UNION ELECTRIC COMPANY
1901 Gratiot Street, St. Louis

Donald F. Schnell
Vice President

October 22, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

ULNRC-1193

Dear Mr. Denton:

DOCKET NUMBER 50-483
CALLAWAY PLANT, UNIT 1
REQUEST FOR EXEMPTION FROM APPENDIX A TO 10 CFR 20 TO ALLOW CREDIT FOR USE OF A RADIOIODINE PROTECTION FACTOR FOR GMR-I FILTER CANISTERS

Appendix A to 10 CFR 20 establishes protection factors for air-purifying respirators for particulates only, and footnote d-2(c) states that "no allowance is to be made for the use of sorbents against radioactive gases or vapors." However, 10 CFR 20.103(e) allows an exemption to be authorized by the Commission in lieu of a NIOSH/MSHA certification schedule based on adequate testing, material and performance characteristics. The manufacturers of the GMR-I canister, Mine Safety Appliances Company (MSA), has performed testing on the basis of the recommended certification process of NUREG/CR-3403, "Criteria and Test Methods for Certifying Air-Purifying Respirator Cartridges and Canisters Against Radioiodine," and obtained reliable test information (summary attached) that the material and performance characteristics of the equipment are capable of providing the proposed degree of protection under specified conditions of use. Therefore, pursuant to 10 CFR 20.103(e) and 10 CFR 20.501, Union Electric hereby applies for an exemption to 10 CFR 20, Appendix A, footnote d-2(c) to allow credit for a radioiodine protection factor in employing the MSA GMR-I canister (No. 466220) for respiratory protection based on the conditions of use specified below.

Based on the test information provided by MSA for the GMR-I canister (No. 466220), Union Electric requests credit for a protection factor of 50 against radioiodine, contingent on the following conditions of use:

A001
1/1

Mailing Address: P.O. Box 149, St. Louis, MO 63166

1) A maximum continuous use period of eight hours will be established, after which the used canisters will be discarded to prevent reuse. The use period will begin when the canister is unsealed and will include periods of nonexposure.

2) Canisters will not be exposed to or used in environments containing organic vapors and chemicals which could cause aging, poisoning or desorption of the absorbed radioiodines.

3) Canisters will be stored in sealed, humidity barrier packaging in a cool, dry environment.

4) Canisters will only be used with full facepiece masks capable of providing protection factors greater than 100.

5) Canister use will be limited to a total challenge concentration of organic iodines and other hologenated (including nonradioactive) compounds of one (1) ppm.

6) Canisters will not be used in environments where temperatures exceed 110°F. Temperatures in the work area will be measured each shift and/or coincidentally with operations which heat the work area to assure temperatures do not exceed 110°F during GMR-I use.

The above restrictions and limitations will be incorporated into specific plant procedures and training will be provided to workers and health physics technicians prior to use of the GMR-I canisters. The existing respiratory protection program requirements and restrictions will also apply to the GMR-I canisters.

This exemption is desirable in reducing physical work effort/stress, as well as personnel radiation exposure, and is consistent with the ALARA concept. The utilization of air-purifying respirators in lieu of air-supplied or self-contained apparatuses will not only reduce the physical work effort and stress on the worker but can result in a 25 percent to 50 percent reduction in personnel exposure. The use of air-purifying respirators provides significantly greater comfort and mobility versus self-contained apparatuses and results in increased worker efficiency with a corresponding decrease in exposure time on the job.

Pursuant to 10 CFR 20.103(g), this letter also represents notification of an intent to use the MSA GMR-I canister (No. 466220) under the conditions and limitations described above thirty (30) days from this date, pending NRC approval of this exemption request.

Any questions concerning this request should be directed to Mr. Mike Williams of my staff.

Very truly yours,

Donald F. Schnell

Donald F. Schnell

MCW/lkr
Attachment

cc: Gerald Charnoff, Esq.
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STATE OF MISSOURI)
)   S S
CITY OF ST. LOUIS)

Donald F. Schnell, of lawful age, being first duly sworn upon oath says that he is Vice President-Nuclear and an officer of Union Electric Company; that he has read the foregoing document and knows the content thereof; that he has executed the same for and on behalf of said company with full power and authority to do so; and that the facts therein stated are true and correct to the best of his knowledge, information and belief.

By Donald F. Schnell
Donald F. Schnell
Vice President
Nuclear

SUBSCRIBED and sworn to before me this 24th day of October, 1985.

Barbara J. Pfaff
BARBARA J. PFAFF
NOTARY PUBLIC, STATE OF MISSOURI
MY COMMISSION EXPIRES APRIL 22, 1989
ST. LOUIS COUNTY

MSA

Mine Safety Appliances Company · 600 Penn Center Boulevard · Pittsburgh, Pennsylvania 15235
412/273-5000

April 13, 1984

Writer's Direct Dial Number

412-273-5140

Mr. Wayne Carr
Health Physics
Alabama Power Company
600 North 18th St.
P. O. Box 2641
Birmingham, AL 35291

Dear Mr. Carr:

In accordance with our agreement, the following report is submitted for your approval.

1. General

It was agreed with Alabama Power Company on March 8, 1984, that MSA would test GMR-I cans to completion in order to be able to statistically project performance at 110°F and 100% RH. In addition, other tests had been run prior to the March 8th agreement and the data are shown in Table I. The tests were conducted under the following conditions:

Challenge Conc.: 5 - 10 ppm CH_3I
Humidity: 60 ± 3% and 90 ± 3% (minimum of six cans at each humidity)
Temperature: 110°F
Cyclic Flow: 192 LPM for 0.82 sec.; 0 LPM for 1.64 sec., repeating this cycle throughout the test. This gives a minute volume of 64 L.
Breakthrough Conc.: 1% of the challenge concentration

2. Test Results

During this program, 48 GMR-I cans have been tested (47 valid tests). These cans came from six production lots made over the period April 14, 1983, to February 2, 1984. Sixteen cans were tested from lot April 14, 1983, 10 at 90% RH and 6 at 60% RH. Only eight results at 90% RH were used in the statistical analysis given below, as one test was invalid (No. 47) and another was stopped before completion. Only a few cans were available from the other lots, so they could not be statistically analyzed; however, all cans run to completion had a service time of

20 hours or greater. The results are shown in Table 1. The original 14 cans <u>not</u> run to completion had service times well in excess of 12 hours - <u>much</u> in excess of the eight hours desired.

3. Statistical Analysis of Lot 4/14/83. Table 2 shows the data used and the statistical analysis to give the 99% prediction interval for individual values of Log Y (log service time), when X (relative humidity) is 100%. The lower limit of this interval is calculated to be 15.8 hours. This predicts that over 99% of the <u>individual</u> GMR-I can service times would be greater than 15.8 hours at 100% RH and the other test parameters used in this program. This gives a considerable safety margin over the eight hours desired.

   One other interesting point to note from the data in Table 2, as well as all of the test data on the GMR-I cans, is that humidity has little or no effect on the service time over the humidity range studied, 60 to 90%. This would indicate that results at 100% RH would be very close to those at 90% on a log service time--log RH plot, unless the slope were extremely steep--which is not the case.

4. Proposed Acceptance Plan. The extremely long service times experienced in this program for the GMR-I cans run to completion, an average of over 29 hours, makes testing to completion for routine lot acceptance impractical; therefore, the following plan is proposed.

   4.1 Interim Plan. On an interim basis, until more data can be gathered as explained in section 4.2, the proposed lot acceptance would be as follows:

      4.1.1 MIL-STD 414, Level II, AQL 1% would be used to (1) select the proper number of cans to test, depending on lot size, and (2) to interpret the results regarding lot acceptance or failure.

      4.1.2 The cans would be tested under the conditions of section 1; however, all tests would be conducted at 90% RH. Tests would be stopped at eight hours and the percent leakage recorded at this time. From evidence presented in the preceding sections, results at 90% are not significantly different from those at 100%.

      4.1.3 The percent leakage values would be compared to the spec. limit of 1.0%, using the single spec. limit, variables unknown, standard deviation method of MIL-STD 414. Acceptance would be based on this analysis.

   4.2 Future. Because the tests in section 4.1 are very time consuming and somewhat difficult to run for regular quality assurance lot acceptance testing, we plan to do further testing on the GMR-I can in an attempt to reduce the time required for testing and also to simplify the test. Parameters that will be investigated are:

4.2.1 Increasing the challenge concentration of CH_3I in an effort to reduce the time to test. Under current conditions, a test to completion might run 40 hours; we would like to reduce this to about two hours. If there were a simple, straight-line relationship between service time to a 1% breakthrough and challenge concentration, it would indicate that a challenge concentration of approximately 200 ppm would be required to do this. We wish to firmly establish the service time---challenge concentration relationship over a range of challenge concentrations from 1 ppm to 500 ppm.

4.2.2 Constant Flow vs. Cyclic Flow. Constant flow tests are much simpler to conduct than cyclic flow tests. From some preliminary information, it appears that constant flow gives similar service times as cyclic flow. If, by further tests, this can be verified, constant flow would be used in lot acceptance tests.

4.2.3 Temperature and Humidity Effects. Further tests will be run to study the effects of temperature and humidity on the performance of the GMR-I can. It would be preferable to test cans for lot acceptance at 25°C and 85% RH (standard NIOSH conditions), if it can be proven that these conditions are as severe as 43°C and 90% RH, or if a good correlation between these two conditions can be established.

5. Conclusion.

5.1 Forty-seven GMR-I cans have been validly tested under the conditions specified in section 1. All of these cans had service times well in excess of 12 hours. This compares to a desired service time of eight hours.

5.2 There were 14 valid tests run on lot 4/14/83. Statistical analysis of this data, projected to 100% RH, 110°F, indicate that over 99% of the GMR-I cans in this lot have service times well over eight hours (15.8 hours). Incidentally, from the data of Table 1, this lot appears to have the shortest average service time of the lots tested.

5.3 In light of sections 5.1 and 5.2, the GMR-I can should be considered qualified to give service times over eight hours under the conditions: 1% breakthrough, cyclic flow (peak 192 LPM, average 64 LPM), 110°F (43°C) and 100% RH.

5.4 Lot Acceptance will be determined by using MIL-STD-414, Level II, AQL 1%. The percent leakage at eight hours service time will be compared to the spec. limit of 1.0%, using the single spec. limit, variables unknown, standard deviation method of MIL-STD-414.

5.5 Further tests will be run studying the effects of challenge concentration, constant flow rate, temperature and humidity on the service time of GMR-1 cans. This program is intended to shorten the required test time and simplify the test procedure.

5.6 From data in this investigation, it appears that relative humidity between 60 to 90% has little effect on service time of the GMR-1 canister. Projecting the service time to 100% RH, using a log-log plot, suggests that the service times at 90% and 100% RH are not significantly different.

If you have any further questions, please do not hesitate to contact me

Very truly yours,

Wayde B. Miller, Jr.

Wayde B. Miller, Jr.
Director of Product & Sales Planning

/jw

Attachments/Tables I and 2

cc: Mr. E. J. Beck
Dr. W. P. King
Dr. E. S. McKee
Mr. J. C. Sheehan
Mr. J. H. Wylie

Table 1. Service Time of GMR-I Canisters

Test Conditions: As given in section I

60% RH

Can #	Mfg. Date	Service Time min.	Service Time hrs.	Comment	Can #	Mfg. Date	Service Time min.	Service Time hrs.	Comment
5	11/30/83	>>720	>>12	Leak @ 12 hrs. 0.25 (Test Stopped)	34	4/14/83	1410	23.5	
6	"	"	"	0.07 (Test Stopped)	35	2/2/84	1680	28.0	
7	"	"	"	0.33 (Test Stopped)	36	4/14/83	1530	25.5	
29	2/2/84	2160	36.0		37	"	1410	23.5	
30	"	2520	42.0		38	1/9/84	1890	31.5	
31	"	2670	44.5		39	4/14/83	1080	18.0	
32	4/14/83	1200	20.0		40	1/9/84	2220	37.0	
33	"	1500	25.0						

90% RH

Can #	Mfg. Date	Service Time min.	Service Time hrs.	Comment	Can #	Mfg. Date	Service Time min.	Service Time hrs.	Comment
3	11/30/83	>>1215	>>20.3	Leakage 0.30 (Test Stopped)	23	10/21/83	2490	41.5	
4	"	>>1215	>>20.3	0.15 (Test Stopped)	24	"	2910	48.5	
8	10/21/83	>> 990	>>16.5	0.45 (Test Stopped)	25	"	2490	41.5	
9	"	"	"	0.25 (Test Stopped)	26	2/2/84	1560	26.0	
10	"	"	"	0.43 (Test Stopped)	27	"	2070	34.5	
11	11/30/83	>>720	>>12	Leak @ 12 hrs. 0.67 (Test Stopped)	28	"	2220	37.0	
12	10/21/83	"	"	0.04 (Test Stopped)	41	4/14/83	1230	20.5	
13	11/30/83	"	"	0.47 (Test Stopped)	42	"	1320	22.0	
14	1/9/84	>>795	>>13.3	0.64 (Test Stopped)	43	"	1650	27.5	
15	"	"	"	0.34 (Test Stopped)	44	"	1320	22.0	
16	"	"	"	0.35 (Test Stopped)	45	"	1500	25.0	
17	1/9/84	1890	31.5	Const. Flow	46	"	1260	21.0	
18	"	3180	53.0	"	47	"	--	--	Test Invalid
19	"	2530	42.2	"	48	"	1350	22.5	
20	9/13/83	2390	39.8	"	49	"	1290	21.5	
21	"	1530*	25.5*	*Test Stopped No Breakthrough	50	"	840*	14.0*	Test Stopped No Breakthrough
22	"	2280*	38.0*						

4/26/84

Table 2.

Statistical Analysis of Lot 4/14/83

X (% RH)	Y (Svc. Time)	Log X	Log Y
60	1200 min.	1.77815	3.07918
60	1500	"	3.17609
60	1410	"	3.14922
60	1530	"	3.18469
60	1410	"	3.14922
60	1080	"	3.03342
90	1650	1.95424	3.21748
90	1230	"	3.08991
90	1320	"	3.12057
90	1500	"	3.17609
90	1260	"	3.18037
90	1350	"	3.13033
90	1290	"	3.11059
90	1320	"	3.12057

Ave. Y_{60} = 1355 min. (22.6 hrs.)

Ave. Y_{90} = 1365 min. (22.7 hrs.)

99% Prediction Interval for Log Y, given Log X = 2 (100% RH)

99% Interval = $\hat{Y} \pm t\,[1.99/2]_{n-2}\; S_{\hat{Y}}$

Where $\hat{Y}$ = bo + b_1X and bo = 3.08231, b_1 = 0.02606

= 3.13443 (1362 min., 22.7 hrs.)

$S_{\hat{Y}} = \sqrt{S_E^2\left[1 + 1/n + \frac{(X-\bar{X})^2}{\Sigma x^2}\right]} = .05543 \qquad S_E^2 = \frac{\Sigma(Y-\hat{Y})^2}{n-2}$

$x = X - \bar{X}$

99% Interval = 3.13443 ± (3.055) (.05543) = 3.13443 ± .16934

= 3.30377 to 2.96509

Y = 33.5 hrs. to 15.4 hrs.

Revision 4/26/84

THE MSA GMR-I CANISTER
FOR USE AGAINST RADIO IODINE
AND ORGANIC IODIDES

Note:

Presented by Dr. E. S. McKee, Mine Safety Appliances Company, Pittsburgh, Pennsylvania for Alabama Power Company to Nuclear Regulatory Commission staff on April 25, 1984 at Bethesda, Maryland

TEST CONDITIONS

Challenge Conc.: 5 - 10 ppm CH_3I
Humidity: 60 ± 3% and 90 ± 3% (minimum of six cans at each humidity)
Temperature: 110°F
Cyclic Flow: 192 LPM for 0.82 sec.; 0 LPM for 1.64 sec., repeating this cycle throughout the test. This gives a minute volume of 64 L.
Breakthrough Conc.: 1% of the challenge concentration

Table 1. Test Results

60% RH

Can #	Mfg. Date	Service min.	Time hrs.	Comment
5*	11/30/83	720	12	0.25%**
6*	"	"	"	0.07 **
7*	"	"	"	0.33 **
29	2/2/84	2160	36.0	
30	"	2520	42.0	
31	"	2670	44.5	
32	4/14/83	1200	20.0	
33	"	1500	25.0	
34	"	1410	23.5	
35	2/2/84	1680	28.0	
36	4/14/83	1530	25.5	

Can #	Mfg. Date	Service min.	Time hrs.	Comment
37	4/14/83	1410	23.5	
38	1/9/84	1890	31.5	
39	4/14/83	1080	18.0	
40	1/9/84	2220	37.0	
57	3/28/84	2490	41.5	
58	"	2280	38.0	
59	"	2610	43.5	
60	"	2460	41.0	
61	"	2250	37.5	
62	"	2460	41.0	

90% RH

Can #	Mfg. Date	Service min.	Time hrs.	Comment
3*	11/30/83	1215	20.3	0.30 **
4*	"	1215	20.3	0.15 **
8*	10/21/83	990	16.5	0.45 **
9*	"	"	"	0.25 **
10*	"	"	"	0.43 **
11*	11/30/83	720	12	0.67 **
12*	10/21/83	"	"	0.04 **
13*	11/30/83	"	"	0.47 **
14*	1/9/84	795	13.3	0.83 **
15*	"	"	"	0.34 **
16*	"	"	"	0.35 **
17	1/9/84	1890	31.5	Const. Flow
18	"	3180	53.0	"
19	"	2530	42.2	"
20	9/13/83	2390	39.8	"
21*	"	1530	25.5	" 0.44**
22*	"	2280	38.0	" 0.09**
23	10/21/83	2490	41.5	
24	"	2910	48.5	
25	"	2490	41.5	

Can #	Mfg. Date	Service min.	Time hrs.	Comment
26	2/2/84	1560	26.0	
27	"	2070	34.5	
28	"	2220	37.0	
41	4/16/83	1230	20.5	
42	"	1320	22.0	
43	"	1650	27.5	
44	"	1320	22.0	
45	"	1500	25.0	
46	"	1260	21.0	
47	"	--	--	Test Invalid
48	"	1350	22.5	
49	"	1290	21.5	
50*	"	840	14.0	0.62**
51	3/28/84	1650	27.5	
52	"	1800	30.0	
53	"	1620	27.0	
54	"	1530	25.5	
55	"	1740	29.0	
56	"	1620	27.0	

Test stopped before 1% breakthrough.
*Leakage when test stopped.

Table ___.

Statistical Analysis of Lot 4/14/83

X (% RH)	Y (Svc. Time)	Log X	Log Y
60	1200 min.	1.77815	3.07918
60	1500	"	3.17609
60	1410	"	3.14922
60	1530	"	3.18469
60	1410	"	3.14922
60	1080	"	3.03342
90	1650	1.95424	3.21748
90	1230	"	3.08991
90	1320	"	3.12057
90	1500	"	3.17609
90	1260	"	3.18037
90	1350	"	3.13033
90	1290	"	3.11059
90	1320	"	3.12057

Ave. Y_{60} = 1355 min. (22.6 hrs.)

Ave. Y_{90} = 1365 min. (22.7 hrs.)

99% Prediction Interval for Log Y, given Log X = 2 (100% RH)

99% Interval = $\text{Log } Y \pm (t\ \ 1.99/2)_{n-2}\, S_{\text{Log } Y}$ (Equivalent to the common expression of $\bar{X} \pm 3\sigma$).

Where $\text{Log } Y = bo + b_1\ \text{Log } X$ and bo = 3.08231, b_1 = 0.02606, where b_0 is the intercept and b_1 the slope of the plot of Log Y vs. Log X.

Log Y = 3.13443 (1362 min., 22.7 hrs.), when Log X - 2 or X = 100

$$S\ \text{Log } Y = \sqrt{S_E^2\left[1 + 1/n + \frac{(\text{Log } X - \overline{\text{Log } X})^2}{\Sigma(\text{Log } X)^2}\right]} = .05543$$

99% Interval of Log Y when Log X = 2 or X = 100 = 3.13443 $\pm$ (3.055) (.05543) = 3.13443 $\pm$ .16934

= 3.30377 to 2.96509

Y = 33.5 hrs to 15.4 hrs.

EGRESSION ALYSIS - GMR-I CANS LOT 4/14/83

og Relative Humidity Linear with Log Service Life | R.H. 60 & 90% | 110°F | Cyclic Flow 192 LPM for 0.82 Sec; 0 LPM 1.64 Sec.

Log ——→

X (Rel. Hum.)	Y Life (Min.)	Log X	Log Y	$X-\bar{X}$	$(X-\bar{X})^2$	$Y-\bar{Y}$	$(X-\bar{X})\cdot(Y-\bar{Y})$	$\hat{Y}$	$(Y-\hat{Y})^2$
60	1200	1.77815	3.07918	-.10062	.01012	-.05209	+.00524	3.12865	.00245
60	1500	"	3.17609	"	"	+.04482	-.00451	"	.00225
60	1410	"	3.14922	"	"	+.01795	-.00181	"	.00042
60	1530	"	3.18469	"	"	+.05342	-.00538	"	.00314
60	1410	"	3.14922	"	"	+.01795	-.00181	"	.00042
60	1080	"	3.03342	"	"	-.09785	+.00985	"	.00907
90	1650	1.95424	3.21748	+.07547	.00570	+.08621	+.00651	3.13324	.00710
90	1230	"	3.08991	"	"	-.04136	-.00312	"	.00188
90	1320	"	3.12057	"	"	-.01070	-.00081	"	.00016
90	1500	"	3.17609	"	"	+.04482	+.00338	"	.00184
90	1260	"	3.10037	"	"	-.03090	-.00233	"	.00108
90	1350	"	3.13033	"	"	-.00094	-.00007	"	.00001
90	1290	"	3.11059	"	"	-.02068	-.00156	"	.00051
90	1320	"	3.12057	"	"	-.01070	-.00081	"	.00016

14 $\bar{X}$ = 1.87877 $\bar{Y}$ = 3.13127 $\sum$ = .10629 $\sum$ = +.00277 $\sum$ = .03049

$$b_1 = \frac{\sum (X-\bar{X})(Y-\bar{Y})}{\sum (X-\bar{X})^2} = \frac{+.00277}{.10629} = \underline{+0.02606}$$

$$\hat{Y} = b_o + b_1 X$$

$$b_o = \bar{Y} - b_1\bar{X} = 3.13127 - .02606\ (1.87877) = +3.08231$$

$$s_E^{\ 2} = \sum (Y-\hat{Y})^2/n-2 = .03049/12 = .00254$$

$$s_{b_1}^{\ 2} = SE^2/\sum x^2 = .00254/.10629 - .02391 \qquad (x = X-\bar{X})$$

$$s_{b_1} = \sqrt{.02391} = .15461$$

99% Conf. Limits on Slope β_1 =

$$b_1 \pm t([1.99/_2)]n-2\ s_{b_1} = .02606 \pm 3.055\ (.15461)$$

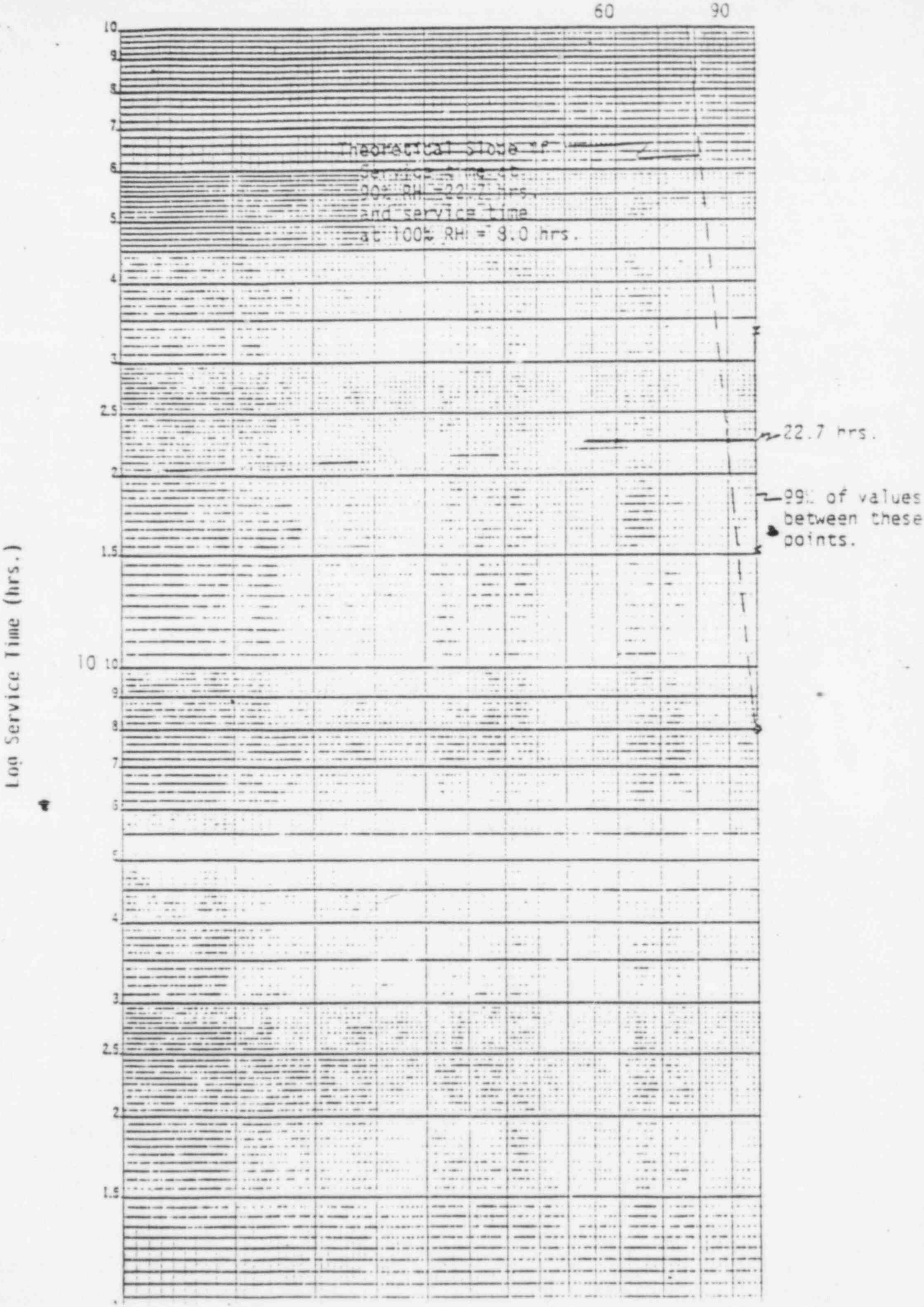
$$= +.49840,\ -.44628$$

99% Prediction Intervals for Logy (Life) Given Log X = 2

$$-\hat{Y} \pm t\ [(1.99/_2)]\ n-2\ \ s_{\hat{Y}}\ ;\ \ \hat{Y} = b_o + b_1\ x = 3.08231\ +.02606(2)$$

$$\underline{\hat{Y} = 3.13443\ \ (22.7\ \text{Hrs})};\quad s_Y = \sqrt{s_E^{\ 2}\ [1 + 1/n + \frac{(X-\bar{X})^2}{\sum x^2}]} = .05543$$

$$3.13443 \pm 3.055(.05543) = \underline{3.30377\ (U)};\ \ \underline{2.96509\ (L)} = \begin{Bmatrix} 33.51\ \text{Hrs.} \\ 15.38\ \text{Hrs.} \end{Bmatrix}$$


60
90
Theoretical Slope of
Service time at
90% RH = 22.7 hrs.
and service time
at 100% RH = 8.0 hrs.
22.7 hrs.
99% of values
between these
points.
Log Service Time (hrs.)

REQUIREMENTS FOR NIOSH APPROVAL FOR AN ORGANIC VAPOR

CHIN CANISTER PER 30 CFR 11

Test Conditions

Challenge conc. 5000 ppm CCl_4

Test Humidity 50 $\pm$ 5% RH

Test Temperature 25 $\pm$ 2.5^{o} C

Flow 64 LPM for as received canisters

32 LPM for equilibrated canisters

Breakthrough conc. 5 ppm

Equilibration Conditions

3 Canisters as received.

2 Canisters equilibrated for 6 hrs., 64 LPM, 25% RH, Room Temp.

2 Canisters equilibrated for 6 hrs., 64 LPM, 85% RH, Room Temp.

Total 7 canisters.

Service Time Requirement 12 minutes. No statistical requirements. If all seven canisters have service times of 12 minutes or more, the canister is approved.

PROPOSED LOT ACCEPTANCE PLAN

4.1.1 MIL-STD 414, Level II, AQL 1% would be used to (1) select the proper number of cans to test, depending on lot size, and (2) to interpret the results regarding lot acceptance or failure.

4.1.2 The cans would be tested under the conditions of section 1; however, all tests would be conducted at 90% RD. Tests would be stopped at eight hours and the precent leakage recorded at this time. From evidence presented in the preceding sections, results at 90% are not significantly different from those at 100%.

4.1.3 The percent leakage values would be compared to the spec. limit of 1.0%, using the single spec. limit, variability unknown, standard deviation method of MIL-STD 414. Acceptance would be based on this analysis.

LOT SIZE	TEST SAMPLE
300-500	7
501-800	10
801-1,300	15
1,301-3,200	20
3,200-8,000	25

EXAMPLE OF LOT EVALUATION PER MIL-STD-414

SINGLE SPECIFICATION LIMIT - FORM 1

VARIABILITY UNKNOWN - STANDARD DEVIATION METHOD (REF. PAGE 37)

LEVEL II AQL = 1.0%

SPEC. LIMIT 1.0%

LOT SIZE - 500 CANS

SAMPLE SIZE (TABLE A_2, B-1) = 7 (n)

TEST RESULTS:

CAN #	8 HOUR BREAKTHROUGH CONCENTRATION (%)
41	.086
42	.028
43	.019
44	.064
45	.027
46	.035
49	.170

SAMPLE MEAN = .06129 ($\bar{x}$)

ESTIMATE OF LOT STANDARD DEVIATION = .05354 (s)

THE QUANTITY $(U-\bar{x})/s = \frac{1.00 - .06129}{.05354} = 17.53$

ACCEPTABILITY CONSTANT (k) = 1.62 (TABLE B-1)

LOT MEETS ACCEPTABILITY CRITERION SINCE $U-\bar{x}/s > k$

SAFETY FEATURES BUILT INTO THE PLAN

1. Flow Rate: 64 LPM ----- a person could not possibly breath at this rate for 8 hours.
   Probably at least twice the average rate.

2. 8 Hours Service Time ------ this is probably double the actual use time required.

3. Actual Service Times ------ minimum of 20 hours ----- 2-1/2 times the required 8 hours.

Conclusion: Would need a catastrophic failure for a can to not give proper protection ----- No destructive test sampling plan will pick up such a failure.

PLANNED FUTURE WORK

The following parameters will be further investigated to give additional support to the foregoing conclusions and proposals, and to develop a better lot acceptance plan.

1. Challenge concentration: 1, 10, 100, 250, 500 ppm
2. RH/T

AH mg/l \ T °C	5	15	25	34	43
4.5	66	35	19.5	12	7.5
9		70	39	24	15
18			79	49	30
36				97	60
54					90

Numbers in the table are the relative humidity percentages corresponding to the absolute humidity/temperature conditions.

3. Rate of Flow: 16, 32, 64 LPM
4. Cyclic vs. Constant Flow.

SUMMARY

1. Data supports approval of the GMR-I can for its intended use.
2. The proposed acceptance plan will assure quality of future lots.
3. Further work will be done to:
   - 3.1. Support the conclusions drawn in 1 and 2.
   - 3.2. Improve the lot acceptance plan by:
     - 3.2.1 Reducing the time required for testing and running the canisters to a 1% breakthrough service time.
     - 3.2.2 Simplifying the test procedure.