UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

MAR 17 [illegible]

Mr. Frank Bergamo, Manager
Nuclear Products, Customer Services
Kaman Instrumentation Corporation
P.O. Box 7463
Colorado Springs, Colorado 80933

Dear Mr. Bergamo,

The Nuclear Regulatory Commission (NRC) has received a report under 10 CFR Part 21 from the Arizona Nuclear Power Project (ANPP) concerning deficiencies they noted in the particulate channel of the containment building radiation monitor (RU-1) at the Palo Verde Nuclear Station (PVNS). The RU-1 monitor was supplied by Kaman Instrumentation and is used for detecting reactor coolant leakage in accordance with NRC Regulatory Guide 1.45. In their report (see attached), ANPP states that erroneous documentation was supplied with the RU-1 monitor. This resulted in an incorrect detector efficiency being used in the RU-1 calibration. They also state that the erasable-programmable-read-only-memory (EPROMs), supplied by Kaman, had been programmed with an incorrect flow conversion factor. The RU-1 operability testing performed at PVNS was inadequate to detect the error in the EPROM programming.

As Mr. Roger Pedersen of my branch discussed with you, my branch's responsibility is to identify and resolve potentially generic industry problems. When appropriate, this responsibility includes notifying the industry via a notice or other document. Since Kaman Instrumentation supplies components to several of our licensees, the reported deficiencies, if verified, could have generic implications.

Assuming that you verify the facts reported, we would like to know: (1) whether you have determined if these deficiencies could exist in components supplied to your other customers; (2) if so, what plans you have to inform them of the potential problems; and (3) steps you have taken (or planned) to prevent a reoccurrence. In cases such as this, when the vendor's resolution is reasonable, successful and thorough, we typically do not issue a notice to the industry, thus avoiding duplication of efforts.

A second potentially generic issue raised by the ANPP deficiency report is whether the RU-1 monitor, as operated at PVNS, is capable of detecting a one gallon per minute leak within one hour as specified in Regulatory Guide 1.45. Two relevant concerns are raised in the report. The first concerns the effect that short-lived radionuclides (predominantly Rb-88) have on the monitor's response and the long filter paper stepping time it dictates. The second concern relates to how the monitor's sensitivity is effected by the relatively low reactor coolant activity coupled with a relatively high background airborne radiation in the containment. Whether ANPP is meeting its licensing commitments is a question we intend to pose to our Office of Nuclear Reactor Regulation; however, any comment you have on this issue will be considered.

8703190098 2pp.

If you have any questions during your review effort, please call Roger Pedersen (301) 492-9425 or me (301) 492-4780.

Sincerely,

Robert L. Baer, Chief
Engineering and Generic
Communications Branch
Division of Emergency Preparedness
and Engineering Response
Office of Inspection and Enforcement

Enclosure:
As Stated

CONTINUING ANALYTIC AND EXPERIMENTAL ASSESSMENT AND VALIDATION OF KAMAN INSTRUMENTATION RADIATION MONITORS

JIM EAMON

KAMAN SCIENCES CORPORATION

KAMAN

PROBLEM

EVALUATE THE SENSITIVITY & TIME RESPONSE OF THE PARTICULATE MONITORING CHANNEL TO VARIATIONS IN:

- AMBIENT BACKGROUND
- NOBLE GAS CONTRIBUTION (BACKGROUND)
- SHORT-LIVED PARTICULATE ISOTOPE ACTIVITY, e.g., Rb-88 ($\lambda_{\frac{1}{2}} \approx$ 18 MIN)
- LONG-LIVED PARTICULATE ACTIVITY, e.g. Cs - 137

METHOD OF SOLUTION

- ACTUAL EXPERIMENTAL VALIDATION IS NOT FEASIBLE
- MUST RELY ON COMPUTER SIMULATION OF MONITOR PERFORMANCE
- EXACT FUNCTIONAL EQUIVALENT OF PARTICULATE PROCESSING ALGORITHM USED IN MONITOR IS CODED IN PC PROGRAM
- SIMULATION PROGRAM "MFCALC" DETERMINES SENSITIVITIES OF ALGORITHM TO VARIOUS PROBLEM PARAMETERS

MFCALC SIMULATION PROGRAM INPUTS

- ACTIVITY OF LONG-LIVED PARTICULATES (e.g., Cs-137)
- ACTIVITY OF SHORT-LIVED PARTICULATES (e.g., Rb-88)
- AMBIENT BACKGROUND, CPM (e.g., 100-300 cpm)
- SENSITIVITY OF PARTICULATE CHANNEL TO NOBLE GAS ACTIVITY (e.g.; 10^6 cpm/μCi/cc)
- NOBLE GAS ACTIVITY
- FLOW RATE, CFM
- TIME STEP & TOTAL RUN TIME

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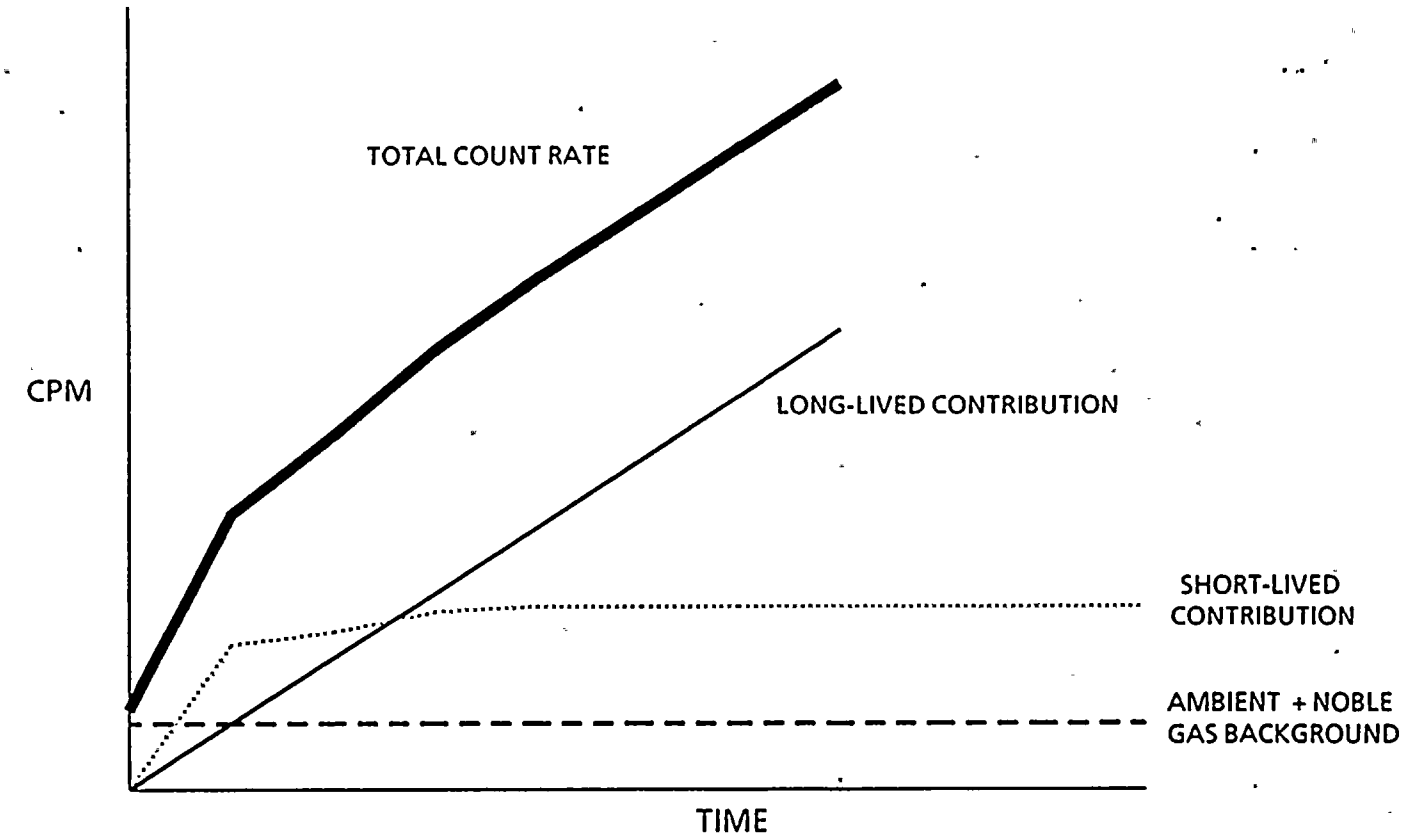
MFCALC SIMULATION FEATURES

- CALCULATES GROSS DETECTOR CPM BASED ON BACKGROUND AND BUILDUP OF SHORT AND LONG-LIVED ISOTOPES ON FILTER
- DECAY OF SHORT-LIVED PARTICULATES IS ACCOUNTED FOR
- STATISTICAL FLUCTUATIONS IN COUNT RATE, BACKGROUNDS, AND FLOW RATE ARE ACCOUNTED FOR
- CALCULATED ACTIVITY CONCENTRATION OF PARTICULATES IS DETERMINED FROM COUNT RATE EXACTLY AS DONE IN MONITOR
- PERCENTAGE DIFFERENCE BETWEEN "CALCULATED" AND "ACTUAL" (I.E., INPUT) ACTIVITY IS COMPUTED AT EACH TIME STEP
- RESULTS ARE PLOTTED VS. TIME

EXAMPLE 1 - THE EASY CASE



[Concentration of Long-Lived Isotopes] >>
[Background + Concentration Short-Lived Isotopes]

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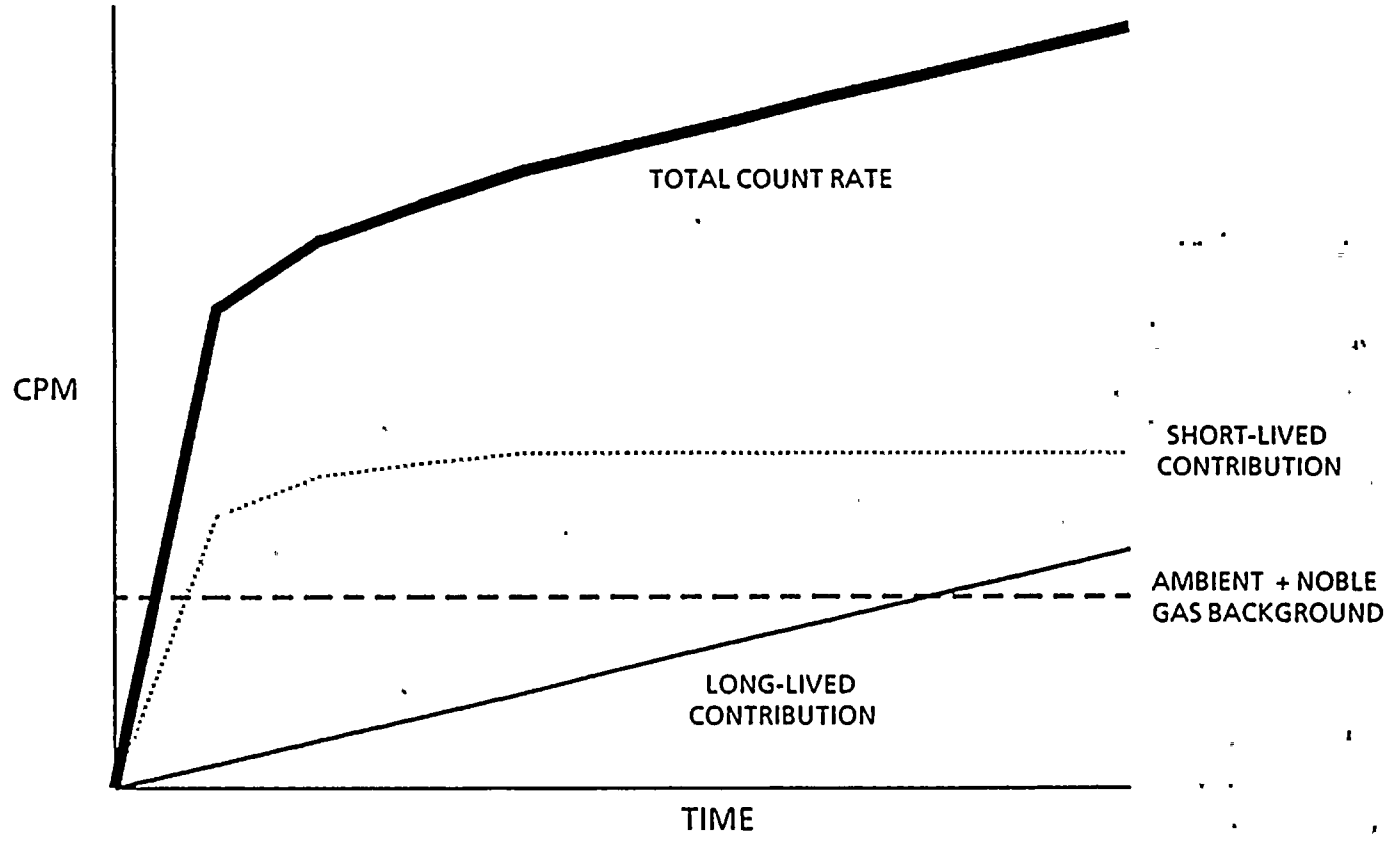
EXAMPLE 2 - THE DIFFICULT CASE



[Concentration of Long-Lived Isotopes] < [Background + Concentration of Short-Lived Isotopes]

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Representative MFCALC Output

FIXED FILTER PARTICULATE CHANNEL PROCESSING SIMULATION PROGRAM
DATE 01-31-1987 TIME 17:50:16 Ver.K, Rev 9 01/30/87
RUN NUMBER 3
INITIAL ACTIVITY- 7E-11 INITIAL FLOW- 2.5 TIME STEP- 1 PRINT TIME- 300
DETECTOR RESP. FACTOR- 440000 CPM/uCi/cc; EST. RUN TIME 75.15658 MIN
AMBIENT BACKGROUND CPM- 0 GAS ACTIVITY .015 GAS BACKGROUND 21000 CPM
FRACTION OF ACTIVITY DUE TO SHORT-LIVED PARTICULATES .25 HALF-LIFE - 18 MIN

T	CPM	MEAS ACTIV	ACT ACTIV	PROJ ACTIV	PCT DIFF	CC	NPTS
295	21318.65	3.641197E-10	7E-11	3.083203E-10	340	-46	24
595	21396.85	4.197585E-10	7E-11	2.318078E-10	231	5	38
595	21396.85	4.197585E-10	7E-11	2.302657E-10	228	-10	30
895	21315.95	1.186128E-10	7E-11	1.447209E-10	106	-23	35
1195	21329.85	1.085356E-10	7E-11	1.478436E-10	111	19	42
1495	21303.15	5.193253E-11	7E-11	1.124572E-10	60	14	31
1795	21313.05	5.216236E-11	7E-11	1.016412E-10	45	14	42
2095	21407.75	1.34632E-10	7E-11	1.111153E-10	58	26	38
2395	21424.15	1.316152E-10	7E-11	7.938693E-11	13	-21	51
2395	21424.15	1.316152E-10	7E-11	8.194691E-11	17	-16	30

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FIXED FILTER PARTICULATE CHANNEL PROCESSING SIMULATION PROGRAM
DATE 01-31-1987 TIME 17:43:12 Ver.K, Rev 9 01/30/87
RUN NUMBER 2

INITIAL ACTIVITY- 4E-11 INITIAL FLOW- 2.5 TIME STEP- 1 PRINT TIME- 300
DETECTOR RESP. FACTOR- 440000 CPM/uCi/cc; EST. RUN TIME 75.15658 MIN
AMBIENT BACKGROUND CPM- 0 GAS ACTIVITY .015 GAS BACKGROUND 21000 CPM
FRACTION OF ACTIVITY DUE TO SHORT-LIVED PARTICULATES .25 HALF-LIFE - 18 MIN

T	CPM	MEAS ACTIV	ACT ACTIV	PROJ ACTIV	PCT DIFF	CC	NPTS
295	21166.38	2.629798E-10	4E-11	5.086622E-10	1171	28	24
595	21259.48	4.39829E-10	4E-11	2.205468E-10	451	7	31
895	21201.88	1.644249E-10	4E-11	1.522921E-10	280	-1	31
1195	21260.98	2.193368E-10	4E-11	1.523214E-10	280	29	42
1495	21217.08	1.136721E-10	4E-11	7.817228E-11	95	-13	31
1795	21168.98	4.61726E-11	4E-11	9.202764E-11	130	8	40
2095	21206.88	7.477208E-11	4E-11	1.252319E-10	213	52	35
2395	21228.58	8.297291E-11	4E-11	8.237611E-11	105	16	60
2695	21233.68	7.669058E-11	4E-11	6.878652E-11	71	-1	37
2995	21218.88	5.811189E-11	4E-11	6.181864E-11	54	7	33
3295	21233.88	6.247917E-11	4E-11	4.495709E-11	12	-17	35
3595	21195.08	3.613029E-11	4E-11	6.148377E-11	53	19	37
3895	21245.48	5.711502E-11	4E-11	4.904727E-11	22	4	36
4195	21241.08	5.241452E-11	4E-11	4.047987E-11	1	-27	31
4495	21236.38	4.596233E-11	4E-11	5.120635E-11	28	20	54
4795	21266.28	5.496655E-11	4E-11	4.660255E-11	16	5	39
5095	21252.38	4.682357E-11	4E 11	4.670452E-11	16	12	60
5395	21303.88	6.474446E-11	4E-11	4.686305E-11	17	5	56
5695	21219.98	3.160865E-11	4E-11	4.527479E-11	13	5	47
5995	21211.78	2.688776E-11	4E-11	4.88094E-11	22	24	38
6295	21279.28	4.622798E-11	4E-11	4.36316E-11	9	6	60
6595	21275.28	4.272275E-11	4E-11	4.533653E-11	13	20	40
6895	21292.58	4.558322E-11	4E-11	3.863461E-11	-4	-1	60
7195	21281.38	4.054687E-11	4E-11	3.910292E-11	-3	-8	33
7495	21349.28	5.635515E-11	4E-11	4.22067E-11	5	13	58
7795	21270.18	3.603973E-11	4E-11	4.027818E-11	0	-2	37
8095	21295.28	3.952088E-11	4E-11	3.55605E-11	-12	-22	37

STABLE TIME- 8400
TOTAL PROBLEM TIME - 423.4805 SECONDS FOR 0 STEPS. 0 STEPS PER SEC

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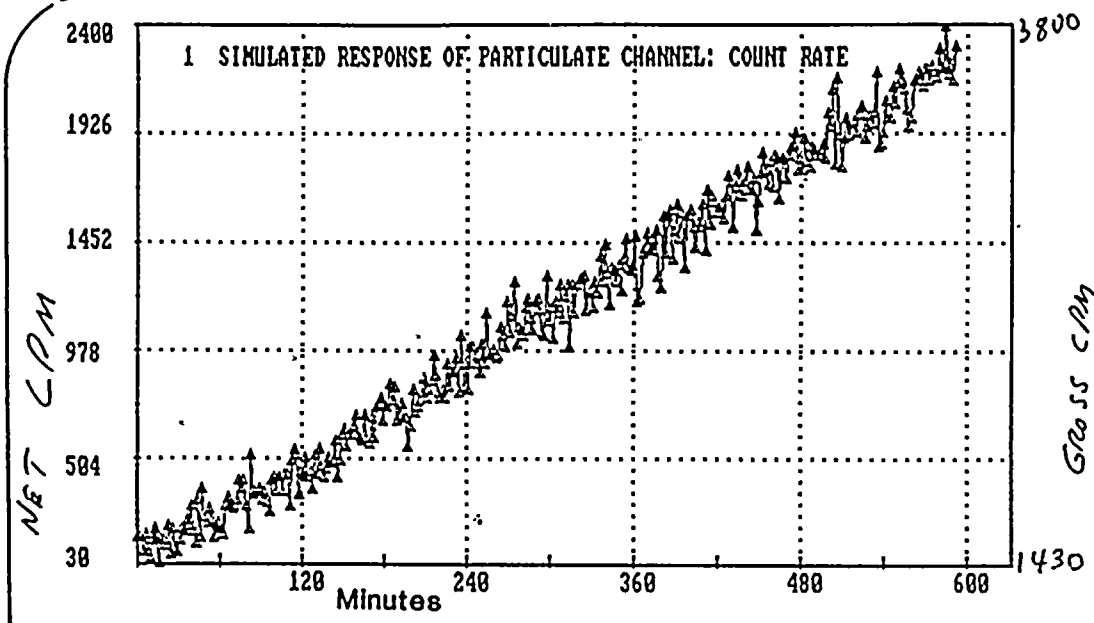
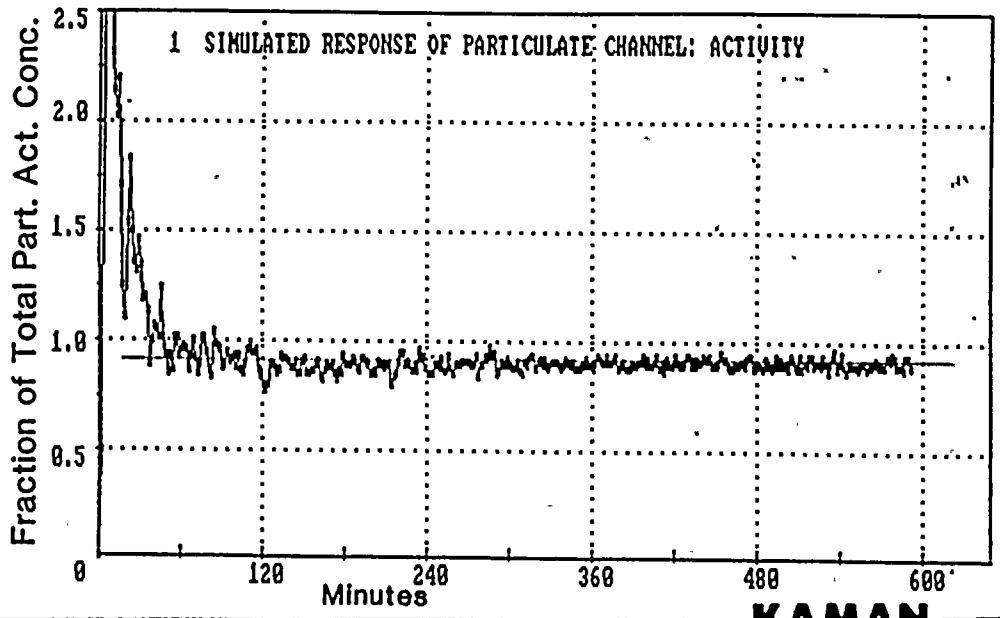


A TYPICAL PLANT SITUATION

Low Particulate Activity
Low Short-Lived Component
Moderate Noble Gas Background

Converges to Long-Lived Activity

- Total Activity 10^{-10} μCi/cc
  - 90% Cs-137 $\lambda \sim 0$
  - 10% Rb-88 $\lambda = 18$ min
- Noble Gas Activity 10^{-3} μCi/cc
  ~ 1400 cpm
- Stabilization Time
  ~ 60 min



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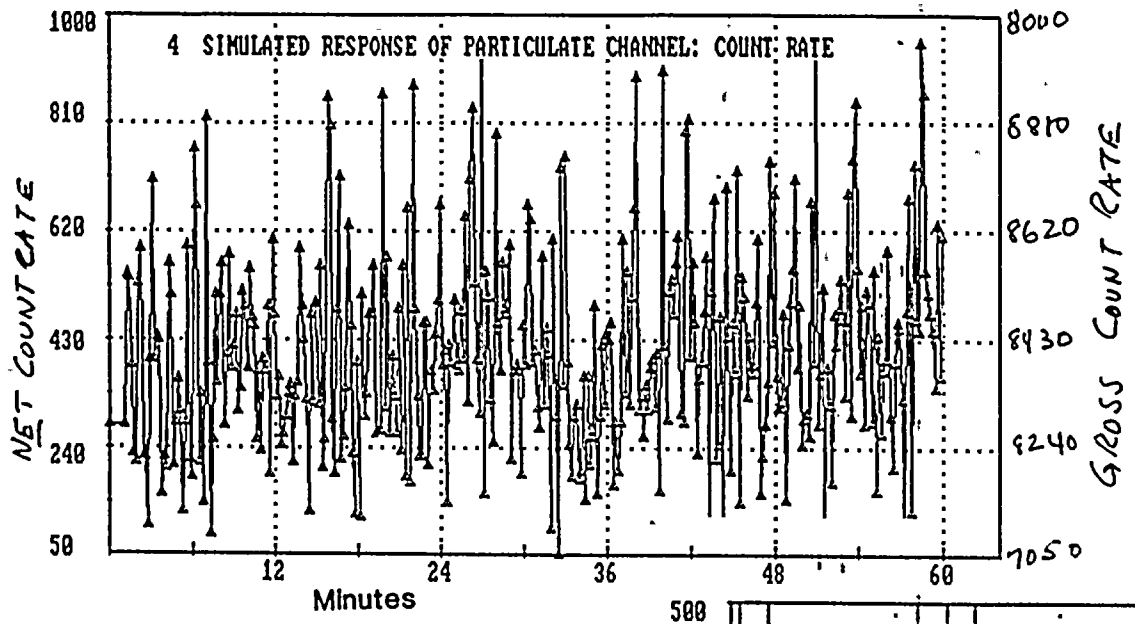
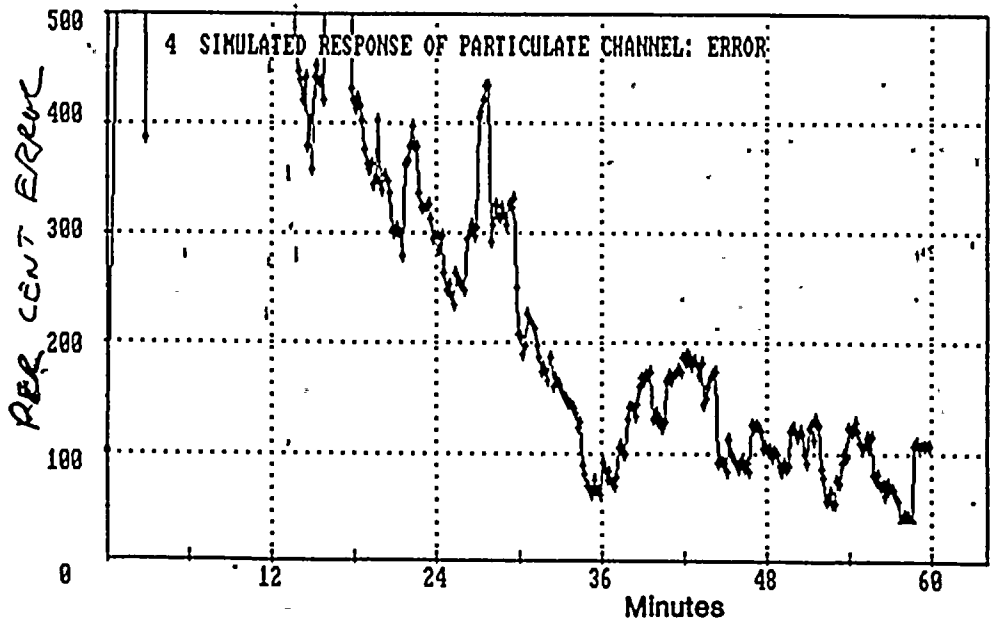


Short-Term-Response

No obvious trend to countrate buildup in one hour.

High Noble Gas Activity



- Total Activity 10^{-10} μCi/cc
  - 90% Cs-137 (long-lived)
  - 10% Rb-88 (λ = 18 min)
- Noble Gas Activity 5×10^{-3} μCi/cc
  ~ 7000 cpm
- STABILIZATION TIME
  > 60 MIN

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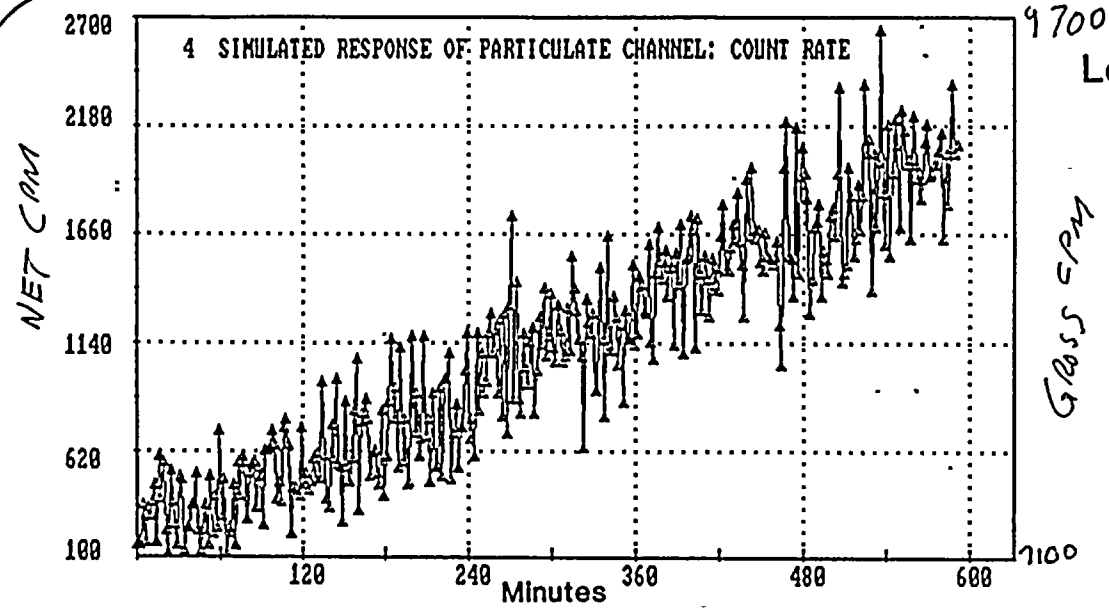
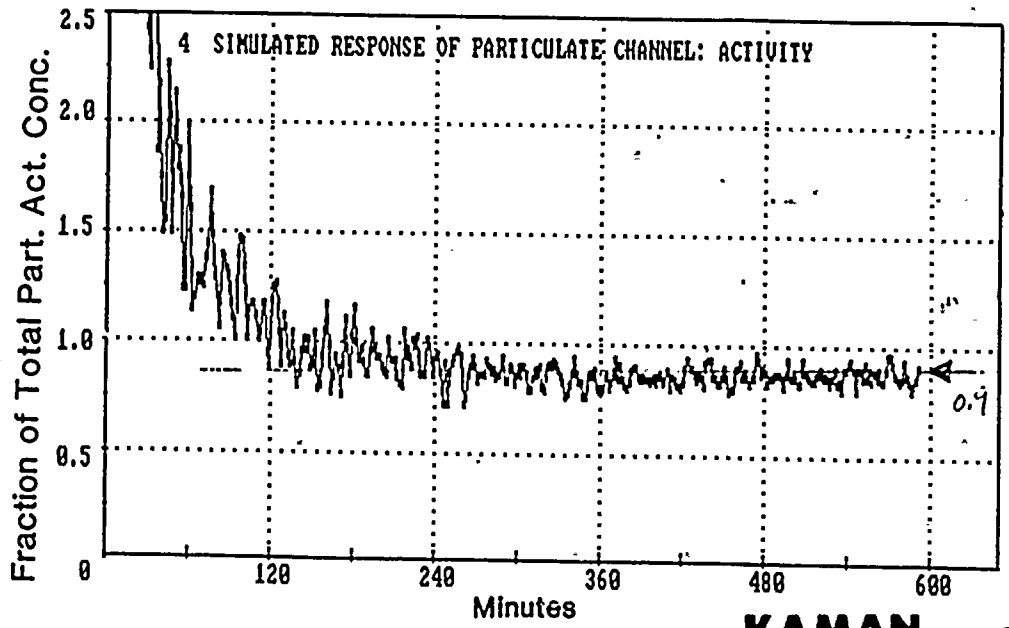


Long-Term Response

High Noble Gas Activity

Trend clear at about four hours.

- Total Activity 10^{-10} μCi/cc
  - 90% Cs-137 $\lambda \sim \infty$
  - 10% Rb-88 $\lambda = 18$ MIN
- Noble Gas (Background) Activity 5×10^{-3} μCi/cc ~7000 CPM
- Stabilization ~ 4 Hours



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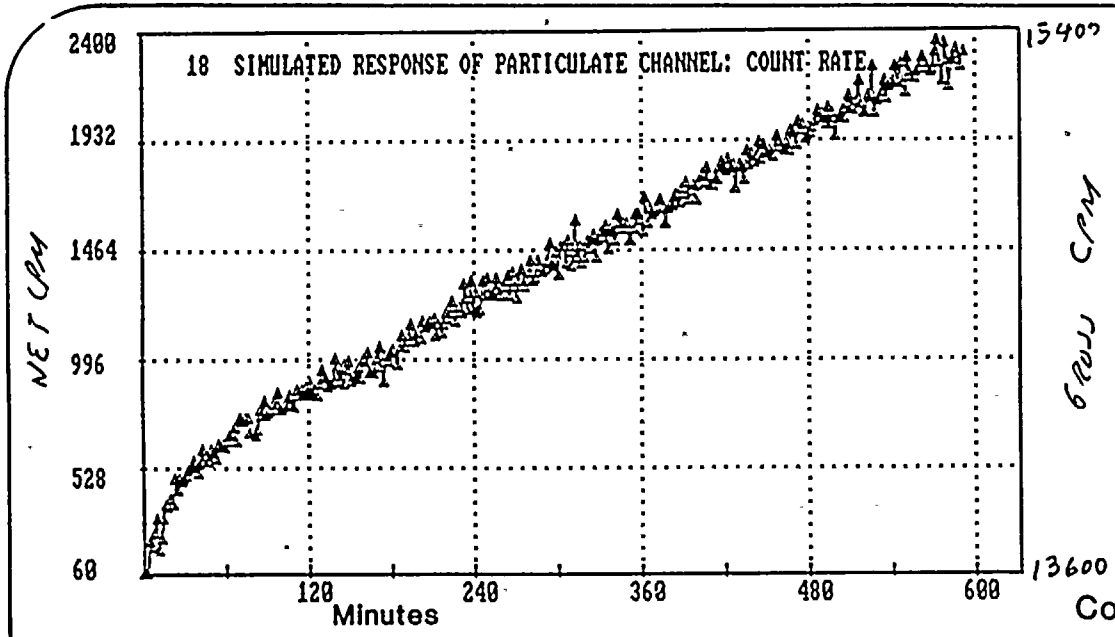


DIFFICULT CONDITIONS

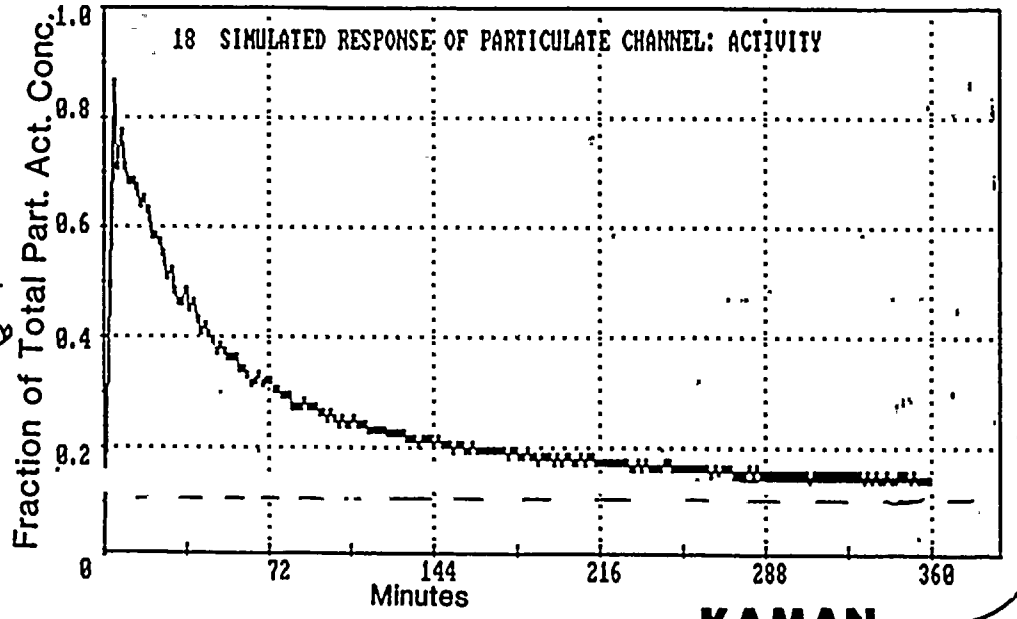
High Concentration of Short-Lived Isotopes

Large Noble Gas Activity

Slow Response

Converges to Long-Lived Component

- TOTAL ACTIVITY 1×10^{-9} μCi/cc
  - 10% Cs-137 $\lambda \sim .\ \infty$
  - 90% Rb-88 $\lambda = 18$ MIN
- NOBLE GAS ACTIVITY 5×10^{-3} μCi/cc
  - ~ 7000 CPM BACKGROUND
- STABILIZATION TIME
  - > 6 HRS



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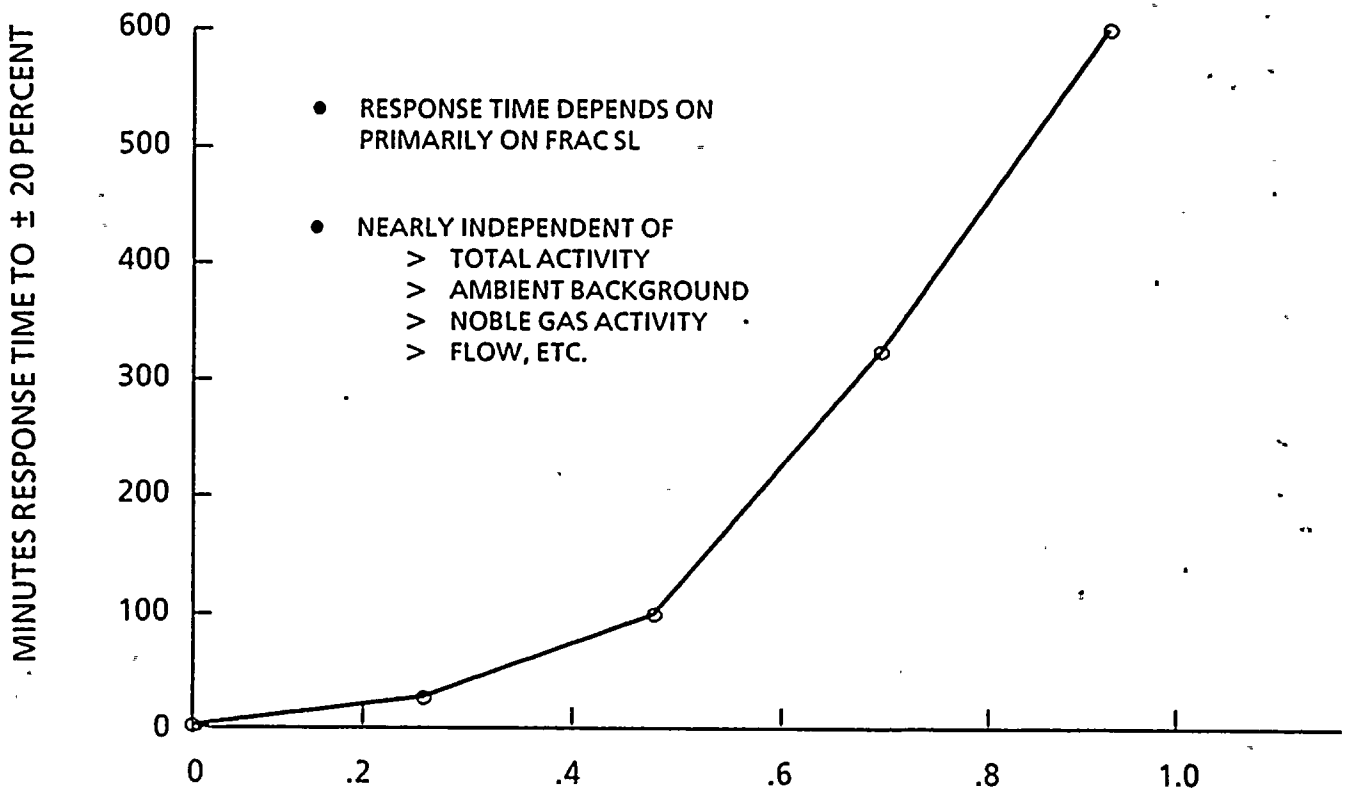
SOME GENERAL CONCLUSIONS

- ALGORITHM HAS BEEN VERIFIED FOR WIDE VARIETY OF INPUT CONDITIONS
- IDENTIFIED AREAS WHERE MONITOR RESPONSE WILL BE VERY SLOW
- IDENTIFIED PRIMARY FACTOR WHICH REDUCES EFFICIENCY OF ALGORITHM (I.E., FRACTION SHORT-LIVED ISOTOPE)
- NOBLE GAS ACTIVITY DOES NOT GREATLY AFFECT MONITOR RESPONSE
- AMBIENT BACKGROUND HAS LITTLE EFFECT ON RESPONSE
- RESPONSE TIME RELATIVELY CONSTANT OVER WIDE RANGE OF PARTICULATE ACTIVITIES (10^{-11} - 10^{-7})


MINUTES RESPONSE TIME TO ± 20 PERCENT
600
500
400
300
200
100
0
0
.2
.4
.6
.8
1.0
• RESPONSE TIME DEPENDS ON PRIMARILY ON FRAC SL
• NEARLY INDEPENDENT OF
> TOTAL ACTIVITY
> AMBIENT BACKGROUND
> NOBLE GAS ACTIVITY
> FLOW, ETC.
FRACTION OF TOTAL ACTIVITY DUE TO SHORT-LIVED ISOTOPES

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