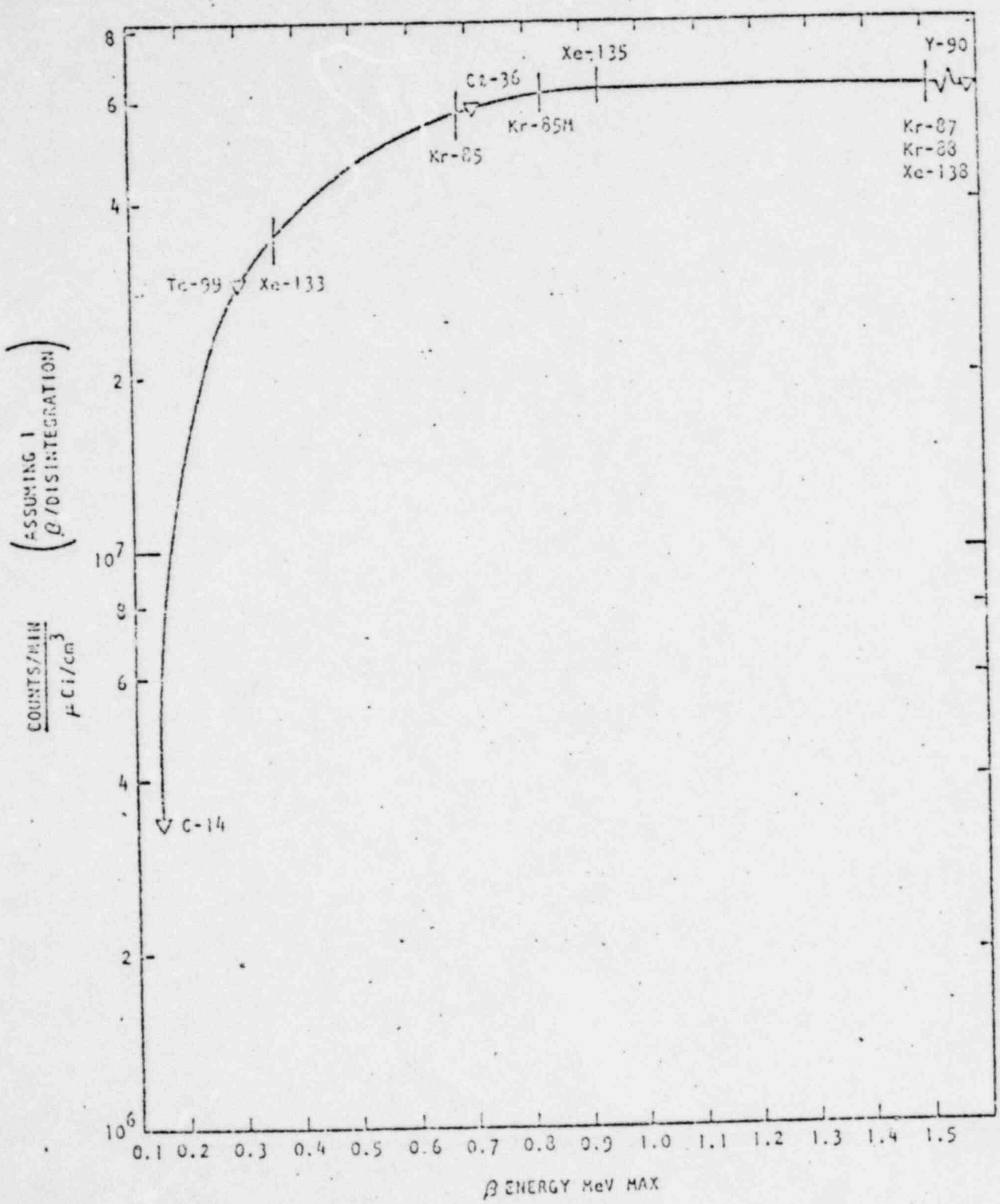

General Atomics Calibration Report E-199-350 (March 1974) - RD-32 detector.

1272 016

Worksheet No. 18-C.2A

SETPOINT CALCULATION WORKSHEET
(Gas β Detector; RD-32-05)

Monitor ______________________________ Date ________ Time ________

1. Limiting isotope concentration: ________ Ci/cc
   (Initial Setpoint: (8.5E-04 μCi/cc based on Xe-133)

2. Detector Efficiency for isotope in step 1= (______________ CPM/μCi/cc) *(0.044)
   (obtained from Figure 18-C.2)

3. Calculated Count Rate: (1) x (2)
   ________ μ Ci/cc x ________ CPM/μ Ci/cc = ________ CPM
   (Initial Count Rate Setpoint: 2243 CPM based on Xe133).

4. Background Count Rate: ________ CPM
   NOTE: Established by isolating monitor and injecting service air or air from room that monitor is located into monitor. If cannot be obtained by this means are zero as background count rate.

5. Monitor Setpoint: (3) + (4)
   _____ CPM + _____ CPM = _____ CPM
   (3) (4) (Setpoint)

_________________________ __________ _________________________ __________
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

1272 017

Worksheet No. 18-C.2B

DETECTOR EFFICIENCY VERIFICATION
(Gas β Detector; RD-32-05)

Monitor ______________________ Date _________ Time __________

1. Sample activity corrected to time of sampling. Use most restricting isotope (controlling lightest concentration).

   (0.044) * _____ μCi/cc (controlling isotope) *(____CPM/μCi/cc)[a] = _________ CPM

   NOTE: [a]Obtained from Figure 18-C.2

2. Background Count Rate: _______ CPM

   NOTE: Established by isolating monitor and injecting service air or air from room that monitor is located into monitor. If cannot be obtained by this means then use zero as the background count rate.

3. Calculated Monitor Count Rate: (1) + (2)
   ______ CPM + ______ CPM = ______ CPM
   (1)   (2)   (3)

4. Monitor count rate reading at time of sampling: _______ CPM

5. Calculate percent deviation: $\frac{(3) - (4)}{(4)}$ X 100

   Percent deviation = _____ CPM _____ CPM
                        (13)   (14)

   ________________________ X 100 = _____ % (a),(b)
   _______ CPM
   (3)

   NOTES: (a) For count rates 10-500 CPM, notify chemical engineer associate or chemical engineer for percent deviations greater than 30%. Note in remarks section.
   (b) For count rates greater than 500 CPM, notify chemical engineer associate or chemical engineer for percent deviations greater than 10%. Note in remarks section.

______________________ ________ ______________________ __________
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

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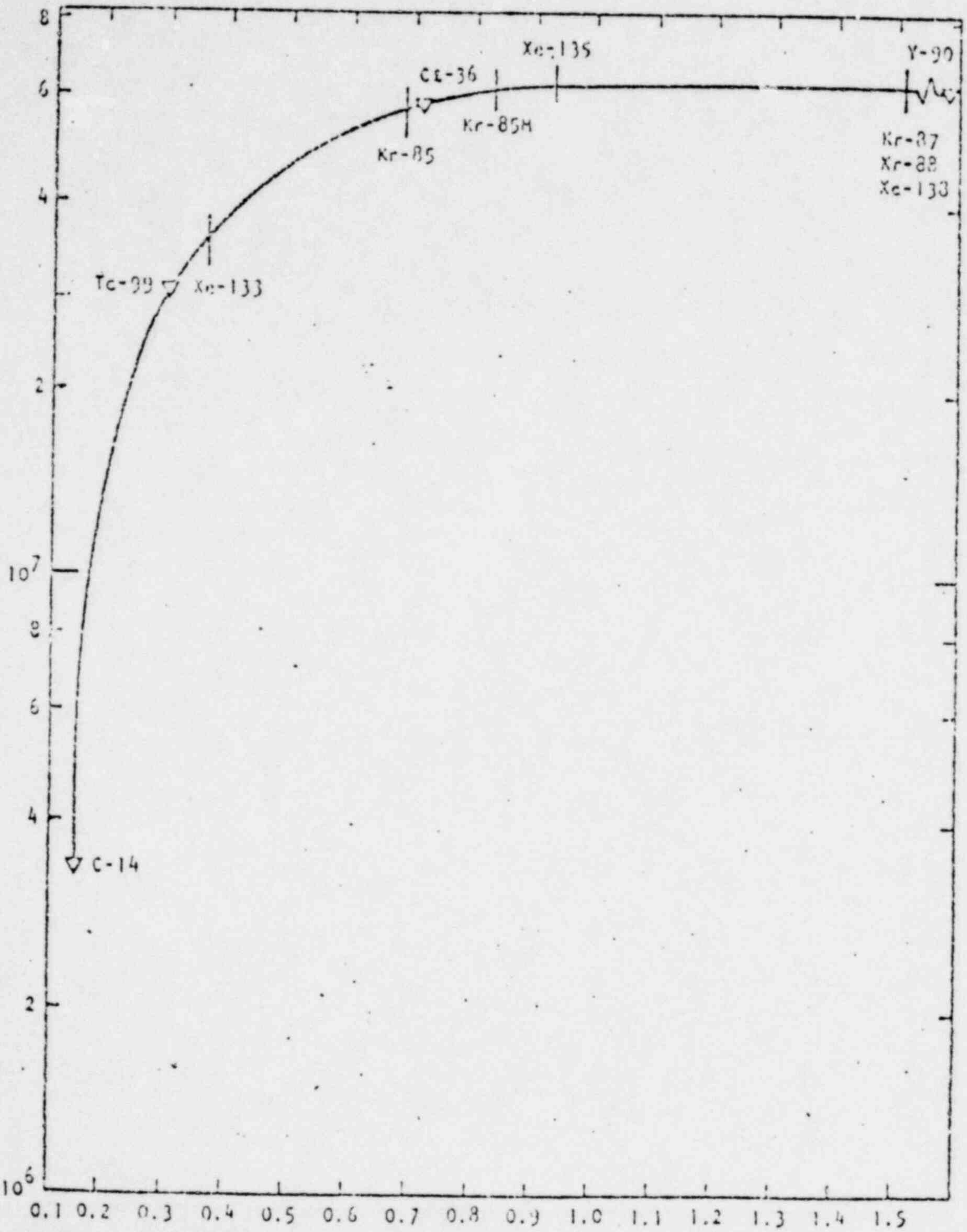


1272 019

GENERAL ATOMICS CALIBRATION REPORT E-199-350 (March 1974). This is a curve for the RD-32 detector. Efficiencies for the RD-32-05 can be obtained by multiplying the efficiency from this curve by the ratio of the detector areas of the RD-32-05 to the RD-32 (Ratio equal to 0.044) and multiplying by percent abundance of each major photopeak.

POOR ORIGINAL

SECTION C.3

RD-32-08 DETECTOR

Monitors: 1-RM-90-99(E)
2-RM-90-99(E)

NOTE: E=Effluent

A. Setpoint Calculation

1. Obtain gaseous release rate (or concentration) limits for nuclides used to determine setpoint.

2. Obtain vent flow of exhaust to be monitored.

3. Complete Worksheet No. 18-C.3A. Calculate setpoint count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all expected nuclides.

B. Detector Efficiency Verification

1. Obtain gaseous sample per TI-16, and record the appropriate monitor's count rate at time of sampling.

2. Count sample according to TI-12, method B.5.

3. Complete Worksheet No. 18-C.3.B. Calculate expected count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides. Compare with monitor count rate at time of sampling. Calculate percent deviation.

NOTE: (a) Sensitivities were determined for the beta rays (with intensities greater than one percent) of anticipated nuclides. The sensitivity for each beta ray was multiplied by the beta ray's intensity, and these products were summed, yielding an overall sensitivity. Sensitivities for these and other nuclides may be determined from Figure 18-C.3 and the nuclide's beta rays and respective intensities. Information supplied by "Nuclear Decay Data for Radionuclides occurring in routine releases from nuclear fuel cycle facilities" (August 1977, prepared by Oak Ridge National Laboratory), and General Atomics calibration report E-115-721, April 1979.

1272 020

Worksheet No. 18-C.3A

SETPOINT CALCULATION WORKSHEET
(Gas β Detector; RD-32-03)

Monitor ______________________ Date ____________ Time __________

1. Obtain Limiting Concentration by dividing release rate limit (Appendix A) by the maximum design vent flowrate (Section D, Appendix B).

Isotope Concentration		Maximum Design Flowrate		Isotope Limiting Conc.
_____ μCi/S AR-41			=	_____ μCi/CC AR-41
_____ μCi/S KR-85			=	_____ μCi/CC KR-85
_____ μCi/S KR-85M			=	_____ μCi/CC KR-85M
_____ μCi/S KR-87			=	_____ μCi/CC KR-87
_____ μCi/S KR-88			=	_____ μCi/CC KR-88
_____ μCi/S KR-89			=	_____ μCi/CC KR-89
_____ μCi/S Xe-131M	÷	(_____ CFM x 28320 CC/CF	=	_____ μCi/CC Xe-131M
_____ μCi/S Xe-133		60S/min)	=	_____ μCi/CC Xe-133
_____ μCi/S Xe-133M			=	_____ μCi/CC Xe-133M
_____ μCi/S Xe-135			=	_____ μCi/CC Xe-135
_____ μCi/S Xe-135M			=	_____ μCi/CC Xe-135M
_____ μCi/S Xe-137			=	_____ μCi/CC Xe-137
_____ μCi/S Xe-138			=	_____ μCi/CC Xe-138
_____ μCi/S (_____)			=	_____ μCi/CC(_____)
_____ μCi/S (_____)			=	_____ μCi/CC(_____)

2. Multiply Limiting Concentration by detector efficiency for each nuclide.

(a) Obtain from General Atomic Calibration Report E-115-721, April 1979.

Isotopic Concentration		Monitor Efficiency - Isotope (a)		Calc. Mon. Response
_____ μCi/CC AR-41	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC KR-85	x	6.23E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC KR-85M	x	6.48E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC KR-87	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC KR-88	x	5.18E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC KR-89	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC XE-131M	x	3.56E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-133	x	3.85E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-133M	x	5.03E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-135	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-135M	x	1.43E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-137	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC Xe-138	x	6.06E05 CPM/μCi/CC	=	_____ CPM
_____ μCi/CC(_____)	x	(_____) CPM/μCi/CC	=	_____ CPM
_____ μCi/CC(_____)	x	(_____) CPM/μCi/CC	=	_____ CPM

(a) Obtained from Figure 18-C.3. (See note on figure).

1272 021

Worksheet No. 18-C.3A

Monitor ________________________ Date _________ Time _______________

3. Total calculated monitor response: _________ CPM

4. Background Count Rate for Monitor: _________ CPM

   NOTE: Established by isolating monitor and inserting service air or air from room that monitor is located into monitor. If cannot be obtained by this method then use zero as the background count rate.

5. Monitor Setpoint = (3) + (4) * 0.1 (safety factor)

   (0.1) * ______ CPM + ______ CPM = ______ CPM
   (3) (4) (Setpoint)

   NOTE: Safety factor can be changed only by the approval of the lead or cognizant chemical engineer and noted in remarks section of worksheet.

________________ __________ ________________________ ______________
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

1272 022

Worksheet No. 18-C.3B

Detector Efficiency Verification
(Gas β Detector; RD-32-08)

Monitor ____________________ Date ____________ Time ____________

1. Sample activity corrected to time of sampling. Obtain count rate.

Isotope Concentration			Mon. Efficiency-Isotope[a]		Computed Mon. Response
____ μCi/CC	Ar-41	x	6.06E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-85	x	6.23E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-85M	x	6.48E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-87	x	6.06E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-88	x	5.17E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-89	x	6.06E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Kr-131M	x	3.56E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Xe-133	x	3.85E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Xe-133M	x	5.03E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Xe-135	x	6.06E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Xe-135M	x	1.43E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	Xe-137	x	6.06E05 CPM/μCi/CC	=	____ CPM
____ μCi/CC	(______)	x	(______) CPM/μCi/CC	=	____ CPM
____ μCi/CC	(______)	x	(______) CPM/μCi/CC	=	____ CPM

[a] Obtained from Figure 18-C.3 (See footnote on figure).

2. Total Calculated Monitor Response ________ CPM

3. Background Count Rate for Monitor: ________ CPM

   NOTE: Established by isolating monitor and injecting service air or air from room that monitor is located into monitor. If cannot be obtained by this means, then use zero as the background count rate.

4. Calculated monitor count rate: (2) + (3)

   _____ CPM + _____ CPM = _____ CPM
   (2) (3)

5. Monitor Count Rate reading at time of sampling: __________ CPM

6. Calculate percent deviation: $\frac{(4) - (5)}{(4)}$ X 100 = % dev.

   $\frac{\_\_\_\_\text{ CPM (4)} - \_\_\_\_\text{ CPM (5)}}{\_\_\_\_\text{ CPM (4)}}$ x 100 = _____ % (1), (2)

1272 023

Worksheet No. 18-C.?

Monitor__________________ Date __________ Time __________

NOTES:

(1) For count rates of 10-500 CPM, notify Chem. Engr. Assoc. or Chem. Engr. for percent deviations gerater than 30%. Note in remarks section.

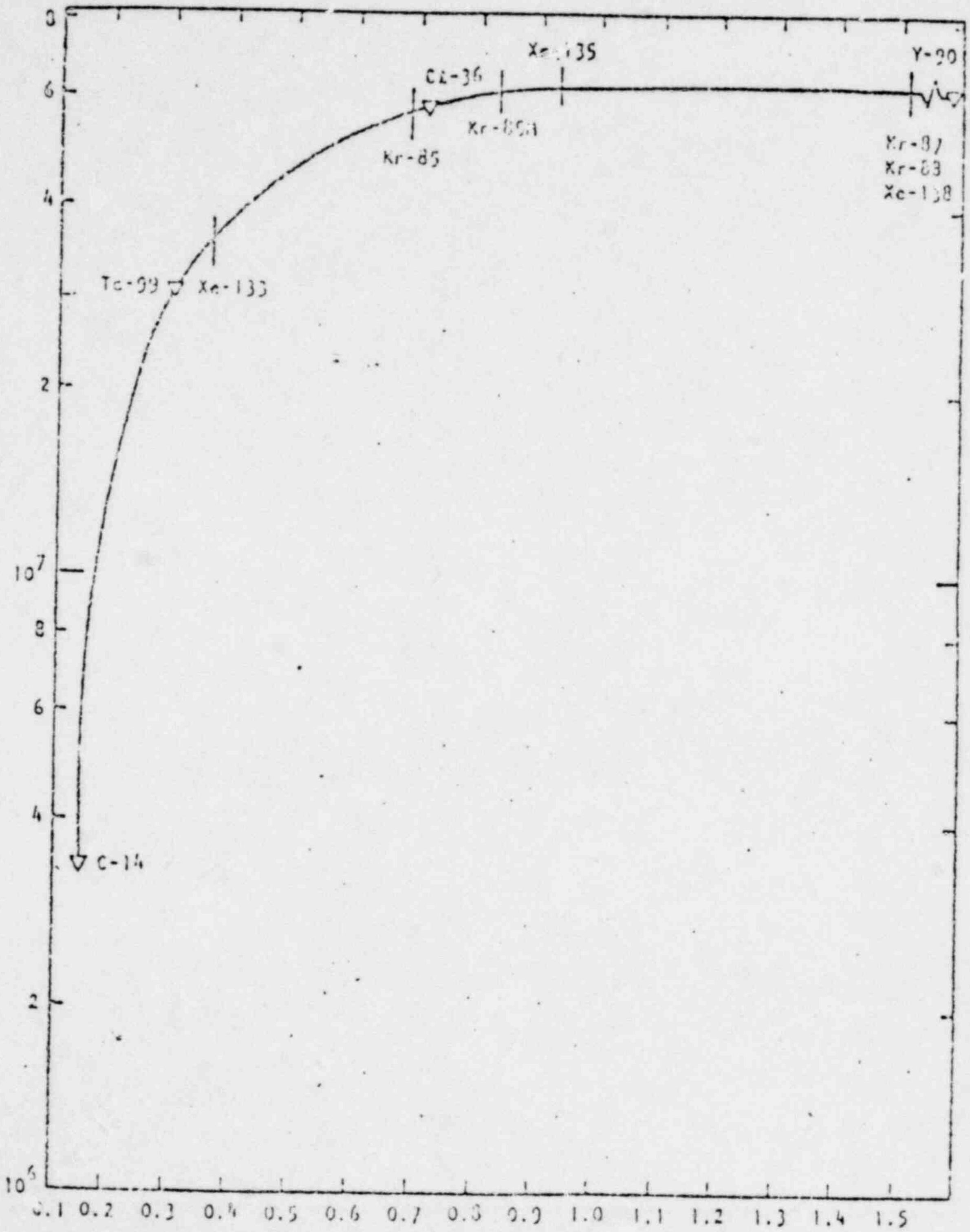
(2) For count rates greater than 500 CPM, notify Chem. Engr. Assoc. or Chem. Engr. for percent deviations greater than 10%. Note in remarks section.

______________________ ________ ______________________ ________
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

1272 024



General Atomics Calibration Report E-199-350 (March 1974)

This is a curve for the RD-32 detector. Efficiencies for the RD-32-03 can be obtained by multiplying the efficiency from this curve by the ratio of the detector areas of the RD-32-08 to the RD-32 (Ratio equal to 0.011) and multiplying by percent abundance of each major photopeak.

POOR ORIGINAL

RD-30-01 DETECTOR

Monitor: 0-MR-90-118(E)

NOTE: E = Effluent

A. Setpoint Calculation

1. Obtain sample, per TI-16, and pressure of gas decay tank to be released.

2. Count sample according to TI-12, Method B.5.

3. Complete worksheet no. 18-C.4A. Calculate setpoint count rate by multiplying the detected nuclides concentration by the detector sensitivity (a) for each nuclide. It is assumed that only KR-85 remains in significant quantity at the time of tank discharge when tank has been held for 60 days.

B. Detector Efficiency Verification

1. Obtain gas sample of gas decay tank exhaust header, per TI-16, and the monitor's count rate at the time of sampling.

2. Count sample according to TI-12, Method B.5.

3. Complete worksheet no. 18-C.4B. Calculate expected count rate by multiplying nuclide concentration by detector sensitivity[a]. Compare with monitor count rate. Calculate percent deviation.

NOTE:

(a) The sensitivity was determined for the beta rays (with intensities greater than one percent) of KR-85. The sensitivity for each beta ray was multiplied by the beta ray's intensity and these products were summed, yielding an overall sensitivity. Sensitivities for the beta rays of KR-85 were determined from Figure 18-C.4. Information supplied by "Nuclear Decay Data for Radionuclides occuring in routine release from Nuclear Fuel Cycle Facilities" (August 1977, prepared by Oak Ridge National Laboratory), and General Atomics Calibration Reports.

1272 026

Worksheet No. 18-C.4A
Setpoint Calculation Worksheet
(Gas β Detector; RD-30-01)

1. Sample activity corrected to time of sampling. Activity concentration should be expressed. At ambient conditions. Multiply by detector isotopic sensitivity.

Isotope Concentration		Monitor Efficiency-Isotope[a]		Comp. Mon. Response
_____ μ Ci/CC	AR-41	x 5.42E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	KR 85	x 4.86E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	KR-85M	x 6.12E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	KR-87	x 5.97E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	KR-88	x 4.23E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	XE-133	x 3.28E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	XE-135	x 5.53E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ CI/CC	Xe-135M	x 9/81E03	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	XE-138	x 5.10E04	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	(_____)	x(_____)	CPM/ μ Ci/CC	= _____ CPM
_____ μ Ci/CC	(_____)	x(_____)	CPM/ μ Ci/CC	= _____ CPM

[a] Obtained from Figure 18-C.4.

2. Total Calculated Monitor Response _______________ CPM

3. Complete monitor setpoint by multiplying by a factor of 1.1 (factor to prevent inadvertent trips)

1.1 x _______ CPM (value in step 2) = _________ CPM

4. Monitor Background Count Rate:

Note: Obtained by taking monitor reading prior to initiating the release.

5. Monitor Setpoint: (3) + (4)
_____ CPM (3) + _____ CPM (4) = _______________ CPM

_________________________ _______ _____________________ _______
Analyst Date Chem. Engr. Assoc. Date

Remarks: ____

____

____

Worksheet No. 18-C.4B
Detector Efficiency Verification
(Gas β Detector; RD-30-01)

1. Sample activity corrected to time of sampling. Express activity concentration at ambient conditions. Multiply by detector sensitivity.

Isotope Concentration	Monitor Efficiency-Isotope[a]		
____ μCi/CC Ar-41	x 5.42E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Kr-85	x 4.86E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Kr-85m	x 6.12E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Kr-87	x 5.97E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Kr-88	x 4.23E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Xe-133	x 3.28E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Xe-135	x 5.53E04 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Xe-135M	x 9.81E03 CPM/ μCi/CC	=	________ CPM
____ μCi/CC Xe-138	x 5.10E04 CPM/ μCi/CC	=	________ CPM
____ μCi/cc(______)	x(______) CPM/ μCi/CC	=	________ CPM
____ μCi/CC(______)	x(______) CPM/ μCi/CC	=	________ CPM

[a] Obtained from figure 18-C.4

2. Total Calculated ________ CPM

3. Compute monitor setpoint by multiplying by a factor of 1.1 (factor to prevent inadvertent trips).

   1.1 x ____ ___ CPM (value in Step 2) = ________ CPM

4. Monitor background count rate: ________ CPM

   NOTE: Obtained by taking reading prior to initiating discharge.

5. Add (3) + (4): ________ CPM (3) + ________ CPM (4) = ________ CPM

6. Monitor count rate reading at time of sampling: ________ CPM

7. Calculate percent deviation: $\frac{(5) \quad (6)}{(5)} \times 100$

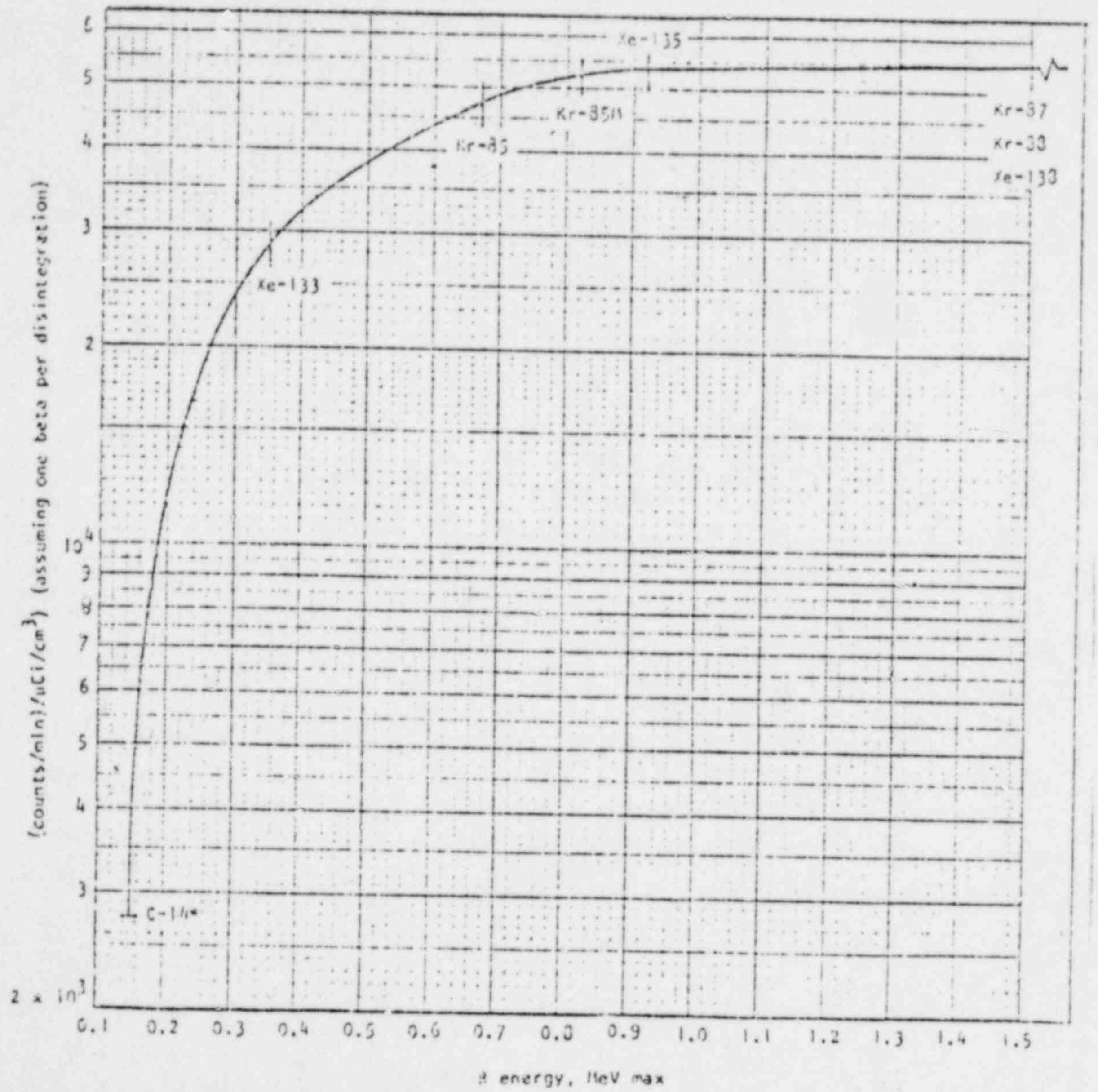
   $\frac{\_\_\_\_\_\_ \text{ CPM (5)} - \_\_\_\_\_\_ \text{ CPM (6)}}{\_\_\_\_\_\_ \text{ CPM (5)}} \times 100 =$ ______ % (a), (b)

NOTES: (a) For count rates 10-500 CPM, notify chem. engr. assoc. or chem. engr. for percent deviations greater than 30%. Note in remark section below.
(b) For count rates greater than 500 CPM, notify chem. engr. assoc. or chem. engr. for percent deviations greater than 10%. Note in remarks section below.

________________ Analyst ________ Date ________________ Chem. Engr. Assoc. ________ Date

Remarks: ____

1272 028



Operating at 760 mm Hg abs and 25°C.

GENERAL ATOMICS CALIBRATION REPORT E-115-593 (March 1978).

1272 029

POOR ORIGINAL

Section C.5

RD-35 Detector

Monitors: 1-RM-90-100(E)	1-RM-90-106(P)
2-RM-90-100(E)	2-RM-90-106(P)
0-RM-90-101(E)	1-RM-90-112(P)
0-RM-90-132(E)	2-RM-90-112(P)

NOTE: P=Process E=Effluent

A. Setpoint Calculation

1. Obtain iodine release rate (or concentration) limit for nuclide used to determine setpoint[a].

2. Obtain maximum design vent flow of exhaust stream to be monitored, monitor sample flowrate (controlled $\leq$ 2 CFM), and sample time (usually 168 hours-one week).

3. Complete worksheet no. 18-C.5A. Calculate setpoint count rate by multiplying nuclide concentration by its sensitivity[a].

B. Detector Efficiency Verification

1. Obtain charcoal filter from monitor per TI-16, and record appropriate monitor's count rate at time of sampling.

2. Count sample according to TI-12, Method B.5.

3. Complete worksheet no. 18-C.5B. Calculate expected count rate by multiplying nuclide[a] concentration by its sensitivity[b]. Compare with monitor count rate. Calculate percent deviation.

NOTE: (a) RD-35 is a single channel analyzer monitoring I-131.
(b) Detector sensitivity for I-131 (2.7×10^4 cpm/μCi) supplied by General Atomics Calibration Report (November 1974).

1272 030

Section C.5
Worksheet No. 18-C.5A

Setpoint Calculation Worksheet
(Iodine γ Detector; RD-35)

1. Obtain Limiting Nuclide Concentration:

   a. For -90-100, -90-101, and -90-132, obtain limiting concentration by dividing release rate limit (Appendix A) by the maximum design vent flowrate (Appendix B).

$$\left(\_\_\_\_\ \mu Ci/Sec\ I\text{-}131\right) \div \left(\frac{\_\_\_\_\ CFM \times 28320\ CC/ft^3}{60\ sec/min}\right) = \_\_\_\_\ \mu Ci/CC\ I\text{-}131$$

   b. For -90-106 and -90-112, obtain limiting concentration from FSAR (Final Safety and Analysis Report), Table 12.1-1.

   ______ μ Ci/CC

2. Calculate average monitor flowrate for sample period.

$$\underset{(avg.)}{\_\_\_\_}\ CFM \times 60\ \frac{min}{hr} \times \frac{24\ hr}{day} \times 2.832E04\ \frac{CC}{ft^3} = \_\_\_\_\ \frac{CC}{day}$$

3. Determine accumulation term by the following equation:

$$A = \frac{\left(\text{Nuclide Concentration (1) } (\_\_\_\ \mu Ci/CC)\right) * \text{Monitor Efficiency}^{(a)} \left(I\text{-}131 = 2.7\times10^4\ CPM/\mu Ci\right) * \text{Monitor Flowrate } \_\_\_ (2)\ (CC/day)}{\_\_\_\_\ \text{(Sample Period (whole days)}}$$

$$A = \frac{\underset{(1)}{\_\_\_\_}\ \mu Ci/CC\ (I\text{-}131) \times 2.7E04\ \frac{(CPM)}{(\mu Ci)} \times \underset{(2)}{\_\_\_\_}\ \frac{CC}{Day}}{\_\_\_\_\ Days}$$

$$A = \_\_\_\_\ \frac{CPM}{(Day)^2}$$

Note: (a) Obtained from General Atomic Calibration Report

1272 031

Section C.5
Worksheet No. 18-C.5A

4. Determine nuclide decay term:

NOTE: For I-131 and a sampling period of 7 days

$DT = 16.5\ D^2$

See Appendix C derivation of equations to evaluate nuclide decay term for sampling periods less than 7 days.

5. Monitor Setpoint = Accumulator term (A) x decay term (DT)
(Less Background) (3) (4)

= ________ $\frac{CPM}{D^2}$ x ________ D^2
(3) (4)

= ________ CPM

6. Monitor background count rate: ________ CPM

7. Add (5) and (6)

________ CPM + ________ CPM = ________ CPM
(5) (6)

1272 032

Section C.5
Worksheet No. 18-C.5B

Detector Efficiency Verification
(Iodine γ Detector; RD-35)

Monitor ____________________ Date ________ Time ________

1. Sample activity corrected to time of sampling:

   ______ μCi (I-131)

2. Monitor Background count rate:

   ______ CPM

3. Monitor count rate at time of sampling:

   ______ CPM

4. Calculated detector sensitivity for I-131:

$$\frac{\underset{(3)}{\_\_\_\_\_\_}\ \text{CPM} - \underset{(2)}{\_\_\_\_\_\_}\ \text{CPM}}{\underset{(1)}{\_\_\_\_\_\_}\ \mu\text{Ci}} = \_\_\_\_\_\_\ \frac{\text{CPM}}{\mu\text{Ci}}$$

5. Calculate percent deviation:

$$\frac{\_\_\_\_\_\_\ \text{CPM}/\mu\text{Ci} - 2.7\text{E}04^{(a)}\ \text{CPM}/\mu\text{Ci}}{2.7\text{E}04\ \text{CPM}/\mu\text{Ci}} \times 100 = \_\_\_\_\_\_\ \%$$

(a) RD-35 Monitor efficiency for I-131.

1272 033

Section C.5
Worksheet No. 18-C.5B

Monitor ____________________ Date __________ Time ____________

Notes: (1) For count rates 10-500 CPM, notify chem. engr. assoc. or chem. engr. for percent deviations greater than 30%. Note in remarks section.

(2) For count rates greater than 500 CPM, notify chem. engr. assoc. or chem. engr. for percent deviations greater than 10%. Note in remarks section.

____________________	__________	____________________	__________
Analyst	Date	Chem. Engr. Assoc.	Date

Remarks: ____

____

____

1272 034

Section C.5

RD-32 Monitor Setpoints - Initial
(Does not include background count rate)

Service Building (-90-132): 3710 CPM

Auxiliary Building (-90-102): 3876 CPM (for 220,000 CFM)

Upper Compartment (-90-112): 29750 CPM

Lower Compartment (-90-106): 29750 CPM

Shield Building (-90-100): 58333 CPM

1272 035

Section C.6

A. RD-36-01 Particulate β Detector for the following process monitors:

(I) 8 CFM Effluent Monitors:

1-RM-90-100	2-RM-90-106
2-RM-90-100	1-RM-90-112
0-RM-90-101	2-RM-90-112
1-RM-90-106	0-RM-90-132

(II) 10 CFM Area Monitors:

0-RM-90-12	0-RM-90-16
0-RM-90-13	0-RM-90-17
1-RM-90-14	1-RM-90-62
2-RM-90-14	2-RM-90-62
0-RM-90-15	0-RM-90-138

(III) Setpoints:

Effluent Monitor	Setpoint
1-RM-90-100	1.1E-8 μCi/CC
2-RM-90-100	1.1E-8 μCi/CC
0-RM-90-101	1.4E-9 μCi/CC
1-RM-90-106	1.5E-5 μCi/CC
2-RM-90-106	1.5E-5 μCi/CC
1-RM-90-112	1.5E-5 μCi/CC
2-RM-90-112	1.5E-5 μCi/CC
0-RM-90-132	2.8E-9 μCi/CC

Area Monitor	Setpoints[(a)]
0-RM-90-12	3.0E-9 μCi/CC
0-RM-90-13	3.0E-9 μCi/CC
1-RM-90-14	3.0E-9 μCi/CC
2-RM-90-14	3.0E-9 μCi/CC
0-RM-90-15	3.0E-9 μCi/CC
0-RM-90-16	3.0E-9 μCi/CC
0-RM-90-17	3.0E-9 μCi/CC
1-RM-90-62	3.0E-9 μCi/CC
2-RM-90-62	3.0E-9 μCi/CC
0-RM-90138	3.0E-9 μCi/CC

Notes: (a) Setpoints for area monitors are initial setpoints only, to be reset by Health Physicist following operating experience.

(b) I-131 is used to convert μCi/CC to CPM for each monitor.

1272 036

Section C.6

B. Detector Efficiency Verification

1. Obtain particulate filter sample according to TI-16, and record the monitor count rate at time of sampling on work sheet no. 18.C.6.1.

2. Count sample according to TI-12, method B.5. Identify the major contributing nuclides and its activity on work sheet no. 18.C.6.1.

3. Obtain the monitors average flow rate for samples duration from SI-2. Record on worksheet no. 18.C.6.a.

4. Complete worksheet no. 18.C.6.1. Calculate expected count rate by dividing each nuclides activity by the monitors average flow rate and the sample duration time, then multiplying by the nuclides sensitivity[(c)] and decay factors using the following formula:

$$\text{Monitor expected CPM} = \frac{\left[\text{Nuclide Activity } (\mu Ci)\right] * \left[\text{Sensitivity CPM}/(\mu Ci/CC)\right] * \left[\text{Decay Correction } (e - \lambda t)\right]}{\text{Avg. Monitor flow rate } (ft^3/min) * \left[\text{Sample duration } (min)\right] * \text{Conversion Factor } (2.83 \times 10^4 cc/ft^3)}$$

Where: $\lambda = \frac{0.693}{\text{Half life (hr)}}$ and, t = duration time (hr)

(c) Obtained from figure 18-C.6

5. Sum the computed CPM' for all detected nuclides and add monitor's background CPM.

6. Compare total expected CPM with the monitor's count rate at time of sampling. Calculate percent deviation.

7. For count rates 10-500 CPM, notify chem. engr. assoc. or chemical engineer for percent deviations greater than 30%.

8. For count rates greater than 500 CPM, notify chemical engineer assoc, or chemical engineer for percent deviations greater than 10%.

1272 037

Section C.6

C. RD-36-01 Particulate β Detector Sensitivities

Radionuclides	Sensitivities[d] 8CFM	Sensitivities[d] 10 CFM	Half Life
Barium - 139	1.03E12	1.08E12	1.38 hours
Barium - 140	9.97E11	1.07E12	307.2 hours
Cesium - 134	7.35E11	7.74E11	1.82E4 hrs
Cesium - 136	6.26E11	7.69E11	314.4 hrs
Cesium - 137	9.45E11	1.037E12	2.645E5 hrs
Cesium - 138	9.77E11	1.03E12	0.503 hrs
Cobalt - 58	1.32E11	1.52E11	1699.2 hrs
Cobalt - 60	5.8E11	7.2E11	4.62E4 hrs
Fluorine - 18	9.86E11	1.03E12	1.83 hrs
Iodine - 131	9.6E11	1.01E12	192.96 hrs
Iodine - 132	1.017E12	1.069E12	2.03 hrs
Iodine - 134	1.0E12	1.07E12	0.943 hrs
Iodine - 135	1.076E12	1.15E12	6.61 hrs
Iron - 59	6.69E11	7.99E11	1070.4 hrs
Lanthanum - 140	1.03E12	1.09E12	42.2 hrs
Molybdenum - 99	1.12E12	1.20E12	66.0 hrs
Rubridium - 88	1.009E12	1.06E12	0.297 hrs
Zirconium - 95	7.14E11	8.87E11	1535.5 hrs
Yttrium - 99	6.26E11	7.69E11	1404.3 hrs

(c) Obtained from figure 18-C.6.

Notes: (c) Sensitivities were determined for the Beta decay (with intensities greater than one percent) of anticipated nuclides. The sensitivity for each Beta decay was multiplied by the beta decays intensity, and these products were summed, yeilding an overall sensitivity. Sensitivities for other nuclides may be determined from curve 18.C.6 and the nuclides. Beta decay energy and respective intensities. Information supplied by "Nuclear Decay Data for Radionuclides occurring in routine releases from Nuclear Fuel Cycle Facilities" (August 1977), prepared by Oak Ridge National Laboratory.

(d) Figure 18-C.6 - sensitivities are based on monitor flow rate of 8 or 10 CFM operating in fixed filter mode for 1 hour(units for sensitivity are (CPM/(μCi/CC))

1272 038

Section C.6
Worksheet 18.C.6.1

CALIBRATION WORKSHEET NO. 18.6-1
((RD-36-01) Particulate Monitors)

Monitor ________
Date ________
Time ________

1. Monitor reading at time of sampling: ________ CPM

2. Average monitor flow rate during ________ ft^3/min sample duration, from SI-2.

3.

Identified Nuclides	Nuclide Activity (μCi/CC)		Nuclide[(e)] Count Rate (CPM)
Ba - 140		=	
Cs - 137		=	
Co - 58		=	
Co - 60		=	
Fe - 59		=	
I - 131		=	

4. Total ________ CPM

NOTE: (e) Count rate calculated by formula in section C.6 (B.4)

5. Expected count rate = total CPM + background
= (#4) + 100 CPM
= ________ CPM

6. Calculate monitors percent deviation:

$$\% \text{ deviation} = \frac{\text{Calculated CPM} - \text{Actual CPM}}{\text{Calculated CPM}} \times 100$$

$$= \frac{(\#\,5) - (\#\,1)}{(\#\,5)} \times 100$$

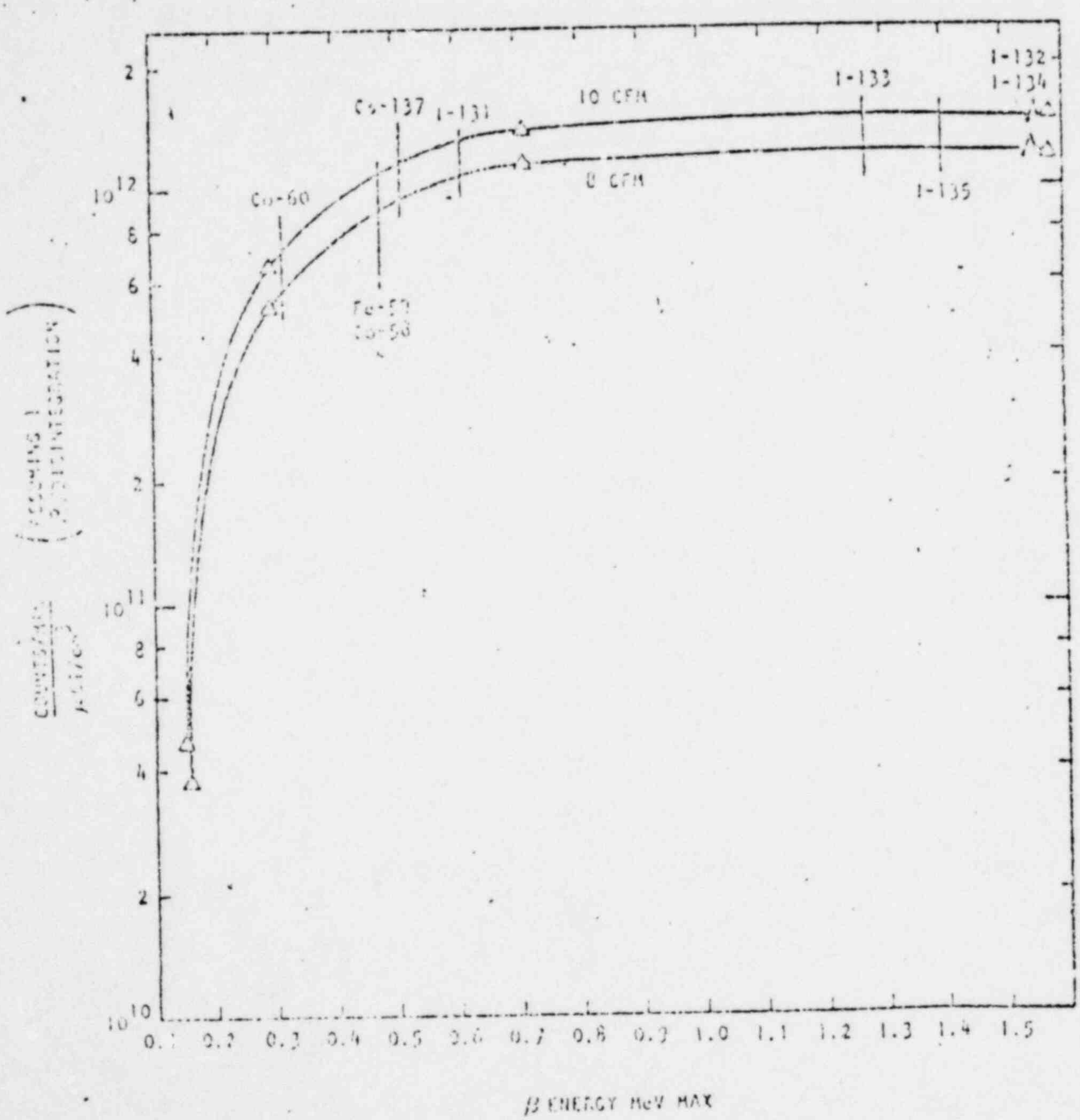
= ________ %

Lab Analyst ________/________ 1272 039

Chemical Eng. ASsoc. ________/________

Approved By Chemical Engineer ________/________

Section C.6



RD-36 particulate detector: count rates operating at 1 in./hr after 2 hr min or operating in fixed filter mode for 1 hr.

General Atomics Calibration Report E-199-349 (March 1974)

1272 040

RD-33 γ DETECTOR

Monitors:			
	1-RM-90-120(E)	2-RM-90-123(P)	0-RM-90-141(E)
	2-RM-90-120(E)	1-RM-90-124(P)	1-RM-90-170(P)
	1-RM-90-121(E)	2-RM-90-124(P)	2-RM-90-170(P)
	2-RM-90-121(E)	0-RM-90-133(E)	0-RM-90-211(E)
	0-RM-90-122(E)	0-RM-90-134(E)	0-RM-90-212(E)
	0-RM-90-123(P)	0-RM-90-140(E)	0-RM-90-225(E)
	1-RM-90-123(P)		

Note: P = Process E = Effluent

A. Setpoint Calculation

1. Obtain liquid sample of medium per TI-16.
2. Count sample according to TI-12, method B.5.
3. Complete Worksheet No. 18-C.7A. Calculate setpoint count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides.

B. Detector Efficiency Verification

1. Obtain liquid sample of medium per TI-16 and record the appropriate monitor's count rate at time of sampling.
2. Count sample according to TI-12, method B.5.
3. Complete Worksheet No. 18-C.7B. Calculate expected count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides. Compare with monitor count rate at time of sampling. Calculate percent deviation.

NOTES: [a] Sensitivities were determined for the gamma rays (with intensities greater than one percent) of anticipated nuclides. The sensitivity for each gamma ray was multiplied by the gamma ray's intensity, and these products were summed, yielding an overall sensitivity. Sensitivities for these and other nuclides may be determined from Figure 18-C.7 and the nuclide's gamma rays and respective intensities Information supplied by "Nuclear Decay Data for Radionuclides Occurring in Routine Releases from Nuclear Fuel Cycle Facilities" (August 1977, prepared by Oak Ridge National Laboratory) and General Atomics Calibration Reports (February 1976).

1272 041

Worksheet No. 18-C.7A

Setpoint Calculation Worksheet
(Liquid γ Detector; RD-33)

Monitor ______ ______________ Date __________ Time __________

1. Sample activity corrected to sample time.

Isotope Concentration		Monitor Sensitivity-Isotope[a]			Isotopic Computed Monitor Response
________ μCi/cc	Sb-122	X 3.01E08 CPM/μCi/cc	(Sb-122)	=	________ CPM
________ μCi/cc	Sb-124	X 6.65E06 CPM/μCi/cc	(Sb-124)	=	________ CPM
________ μCi/cc	Ba-140	X 1.34E08 CPM/μCi/cc	(Ba-140)	=	________ CPM
________ μCi/cc	Ce-144	X 3.65E07 CPM/μCi/cc	(Ce-144)	=	________ CPM
________ μCi/cc	Cs-134	X 8.79E08 CPM/μCi/cc	(Cs-134)	=	________ CPM
________ μCi/cc	Cs-137	X 3.41E08 CPM/μCi/cc	(Cs-137)	=	________ CPM
________ μCi/cc	Cr-51	X 4.08E07 CPM/μCi/cc	(Cr-51)	=	________ CPM
________ μCi/cc	Co-58	x 5.06E08 CPM/μCi/cc	(Co-58)	=	________ CPM
________ μCi/cc	Co-60	X 6.48E08 CPM/μCi/cc	(Co-60)	=	________ CPM
________ μCi/cc	F-18	X 8.03E08 CPM/μCi/cc	(F-18)	=	________ CPM
________ μCi/cc	I-131	X 4.02E08 CPM/μCi/cc	(I-131)	=	________ CPM
________ μCi/cc	I-133	X 4.06E08 CPM/μCi/cc	(I-133)	=	________ CPM
________ μCi/cc	I-135	X 3.99E08 CPM/μCi/cc	(I-135)	=	________ CPM
________ μCi/cc	Fe-59	X 3.47E08 CPM/μCi/cc	(Fe-59)	=	________ CPM
________ μCi/cc	La-140	X 7.05E08 CPM/μCi/cc	(La-140)	=	________ CPM
________ μCi/cc	Mn-54	X 3.80E08 CPM/μCi/cc	(Mn-54)	=	________ CPM
________ μCi/cc	Mn-56	X 4.82E08 CPM/μCi/cc	(Mn-56)	=	________ CPM
________ μCi/cc	Mo-99	X 1.19E08 CPM/μCi/cc	(Mo-99)	=	________ CPM
________ μCi/cc	Nb-95	X 3.89E08 CPM/μCi/cc	(Nb-95)	=	________ CPM
________ μCi/cc	Na-24	X 5.20E08 CPM/μCi/cc	(Na-24)	=	________ CPM
________ μCi/cc	Tc-99m	X 3.09E08 CPM/μCi/cc	(Tc-99m)	=	________ CPM
________ μCi/cc	Xe-133	X 1.85E07 CPM/μCi/cc	(Xe-133)	=	________ CPM
________ μCi/cc	Xe-135	X 3.80E08 CPM/μCi/cc	(Xe-135)	=	________ CPM
________ μCi/cc	Zn-65	X 1.88E08 CPM/μCi/cc	(Zn-65)	=	________ CPM
________ μCi/cc	Zr-95	X 3.89E08 CPM/μCi/cc	(Zr-95)	=	________ CPM
________ μCi/cc	Ru-103	X 3.80E08 CPM/μCi/cc	(Ru-103)	=	________ CPM
________ μCi/cc	(______)	X (________) CPM/μCi/cc	(______)	=	________ CPM
________ μCi/cc	(______)	X (________) CPM/μCi/cc	(______)	=	________ CPM
________ μCi/cc	(______)	X (________) CPM/μCi/cc	(______)	=	________ CPM

2. (Total Calculated) = ________ CPM

[a] Obtained from Figure 18-C.7. (Summary of isotopic energies multiplied by their respective isotope (major peaks) percent abundances).

Date __________ Time __________

3. For monitor(s) 1-RM-90-120(E)
2-RM-90-120(E)
1-RM-90-121(E)
2-RM-90-121(E)
0-RM-90-122(E) 0-RM-90-225(E)

NOTE: E = Effluent

The setpoint will be ≥ 1.25[1] X Total calculated (from Step No. 2).
Setpoint for monitor ____-RM-90-____ is: 1.25 X ________ CPM = ________CPM
Background = +______________ CPM
Total ____________CPM

(a) For monitor(s) 0-RM-90-123(P) 2-RM-90-124(P)
1-RM-90-123(P) 1-RM-90-170(P) 0-RM-90-134(E)
2-RM-90-123(P) 2-RM-90-170(P) 0-RM-90-140(E)
1-RM-90-124(P) 0-RM-90-133(E) 0-RM-90-141(E)
0-RM-90-212(E)

The setpoint will be 1.00 X Total Calculated (From Step No. 2).
Setpoint for monitor ___________ is: 1.00 X ________CPM = ___________CPM
Background = +________________CPM
Total =________________CPM

(b) For monitor 0-RM-90-211 the setpoint will be 0.90 X Total Calculated (From Step No. 2).
Setpoint for monitor 0-RM-90-211 is: 0.90 X ______ CPM = ___________CPM
Background = +________________CPM
Total =________________CPM

NOTES:

(1) Scaling factor to prevent alarms/trips due to variations in the effluent concentrations at the release point.
This cannot be changed without the prior approval of the lead or cognizant chemical engineer and noted in the remarks section of worksheet.

_________________________ Lab Analyst ________ Date _______________ Chem. Engr. Assoc. ________ Date

Remarks: ____

____

1272 043

Worksheet No. 18-C.7B

Detector Efficiency Verification Worksheet
(Liquid γ Detector; RD-33)

Monitor ____________________ Date __________ Time __________

1. Sample activity corrected to sample time. Obtain Count Rate.

Isotope Concentration	Monitor Sensitivity-Isotope[a]		Isotopic Computed Monitor Response
________ μCi/cc	Sb-122 X 3.01E08 CPM/μCi/cc	(Sb-122) =	________ CPM
________ μCi/cc	Sb-124 X 6.65E08 CPM/μCi/cc	(Sb-124) =	________ CPM
________ μCi/cc	Ba-140 X 1.34E08 CPM/μCi/cc	(Ba-140) =	________ CPM
________ μCi/cc	Ce-144 X 3.65E07 CPM/μCi/cc	(Ce-144) =	________ CPM
________ μCi/cc	Cs-134 X 8.79E08 CPM/μCi/cc	(Cs-134) =	________ CPM
________ μCi/cc	Cs-137 X 3.41E08 CPM/μCi/cc	(Cs-137) =	________ CPM
________ μCi/cc	Cr-51 X 4.08E07 CPM/μCi/cc	(Cr-51) =	________ CPM
________ μCi/cc	Co-58 x 5.06E08 CPM/μCi/cc	(Co-58) =	________ CPM
________ μCi/cc	Co-60 X 6.48E08 CPM/μCi/cc	(Co-60) =	________ CPM
________ μCi/cc	F-18 X 8.03E08 CPM/μCi/cc	(F-18) =	________ CPM
________ μCi/cc	I-131 X 4.02E08 CPM/μCi/cc	(I-131) =	________ CPM
________ μCi/cc	I-133 X 4.06E08 CPM/μCi/cc	(I-133) =	________ CPM
________ μCi/cc	I-135 X 3.99E08 CPM/μCi/cc	(I-135) =	________ CPM
________ μCi/cc	Fe-59 X 3.[illegible]7E08 CPM/μCi/cc	(Fe-59) =	________ CPM
________ μCi/cc	La-140 X 7.05E08 CPM/μCi/cc	(La-140) =	________ CPM
________ μCi/cc	Mn-54 X 3.80E08 CPM/μCi/cc	(Mn-54) =	________ CPM
________ μCi/cc	Mn-56 X 4.82E08 CPM/μCi/cc	(Mn-56) =	________ CPM
________ μCi/cc	Mo-99 X 1.19E08 CPM/μCi/cc	(Mo-99) =	________ CPM
________ μCi/cc	Nb-95 X 3.89E08 CPM/μCi/cc	(Nb-95) =	________ CPM
________ μCi/cc	Na-24 X 5.20E08 CPM/μCi/cc	(Na-24) =	________ CPM
________ μCi/cc	Tc-99m X [illegible].09E08 CPM/μCi/cc	(Tc-99m) =	________ CPM
________ μCi/cc	Xe-133 X 1.85E07 CPM/μCi/cc	(Xe-133) =	________ CPM
________ μCi/cc	Xe-135 X 3.80E08 CPM/μCi/cc	(Xe-135) =	________ CPM
________ μCi/cc	Zn-65 X 1.88E08 CPM/μCi/cc	(Zn-65) =	________ CPM
________ μCi/cc	Zr-95 X 3.89E08 CPM/μCi/cc	(Zr-95) =	________ CPM
________ μCi/cc	Ru-103 X 3.80E08 CPM/μCi/cc	(Ru-103) =	________ CPM
________ μCi/cc	(______) X ________ CPM/μCi/cc	(______) =	________ CPM
________ μCi/cc	(______) X ________ CPM/μCi/cc	(______) =	________ CPM
________ μCi/cc	(______) X ________ CPM/μCi/cc	(______) =	________ CPM

2. (Total Calculated) = ________ CPM

[a] Obtained from Figure 18-C.7 (Summing of isotopic energies multipled by their respective isotope (major peaks) percent abundance).

1272 044

Date __________ Time __________

3. Monitor __________ Reading at time of sampling: __________CPM (Less Background).

4. Calculate monitor's percent deviation from calculated value:

$$\% \text{ Deviation} = \frac{(\text{Value in Step No. 2}) - (\text{Value in Step No. 3})}{(\text{Value in Step No. 2})} \times 100 = \_\_\_\_\_\_ \% \text{ (a),(b)}$$

NOTES: (a) For count rates 10-500 CPM, notify Chemical Engineering Associate or Chemical Engineer for percent deviations greater than 30%.

(b) For count rates greater than 500 CPM, notify Chemical Engineering Associate or Chemical Engineer for percent deviations greater than 10%.

Analyst	Date	Chem. Engr. Associate	Date

Remarks: ____

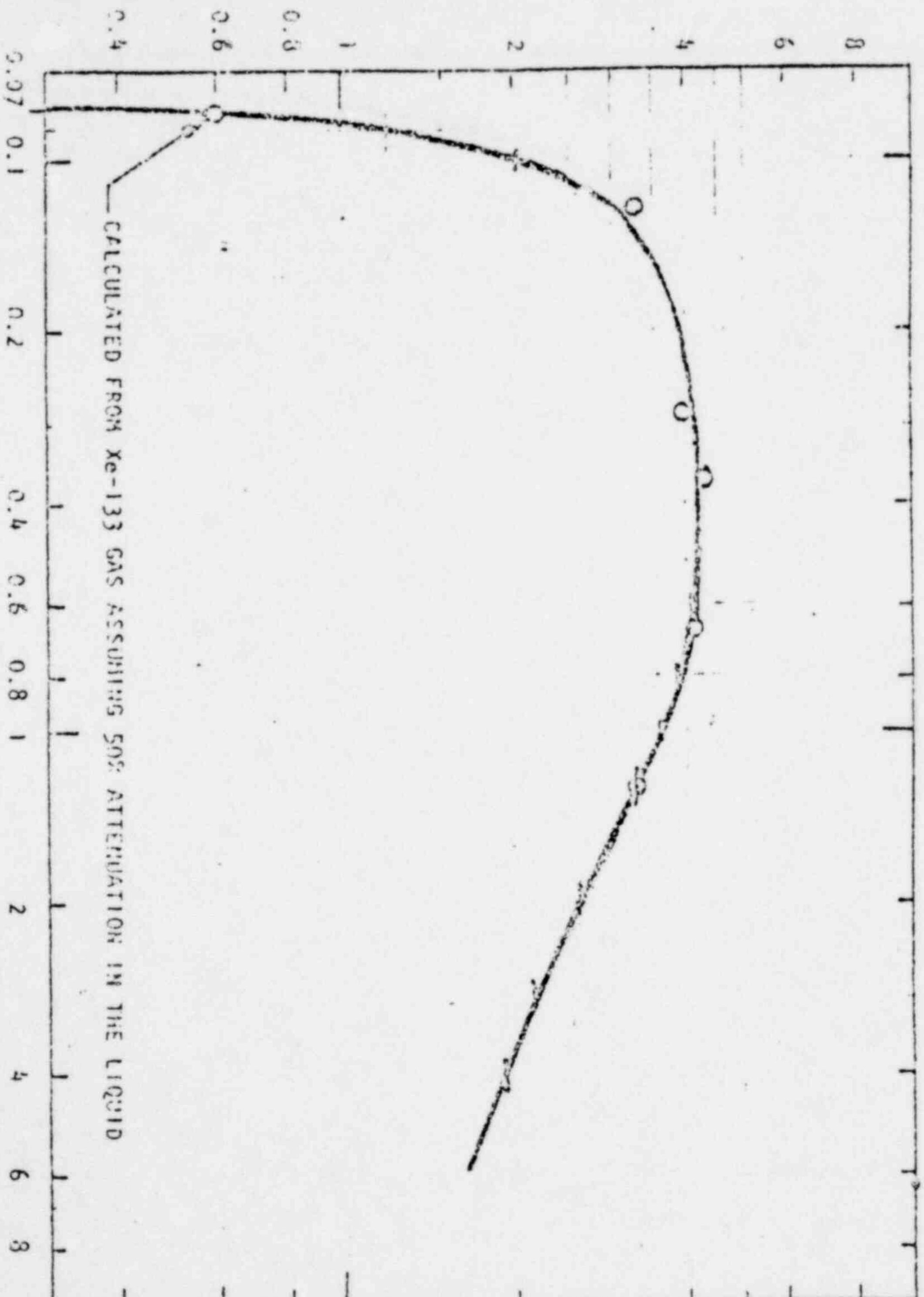
____

____

1272 045

FIGURE 18-C.7

(COUNTS/MIN)/(μCi/ml) X 10^8
(ASSUMING ONE GAMMA/DISINTEGRATION)



GAMMA RAY ENERGY, MeV

RD-33 Offline Gamma Detector Sensitivity to Liquid Effluent

General Atomics Calibration Report E-199-352 (February 1976)

1272 046

POOR ORIGINAL

RD-33-06 γ DETECTOR

Monitors: 1-RM-90-104(P) 2-RM-90-104(P)

NOTE: P = Process

A. Setpoint Determination

1. Setpoint is to reflect any detection of failed fuel in the primary coolant and remain above expected activity levels as the life of the core progresses. The alarm will be arbitrarily set amid scale (10^4 CPM) initially and readjustment based on operating experience.

B. Detector .iciency Verification

1. Obtain liquid sample of coolant letdown per TI-16, and record the monitor count rate at the time of sampling.

2. Count sample according to TI-12, method B.5.

3. Complete Worksheet No. 18-C.8B. Calculate expected count rate by multiplying nuclide concentration by its sensitivity[a] and summing for all detected nuclides. Compare with monitor count rate at time of sampling. Calculate percent deviation.

NOTES: [a] Sensitivies were determined for the gamma rays (with intensities greater than 1 percent) of participated nuclides. The sensitivity for each gamma ray was multiplied by the gamma ray's intensity, and these products were summed, yielding an overall sensitivity. Sensitivities for other nuclides may be determined from Figure 18-C.8 and the nuclide's gamma rays and respective intensities. Information supplied by Nuclear decay data for Radionuclies occurring in routine releases from nuclear fuel cycle facilities" (August 1977, prepared by Oak Ridge National Laboratory) and General Atomics Calibration Report (July 1975).

1272 047

Worksheet No. 18-C.8A

Setpoint Calculation Worksheet
(Liquid γ Detector; RD-33-06)

Monitor ____________________ Date __________ Time __________

1. Sample activity corrected to sample time.

Isotope Concentration			Monitor Sensitivity-Isotope[a]			Isotopic Computed Monitor Response
________ μCi/cc	Sb-122	X	2.57E05 CPM/μCi/cc	(Sb-122)	=	________ CPM
________ μCi/cc	Sb-124	X	6.04E05 CPM/μCi/cc	(Sb-124)	=	________ CPM
________ μCi/cc	Ba-140	X	1.14E04 CPM/μCi/cc	(Ba-140)	=	________ CPM
________ μCi/cc	Ce-144	X	2.54E04 CPM/μCi/cc	(Ce-144)	=	________ CPM
________ μCi/cc	Cs-134	X	7.81E05 CPM/μCi/cc	(Cs-134)	=	________ CPM
________ μCi/cc	Cs-137	X	3.01E05 CPM/μCi/cc	(Cs-137)	=	________ CPM
________ μCi/cc	Cr-51	X	3.45E04 CPM/μCi/cc	(Cr-51)	=	________ CPM
________ μCi/cc	Co-58	x	4.46E05 CPM/μCi/cc	(Co-58)	=	________ CPM
________ μCi/cc	Co-60	X	6.04E05 CPM/μCi/cc	(Co-60)	=	________ CPM
________ μCi/cc	F-18	X	6.96E05 CPM/μCi/cc	(F-18)	=	________ CPM
________ μCi/cc	I-131	X	3.43E05 CPM/μCi/cc	(I-131)	=	________ CPM
________ μCi/cc	I-133	X	3.56E05 CPM/μCi/cc	(I-133)	=	________ CPM
________ μCi/cc	I-135	X	3.67E05 CPM/μCi/cc	(I-135)	=	________ CPM
________ μCi/cc	Fe-58	X	3.18E05 CPM/μCi/cc	(Fe-59)	=	________ CPM
________ μCi/cc	La-140	X	6.45E05 CPM/μCi/cc	(La-140)	=	________ CPM
________ μCi/cc	Mn-54	X	3.39E05 CPM/μCi/cc	(Mn-54)	=	________ CPM
________ μCi/cc	Mn-56	X	4.42E05 CPM/μCi/cc	(Mn-56)	=	________ CPM
________ μCi/cc	Mo-99	X	9.95E04 CPM/μCi/cc	(Mo-99)	=	________ CPM
________ μCi/cc	Nb-95	X	3.47E05 CPM/μCi/cc	(Nb-95)	=	________ CPM
________ μCi/cc	Na-24	X	5.23E05 CPM/μCi/cc	(Na-24)	=	________ CPM
________ μCi/cc	Tc-99m	X	2.18E05 CPM/μCi/cc	(Tc-99m)	=	________ CPM
________ μCi/cc	Xe-135	X	3.12E05 CPM/μCi/cc	(Xe-135)	=	________ CPM
________ μCi/cc	Zn-65	X	1.69E05 CPM/μCi/cc	(Zn-65)	=	________ CPM
________ μCi/cc	Zr-95	X	3.47E05 CPM/μCi/cc	(Zr-95)	=	________ CPM
________ μCi/cc	Ru-103	X	3.30E05 CPM/μCi/cc	(Ru-103)	=	________ CPM
________ μCi/cc	(______)	X	______ CPM/μCi/cc	( )	=	________ CPM
________ μCi/cc	(______)	X	______ CPM/μCi/cc	( )	=	________ CPM
________ μCi/cc	(______)	X	______ CPM/μCi/cc	( )	=	________ CPM

2. (Total Calculated) = ________ CPM

[a] Obtained from Figure 18-C.8. (Summing of isotopic energies multiplied by their major peaks respective isotope percent abundances).

1272 048

WORKSHEET NO. 18-C.8A

Date__________ Time__________

3. For Monitor(s) 1-RM-90-104
   2-RM-90-104

The setpoint will be 1.00 X Total Calculated (From Step No. 2).
Setpoint for monitor ___-RM-90-104 is: (1.00) X (__________CPM) = __________CPM

__________________ Lab Analyst __________ Date __________________ Chem. Engr. Associate __________ Date

Remarks:____

____

Worksheet No. 18-C.8B

Detector Efficiency Verification Worksheet
(Liquid γ Detector; RD-33-06)

Monitor ________________ Date ________ Time ________

1. Sample activity corrected to sample time. Obtain count rate.

Isotope Concentration		Monitor Sensitivity-Isotope[a]				Isotopic Computed Monitor Response	
________	μCi/cc	Sb-122	X 2.57E05	CPM/μCi/cc	(Sb-122) =	________	CPM
________	μCi/cc	Sb-124	X 6.04E05	CPM/μCi/cc	(Sb-124) =	________	CPM
________	μCi/cc	Ba-140	X 1.14E04	CPM/μCi/cc	(Ba-140) =	________	CPM
________	μCi/cc	Ce-144	X 2.54E04	CPM/μCi/cc	(Ce-144) =	________	CPM
________	μCi/cc	Cs-134	X 7.81E05	CPM/μCi/cc	(Cs-134) =	________	CPM
________	μCi/cc	Cs-137	X 3.01E05	CPM/μCi/cc	(Cs-137) =	________	CPM
________	μCi/cc	Cr-51	X 3.45E04	CPM/μCi/cc	(Cr-51) =	________	CPM
________	μCi/cc	Co-58	x 4.46E05	CPM/μCi/cc	(Co-58) =	________	CPM
________	μCi/cc	Co-60	X 6.04E05	CPM/μCi/cc	(Co-60) =	________	CPM
________	μCi/cc	F-18	X 6.96E05	CPM/μCi/cc	(F-18) =	________	CPM
________	μCi/cc	I-131	X 3.43E05	CPM/μCi/cc	(I-131) =	________	CPM
________	μCi/cc	I-133	X 3.56E05	CPM/μCi/cc	(I-133) =	________	CPM
________	μCi/cc	I-135	X 3.67E05	CPM/μCi/cc	(I-135) =	________	CPM
________	μCi/cc	Fe-58	X 3.18E05	CPM/μCi/cc	(Fe-59) =	________	CPM
________	μCi/cc	La-140	X 6.45E05	CPM/μCi/cc	(La-140) =	________	CPM
________	μCi/cc	Mn-54	X 3.39E05	CPM/μCi/cc	(Mn-54) =	________	CPM
________	μCi/cc	Mn-56	X 4.42E05	CPM/μCi/cc	(Mn-56) =	________	CPM
________	μCi/cc	Mo-99	X 9.95E04	CPM/μCi/cc	(Mo-99) =	________	CPM
________	μCi/cc	Nb-95	X 3.47E05	CPM/μCi/cc	(Nb-95) =	________	CPM
________	μCi/cc	Na-24	X 5.23E05	CPM/μCi/cc	(Na-24) =	________	CPM
________	μCi/cc	Tc-99m	X 2.18E05	CPM/μCi/cc	(Tc-99m) =	________	CPM
________	μCi/cc	Xe-135	X 3.12E05	CPM/μCi/cc	(Xe-135) =	________	CPM
________	μCi/cc	Zn-65	X 1.69E05	CPM/μCi/cc	(Zn-65) =	________	CPM
________	μCi/cc	Zr-95	X 3.47E05	CPM/μCi/cc	(Zr-95) =	________	CPM
________	μCi/cc	Ru-103	X 3.30E05	CPM/μCi/cc	(Ru-103) =	________	CPM
________	μCi/cc	(______)	X ______	CPM/μCi/cc	(______) =	________	CPM
________	μCi/cc	(______)	X ______	CPM/μCi/cc	(______) =	________	CPM
________	μCi/cc	(______)	X ______	CPM/μCi/cc	(______) =	________	CPM

2. (Total Calculated) = ________ CPM

[a] Obtained from Figure 18-C.8. (Summing of isotopic energies multiplied by their respective major peak(s) isotope percent abundances).

1272 050

Worksheet No. 18-C.8B

Date_________Time_________

3. Monitor ____-RM-90-104 reading at time of sampling: ________ CPM (less background)

4. Calculate monitor's percent deviation from calculated value:

$$\% \text{ deviation} = \frac{(\text{Value in No. 2}) - (\text{Value in No. 3})}{(\text{Value in No. 2})} \times 100 = \_\_\_\_\_\_\_\_\%$$

NOTES: (1) For count rates 10 - 500 CPM, notify Chemical Engineering Associate. or Chemical Engineer for percent deviations greater than 30 percent.

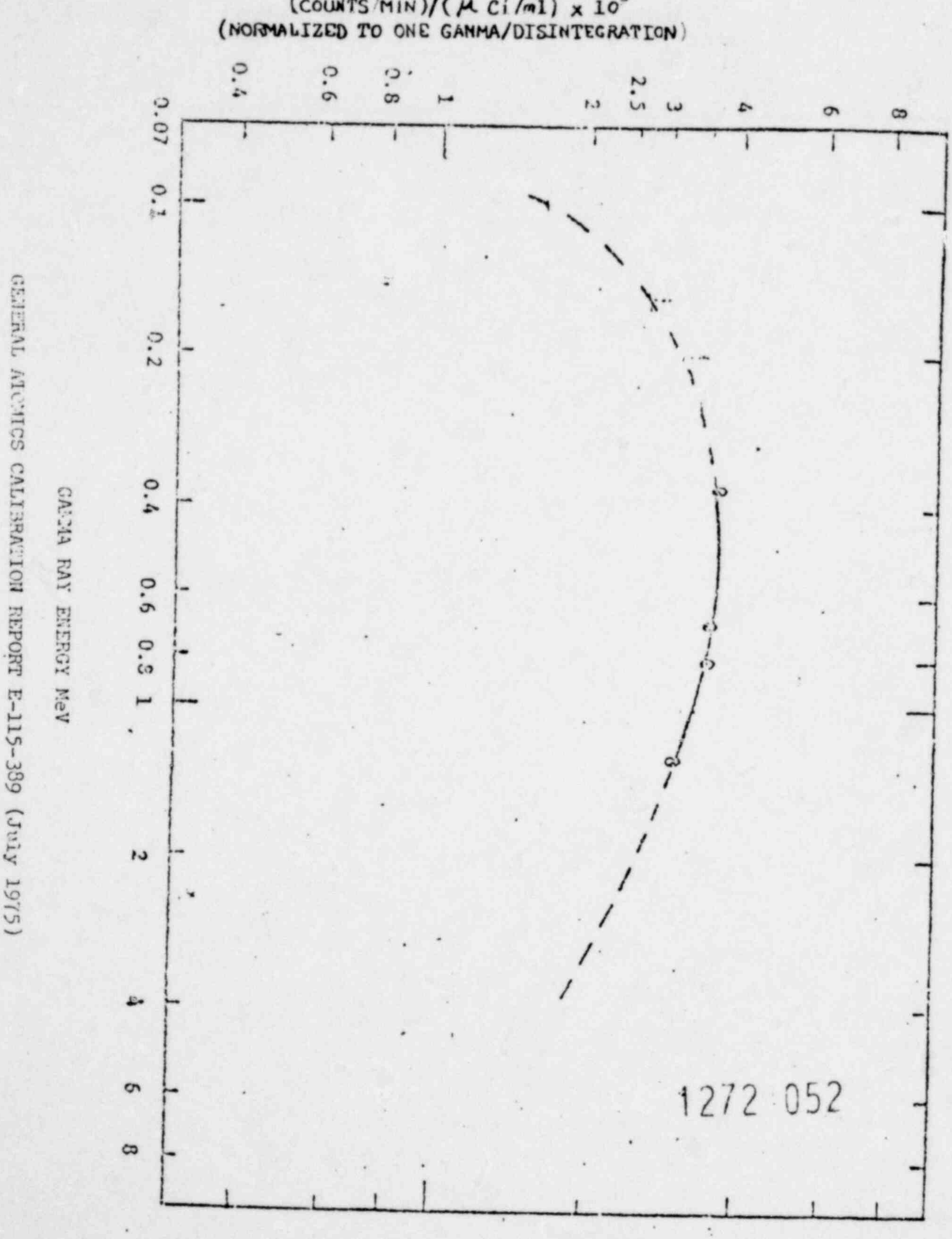
(2) For count rates greater than 500 CPM, notify Chemical Engineering Associate or Chemical Engineer for percent deviations greater than 10 percent.

1272 051

Lab Aanalyst	Date	Chem. Engr. Associate	Date

Remarks:____

Figure 18-C.8



1272 052

POOR ORIGINAL

D. Liquid Release Records. Batch and Continuous Releases.

Attachment A is to number and to chronologically list releases - Batch and Continuous.

Attachment B is to number and to chronologically list all releases for a particular tank (separate sheet for each tank)

1. Evaluate the release permit number to be assigned to the (batch or continuous) liquid release by obtaining the next sequential number from Attachment A logsheet being used and log on an appropriate SI and TI-18 Attachments A and B. The release permit number is evaluated using the following numbered sequential formula:

   (1) - (2) - (3) - (4)

   Release Permit Number = (XX) - (XXXXX), (XX) - (XXX)

   (1) Current Year (i.e. 79, 80, 81, . . .)
   (2) Sequential Number of Total Plant Releases
   (3) Tank Number

      01 Laundry and Hot Shower Tank "A"
      02 Laundry and Hot Shower Tank "B"
      03 Chemical Drain Tank
      04 Waste Condensate Tank "A"
      05 Waste Condensate Tank "B"
      06 Waste Condensate Tank "C"
      07 Monitor Tank
      08 Cask Decontamination Collector Tank
      09 High Crud Tank "A"
      10 High Crud Tank "B"
      11 Non-Reclaimable Waste Tank
      12 Waste Evaporator Distillate Tank "A"
      13 Waste Evaporator Distillate Tank "B"
      14 U1 Steam Generator Blowdown Flash Tank
      15 U2 Steam Generator Blowdown Flash Tank
      16 CDWE Blowdown Tank

   (4) Sequential Number of Individual Tank Releases

1272 053

ATTACHMENT A
Liquid-Batch and Continuous Releases

Release Permit Number XX-XX-XXXXX-XXX	Date	Time Start	Time Stop	Maximum Allowable Flow(GPM)	Dilution Flow (GPM)	Volume Released (GAL)	Total MPC Before Release	Fraction After Release	Total Release Activity(Ci)	Analyst

ATTACHMENT B

Tank ______________________ Tank Number ____________________

Liquid-Batch and Continuous Releases

Release Permit Number XXXXXXXXXXXX	Date	Time Start	Time Stop	Maximum Allowable Flow(GPM)	Dilution Flow (GPM)	Volume Released (GAL)	Total MPC Before Release	Fraction After Release	Total Release Activity(Ci)	Analyst

1272 055

E. Gaseous Release Record - Batch (Gas Decay Tank Releases)

Evaluate the release permit number to be assigned to the batch gaseous release (gas decay tank or containment purge) by obtaining the next sequential release number from Attachment C logsheet being used and log on appropriate SI and TI-18 Attachment C. The release permit number is evaluated using the following numbered sequential formula.

Rlease Permit Number = (XX) - (XXXX) - (XX) - (XXX)
(1) (2) (3) (4)

(1) Current Year (i.e. 79, 80, 81 . . .)
(2) Sequential Release Number (Total for Plant)
(3) Gas Decay Tank (A, B, C, . . .) or Containment Purge (P)
(4) Sequential Release Number (for individual tank)

1272 056

ATTACHMENT C
GASEOUS RADWASTE - BATCH RELEASES

Release Permit Number XX-XXXX-X-XXX	Date Start	Time Start XXXX	Date Stop	Time Stop XXXX	Max.Allowable Flowrate (CFM)	Monitor Setpoint (μCi/cc)	Total Curies Released (Ci)	Cumulative Curies Release (Ci)	Analyst

1272 057

J. R. Calhoun, Director of Nuclear Power, 716 EB, C

G. F. Stone, Acting Director of Occupational Health and Safety, ROB, M

September 28, 1979

SEQUOYAH NUCLEAR PLANT ENVIRONMENTAL TECHNICAL SPECIFICATIONS

This is in response to your memorandum of September 19, 1979. Attached are the revised calculations of maximum instantaneous plant gaseous release rate limits for SQN which include limits for the service building. These release rates have been back-calculated from 10CFR20 dose limits of 500 mrem/yr to the total body from noble gases and 1,500 mrem/yr to the thryoid from iodines and particulates. Due to the addition of the service building releases, release rate limits for the containment, auxiliary, and turbine buildings are approximately 99 percent of those which were transmitted from E. A. Belvin to H. J. Green on March 29, 1979. Because the dose rates at any time, due to radioactive materials release in gaseous effluents from the site, shall be limited to the above values (Specification-tion 3.11.2.1, NUREG-0472, Draft Radiological Effluent Technical Specification for PWR's), the attached release rates represent upper limits which should not be exceeded. However, the plant will not be in violation of Specification 3.11.2.1 unless the instantaneous total plant release rate exceeds the total plant release rate limit specified in the attachments. Where automatic isolation does not exist, the actual monitor alarm set-points should be set at some fraction of the above values. This should be done to assure that total plant releases do not at any instant exceed the above limits. In all cases, detector fluctuations (e.g., voltage variation) should be considered when calculating the setpoints. Please address questions to Regis Nicoll or Rod Reed at extension 2767.

G. F. Stone

RMN:SH
Attachments
cc (Attachments):
ARMS PP, 823 EB-C
J. M. Ballentine, SQN
E. F. Thomas, 550 CST2, C
L. M. Mills, 400 CST2, C
D. R. Patterson, W10C126 C, K

bc (Attachments):
John Dills, SQN
Ronnie Kitts, SQN
R. B. Maxwell, ROB, M
M. L. Rollins, 401 KB, C

1272 058

TABLE 1

SQN MAXIMUM INSTANTANEOUS PLANT RELEASE RATE LIMITS FOR 10CFR20 COMPLIANCE[a]

NOBLE GASES

(μCi/s)

Nuclide	Containment Building	Auxiliary Building	Turbine Building	Service Building	Total
Ar-41	1.8E+03	-	-	1.8E+01	1.8E+03
Kr-85m	1.7E+02	1.6E+02	1.1E+02	4.5E+00	4.4E+02
Kr-85	3.7E+04	1.4E+02	9.1E+01	3.7E+02	3.8E+04
Kr-87	6.0E+01	8.7E+01	6.0E+01	2.1E+00	2.1E+02
Kr-88	2.6E+02	3.0E+02	2.0E+02	7.6E+00	7.7E+02
Kr-89	6.1E-01	2.0E+00	4.7E+00	7.3E-02	7.4E+00
Xe-131m	1.9E+03	1.2E+02	8.0E+01	2.2E+01	2.1E+03
Xe-133m	1.2E+03	2.7E+02	1.8E+02	1.7E+01	1.7E+03
Xe-133	1.8E+05	2.1E+04	1.4E+04	2.1E+03	2.2E+05
Xe-135m	5.8E+00	1.4E+01	1.5E+01	3.4E-01	3.5E+01
Xe-135	7.3E+02	5.1E+02	3.3E+02	1.6E+01	1.6E+03
Xe-137	1.3E+00	4.2E+00	8.7E+00	1.4E-01	1.4E+01
Xe-138	1.8E+01	4.3E+01	4.6E+01	1.1E+00	1.1E+02
Total	2.2E+05	2.3E+04	1.5E+04	2.6E+03	2.6E+05

a. Calculated for worst case land site boundary, N sector, 950 meters, where total body submersion dose equals 2.13E-01 mrem/yr.

1272 059

TABLE 2

SQN MAXIMUM INSTANTANEOUS PLANT RELEASE RATE[a] LIMITS FOR 10CFR20 COMPLIANCE IODINE AND PARTICULATES (μCi/s)

Nuclide	Containment Building	Auxiliary Building	Turbine Building	Service Building	Total
H-3	-	-	1.8E+03	1.8E+01	1.8E+03
C-14	2.7E+01	-	-	2.7E-01	2.7E+01
Cr-51	8.7E-07	6.7E-08	1.2E-06	2.2E-08	2.2E-06
Mn-54	1.0E-06	5.5E-08	1.5E-06	2.6E-08	2.6E-06
Fe-59	1.0E-06	7.2E-08	1.8E-06	3.0E-08	2.9E-06
Co-58	3.0E-07	1.8E-08	3.1E-05	3.1E-07	3.2E-05
Co-60	1.0E-06	5.3E-08	9.2E-07	2.0E-08	2.0E-06
Br-84	1.7E-05	1.2E-03	5.8E-05	1.3E-05	1.3E-03
Br-85	4.4E-07	4.0E-05	8.3E-07	4.1E-07	4.2E-05
Rb-88	7.0E-02	5.3E-02	3.5E-04	1.2E-03	1.3E-01
Sr-89	4.0E-07	2.6E-08	5.5E-07	9.7E-09	9.9E-07
Sr-90	1.5E-08	7.4E-10	2.9E-08	4.4E-10	4.5E-08
Sr-91	4.0E-08	5.0E-08	3.0E-07	3.9E-09	3.9E-07
Y-90	1.6E-08	1.3E-09	2.8E-08	4.5E-10	4.6E-08
Y-91m	2.5E-08	3.1E-08	1.4E-07	1.9E-09	2.0E-07
Y-91	2.4E-06	1.5E-07	6.4E-06	8.9E-08	9.0E-06
Y-93	8.2E-09	1.0E-08	1.2E-07	1.4E-09	1.4E-07
Zr-95	7.2E-08	4.4E-09	2.9E-07	3.6E-09	3.7E-07
Nb-95	7.3E-08	3.7E-09	2.8E-07	3.6E-09	3.6E-07
Mo-99	1.0E-04	3.4E-05	4.8E-04	6.2E-06	6.2E-04
Tc-99m	9.5E-05	3.0E-05	3.5E-04	4.7E-06	4.8E-04
Ru-106	1.4E-08	7.4E-10	2.9E-08	4.3E-10	4.3E-08
Te-132	6.8E-06	2.0E-06	7.0E-05	7.8E-07	8.0E-05
I-131	2.1E-02	7.6E-02	1.6E-02	1.1E-03	1.1E-01
MI-131	2.1E-02	7.6E-02	1.6E-02	1.1E-03	1.1E-01
I-132	6.3E-04	2.8E-02	4.4E-03	3.3E-04	3.3E-02
MI-132	6.3E-04	2.8E-02	4.4E-03	3.3E-04	3.3E-02
I-133	5.6E-03	1.1E-01	2.3E-02	1.4E-03	1.4E-01
MI-133	5.6E-03	1.1E-01	2.3E-02	1.4E-03	1.4E-01
I-134	1.8E-04	1.2E-02	8.5E-04	1.3E-04	1.3E-02
MI-134	1.8E-04	1.2E-02	8.5E-04	1.3E-04	1.3E-02
I-135	1.5E-03	5.5E-02	9.1E-03	6.6E-04	6.6E-02
MI-135	1.5E-03	5.5E-02	9.1E-03	6.6E-04	6.6E-02
Cs-134	3.6E-05	1.9E-06	2.2E-04	2.5E-06	2.6E-04
Cs-136	9.0E-06	9.7E-07	1.2E-04	1.3E-06	1.3E-04
Cs-137	2.6E-05	1.3E-06	1.8E-04	2.1E-06	2.1E-04
Ba-140	1.5E-07	1.6E-08	7.1E-07	8.7E-09	8.8E-07
La-140	1.6E-07	1.1E-08	4.8E-07	6.4E-09	6.6E-07
Ce-144	4.6E-08	2.4E-09	1.4E-07	1.9E-09	1.9E-07
Pr-143	3.8E-08	3.7E-09	1.4E-07	1.8E-09	1.8E-07
Pr-144	4.6E-08	2.6E-09	9.5E-08	1.4E-09	1.5E-07
Np-239	2.4E-07	9.0E-08	4.1E-06	4.5E-08	4.5E-06
Total	2.7E+01	6.2E-01	1.8E+03	1.8E+01	1.8E+03

1. Calculated for worst case land site boundary, N sector, 950 meters, where infant thyroid dose equals 1.39E+01 mrem/yr.

PLANT VENT FLOWRATES
(Maximum Design Flow)

Shield Building: 28,000 CFM (Each)

Auxiliary Building: 200,000 CFM

Service Building: 10,400 CFM (Monitored by radiation detector)

Condenser Vacuum Exhaust (Turbine Building): 100 CFM[1]

Gas Decay Tank Exhaust Header: 22.5 CFM

Reference: 47W866 Series

[1] Design maximum flowrate is 45 CFM - using value of 100 CFM for conservatism.

1272 061

RD-35 DETECTOR-IODINE SETPOINT CALCULATION EQUATIONS

Assume infinte number of layers of radioative material being deposited on monitoring medium. The summation of the product of the rate of accumulation A(t) and the rate of decay EXP(-Lt) is proportional to the monitor count rate.

1.a. $$\text{Counts} = \sum A(t_i)(\text{EXP}(-Lt_i)(\Delta t_i)$$

The limit of this summation as Δt_i approaches zero is the definite integral of the above mentioned product.

1.b. $$\text{LIM}_{i \to 0} \sum A(t)_i \ \text{EXP}(-Lt_i) \ \Delta t_i = \int A(t) \ \text{EXP}(-Lt)(dt) = \text{Counts}$$

Assume linear rate of accumulation over 1 week relative to reactor life. One week is normal sample period.

2. $$A(t) = \int_0^{t_s} f(t) \ dt$$

where $f(t) = A(t)$

Substitute Eq. in Step (2) into Eq. in Step (1.b)

3. $$\text{Counts} = \int_0^{t_s} A(t) \ \text{EXP}(-Lt) \ dt = A\int_0^{t_s}(t)(\text{EXP}(-Lt) \ (dt)$$

Integrate Eq. (3) by parts

Let $U = t$ $\quad dv = \text{EXP}(-Lt)dt$
$dU = dt$ $\quad v = \frac{-1}{L} \text{EXP}(-Lt)$

$$\int_0^{t_s} (t)(\text{EXP}(-Lt) \ (dt) = \int (-t)\left(\frac{1}{L}\right)\text{EXP}(-Lt) - \int -\left(\frac{1}{L}\right)\text{EXP} \ (-Lt) \ dt$$

$$= \left[\left(\frac{-t}{L}\right)\text{EXP} \ (-Lt) + \left(\frac{-1}{L^2}\right)\text{EXP} \ (-Lt)\right]_0^t$$

$$= \left(\left(\frac{-t_s}{L}\right)\text{EXP}(-Lt_s) - \left(\frac{\text{EXP}(-Lt_s)}{L^2}\right) - \left(0 - \left(\frac{1}{L^2}\right)\right)\right)$$

4. $$= \left(\frac{1}{L^2}\right) - \left(\frac{t_s\text{EXP}(-Lt_s)}{L}\right) - \left(\frac{\text{EXP}(-Lt_s)}{L^2}\right)$$

1272 062

where L (Lamda) = $\frac{LN(2)}{t(1/2)} = \frac{0.693}{8.04d} = 0.0862d^{-1}$

t_s = 7d   t(1/2) = Half Life I-131

Insert these values for L and t_s into Eq. in Step (4) and evaluate.

$$\int_0^{7d} (t)(\ EXP(-Lt))(dt) = 16.5d^2$$

5. The accumulation term is determined by the following equation.

$$A(t) = \frac{(\text{Max. instantaneous nuclide Conc.}) \times (\text{Monitor Efficiency}) \times (\text{Mon. Flowrate})}{(\text{Monitor Time})}$$

Assume exhaust concentration is equal to concentration in monitor sample stream.

The product of Eq. in Step (5) and Step (4) will given the desired concentration.

1272 063

SETPOINTS FOR RADIATION MONITORING

(I) Process and Effluent Monitor Setpoints in FSAR and Technical Specification (process/monitors) are tabulated as follows:

Monitor	Reference	Setpoint
RM-90-106	Table 3.3-6 (Tech.Spec)	1.95×10^{-2} μCi/cc - Noble Gas
RM-90-112	Table 3.3-6 (Tech.Spec)	1.95×10^{-2} μCi/cc - Noble Gas
RM-90-106	Table 3.3-6 (Tech.Spec)	1.5×10^{-5} μCi/cc - Particulate
RM-90-112	Table 3.3-6 (Tech.Spec)	1.5×10^{-5} μCi/cc - Particulate
RM-90-125	FSAR Section 11.4.2.2.5	1×10^{-5} μCi/cc Based on Xe-133
RM-90-126	FSAR Section 11.4.2.2.5	1×10^{-5} μCi/cc Based on Xe-133
RM-90-205	FSAR Section 11.4.2.2.5	1×10^{-5} μCi/cc Based on Xe-133
RM-90-206	FSAR Section 11.4.2.2.5	1×10^{-5} μCi/cc Based on Xe-133
RM-90-123	FSAR Section 11.4.2.1.3	1.5×10^{-6} μCi/cc Based on I-131
RM-90-124	FSAR Section 11.4.2.1.5	5.0×10^{-5} μCi/cc Based on I-131
RM-90-133	FSAR Section 11.4.2.1.2	1.5×10^{-6} μCi/cc Based on I-131
RM-90-134	FSAR Section 11.4.2.1.2	1.5×10^{-6} μCi/cc Based on I-131
RM-90-140	FSAR Section 11.4.2.1.2	1.5×10^{-6} μCi/cc Based on I-131
RM-90-141	FSAR Section 11.4.2.1.2	1.5×10^{-6} μCi/cc Based on I-131
RM-90-170	FSAR Section 11.4.2.1.6	1.0×10^{-5} μCi/cc Based on I-131
RM-90-102	FSAR Section 11.4.2.2.3	10 mr/hr
RM-90-103	FSAR Section 11.4.2.2.3	10 mr/hr

1272 064