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 Time min.	Service 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	
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 Time min.	Service 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	
26	2/2/84	1560	26.0	
27	"	2070	34.5	
28	"	2220	37.0	
41	4/14/83	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 2.

Statistical Analysis of Lot 4/14/83

X (% RH)	Y (Svc. Time)	Log X	Log Y	
60	1200 min.	1.77815	3.07918	Ave. Y_{60} = 1355 min. (22.6 hrs.)
60	1500	"	3.17609	
60	1410	"	3.14922	Ave. Y_{90} = 1365 min. (22.7 hrs.)
60	1530	"	3.18469	
60	1410	"	3.14922	
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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	

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

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

Where Log Y = bo + b_1 Log X and bo = 3.08231, b_1 = 0.02606, where b_o 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

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

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.

REGRESSION ANALYSIS - GMR-I CANS LOT 4/14/83

Log 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

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

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

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

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

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

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

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

99% Conf. Limits on Slope β_1 =

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

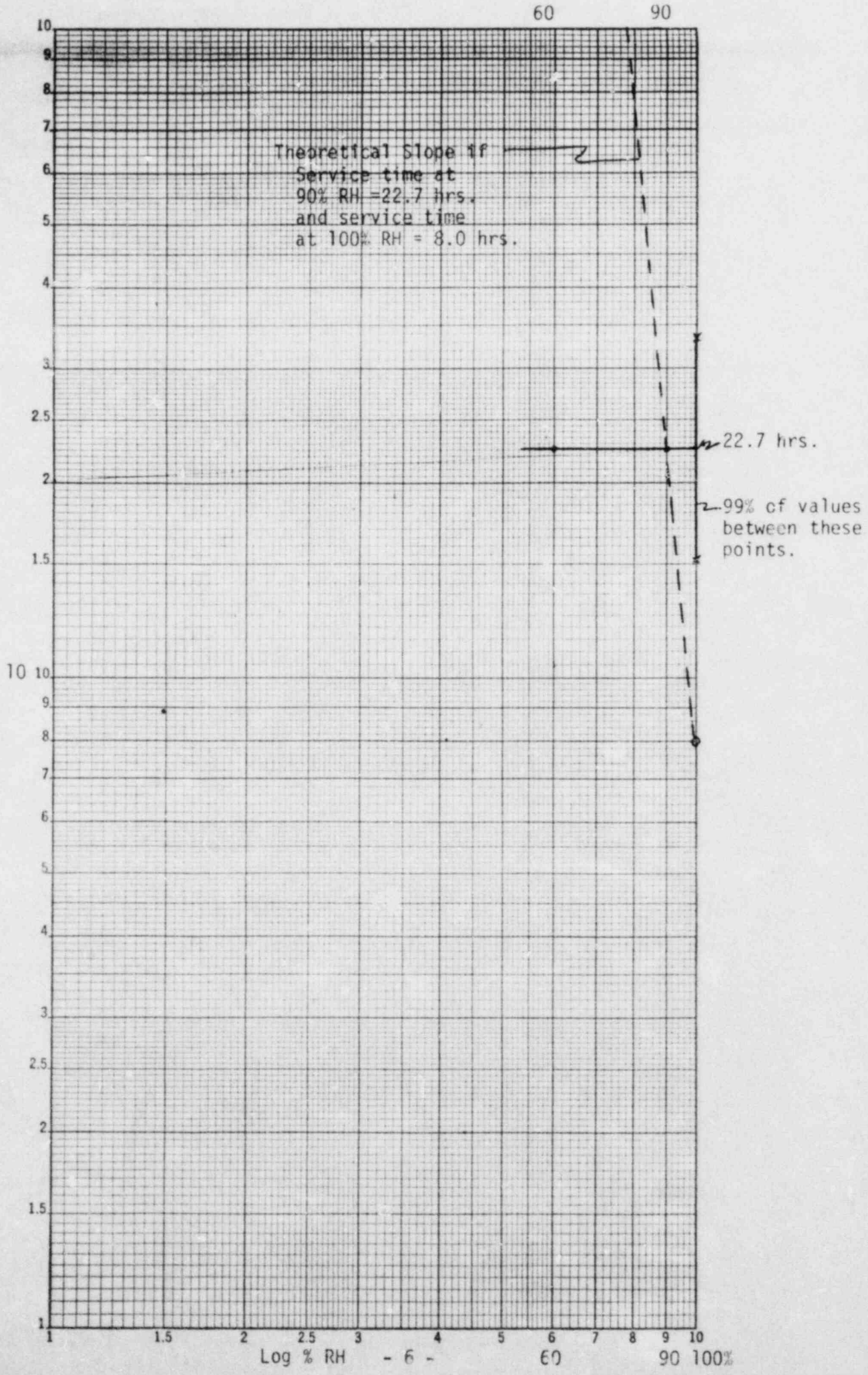
$$= +.49840, -.44628$$

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

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

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

$3.13443 \pm 3.055(.05543) =$ 3.30377 (U); 2.96509 (L) = { 33.51 Hrs. / 15.38 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 ± 5% RH

Test Temperature 25 ± 2.5° 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.
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Table 2.

Statistical Analysis of Lot 4/14/83

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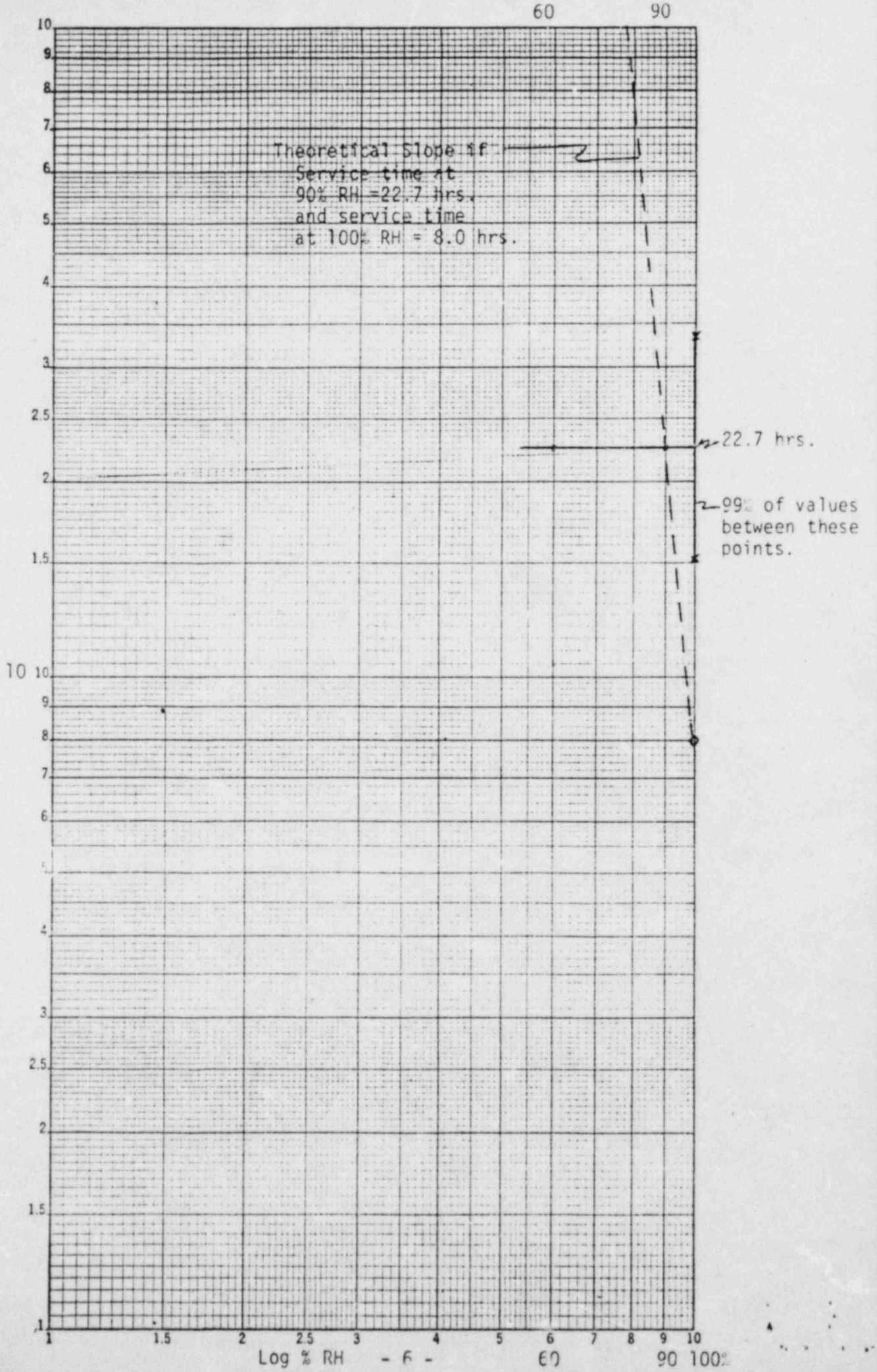
60
90
Theoretical Slope if
Service time at
90% RH =22.7 hrs.
and service time
at 100% RH = 8.0 hrs.
22.7 hrs.
99% of values
between these
points.
Log Service Time (hrs.)
Log % RH
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90
100%

REQUIREMENTS FOR NIOSH APPROVAL FOR AN ORGANIC VAPOR CHIN CANISTER PER 30 CFR 11

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SUMMARY/5/16/84

Requestor's ID:
PAM

dupe

Author's Name:
EReeves/pws

Document Comments:
MEETING HELD APRIL 25

MEETING SUMMARY DISTRIBUTION
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Gray File
Plant Service List

NRC Participants

Richard Serbu
Lynnette Hendricks
Oliver D. T. Lynch, Jr.

Dupe

Docket Nos. 50-348
and 50-364

May 17, 1984

LICENSEE: Alabama Power Company (APCo)

FACILITY: Farley Units 1 and 2

SUMMARY OF MEETING HELD ON APRIL 25, 1984, BETWEEN THE NRC STAFF AND ACPO REPRESENTATIVES TO DISCUSS APCO'S REQUEST FOR EXEMPTION TO 10 CFR 20 TO ALLOW USE OF PROTECTIVE FACTORS FOR RADIOIDINE CANISTERS

INTRODUCTION

The NRC Project Manager introduced the subject of the meeting as noticed on April 11, 1984. The NRC staff was introduced. Alabama Power Company (APCo) representative, Mr. Wayne Carr, was introduced. The meeting was held in response to APCo's letter dated March 5, 1984. List of attendees is attached.

DISCUSSION

By letter dated January 13, 1984, supplemented February 13, 1984 APCO applied to the Commission for exemption to 10 CFR 20 as it relates to Appendix A protection factors. The NRC review has been suspended pending APCo's obtaining additional canister qualification information and responding to NRC staff concerns expressed in NRC letter dated February 17, 1984. APCo's letter dated March 5, 1984, advised that a final response would be delayed unit testing was completed. APCo desired to meet with NRC at that time.

APCo representative, Mr. W. Carr, introduced the canister vendor representative, Dr. E. McKee, of Mine Safety Appliances Company (MSA) who discussed the current qualification data for their GMR-I canisters. A vue-graph presentation included the attached material. The MSA proposed lot acceptance plan was included in the discussion. Dr. McKee, MSA, stated the plan would conform to MIL-STD 414, Level II, AQL 1%.

MSA letter to APCo dated April 13, 1984 was presented for information. The letter will be submitted by APCo to NRC in response to NRC staff concerns expressed in NRC letter dated February 17, 1984. Other NRC concerns expressed in NRC letter dated February 17, 1984 were discussed. APCo agreed to provide a detailed response in the near future. At that time the NRC staff review would continue.

Dupe

SUMMARY

It was agreed that the meeting was useful and the NRC concerns appear to be resolved pending review of APCo's formal submittal.

Sincerely,

ORIGINAL SIGNED BY

Edward A. Reeves, Project Manager
Operating Reactors Branch # 1
Division of Licensing

Enclosures:
As stated

cc w/enclosures:
See next page

Dupe

ORB#1:DL
EReeves;ps
5/17/84

L-ORB#1:DL
SVarga
5/17/84

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 Time min.	Service 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	
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 Time min.	Service 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	
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.

MEETING SUMMARY DISTRIBUTION
OPERATING REACTORS BRANCH NO. 1

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