Bores

August 2, 1979

MEMORANDUM FOR: George H. Smith, Chief, Fuel Facility & Materials Safety Branch

FROM: R. J. Bores, Radiation Specialist

SUBJECT: RESIDENT WHOLE BODY COUNTING AT TMI

I have reviewed 746 of the approximately 765 resident whole body count results from Helgesen. In discussions with Mr. D. Pollard of Helgesen Nuclear Services on August 2, 1979, I relayed the problems found in my limited review of the data and my concerns with the radium and cesium results indicated. Approximately 20 results sheets were either missing or needed recalculation as results of some rather gross calculational problems. Mr. Pollard said that these sheets would be reviewed and sent out yet today, hopefully (August 2).

As discussed with you, the problems with the results ranged from completely missing results for individuals to gross problems - no potassium as a result of analyzer problems, to misspelled names, incorrect ages, count times, etc.

In my review of the whole body data taken as a whole, one of the conclusions that can be drawn is that no TMI related nuclides were identified. Approximately 28% of the individual results indicated small amounts of Cs-137 (generally 1 to 2 nanocuries with a similar size uncertainty). These levels, if real, can be generally attributed to residual cesium from fallout debris from nuclear weapons testing in the 1960s. However, I will return to this point later. (See Table 1 of Attachment 1).

The only other radioactivity indicated besides natural potassium-40 was that of RaBC and the implied Ra-226. Approximately 61% of the 746 individuals counted had Ra-226 activity indicated (see Table 2 of Attachment 1). The Ra-226 values were not measured, but were calculated/inferred from the RaBC daughters and assumed that equilibrium existed between the radium daughters and Ra-226. Dose commitments were then calculated for the Ra-226 burdens. The lack of equilibrium between RaBC and Ra-226 appears to be demonstrated in Attachment 2, which shows the original count and recount data for several individuals apparently with high radium burdens. The recount in each case, except for File 746, showed no radium activity higher than that of individuals counted at about that same time. As for File 746, I suspect that the recount of that individual was subject to the same phenomenon that had resulted in the previous anomalous type results.

In looking at the results of the whole body counts as a function of time (file number and counting sequence), one notes that as many as 15 or 20 counts in succession may have indicated the presence of radium, often correlated to wind speed and atmospheric stability. Then when a new background was run, there was often an abrupt change in the pattern such that the next several counts showed no radium, but then a gradual radium pattern was reestablished. On several days, when the radium presence was particularly noticeable, the atmospheric stability was classified as moderately or extremely stable for most of the day and the wind speed was low. Futher, the levels tend to change gradually rather than randomly, and independently of the age of the individual. (One would expect larger radium burdens in older individuals than in children if the source is common such as a water supply.) There also appeared to be no pattern based on geographical location of residence or on family relationships in those not counted in the same sequence. (Attachments 3a, b and c, and also Table 3 of Attachment1 show the fluctuations described.)

I have concluded that the bulk of the radium levels attributed to the TMI residents were the result of radon/daughter build-up in the whole body counter and the use of too few backgrounds. In part, the latter was due to the desire to "push people through" so as not to force them to wait in line and further inconvenience/irritate them.

After having described the pattern of radium appearance, I return to the cesium once more to make one additional point. The cesium appearance mimics that of the radium in that it too may appear in 8 of 10 counts on a given day after a new background. After a new background or on a day with less atmospheric stability, the frequency may be about 1 in 10. In looking at the radium BC spectrum, one sees that the RaC (Bi-214) has a 0.61 Mev gamma. Cs-137 has a 0.661 Mev gamma. (Attachment 4) With only a slight gain shift using NaI detectors, the RaC peak can be misread as cesium-137. Even though the levels of Cs-137 are not high enough to be of concern (residual fallout levels) the abrupt changes in the pattern of appearance dependent on counter backgrounds makes one suspect that most of the reported cesium levels are due to changes in the radon backgrounds and slight instrument gain shifts.

In conclusion, (1) the data indicate no TMI related nuclides were identified in the residents; (2) most of the radium attributed to the residents is probably due to the radon daughter background fluctuations and relatively infrequent counter background counts; and (3) the cesium levels are similarly due to background changes and possibly slight instrument gain shifts.

In order to further try to pin down the radium problem, it is recommended that a number of individuals with reported radium levels of 15 - 30

nanocuries be selected and recounted in a more controlled manner. I would suggest the University of Pittsburgh or ORNL rather than a portable facility, and that the count times be extended to get good statistics. (A gross peak height of approximately 15 counts in a channel in six minutes would lead to a inferred radium-226 burden of about 10 nanocuries in the TMI setup.) Factors to be weighed in making the above decision include additional costs for relatively low indicated levels of activity and dose commitment (once one assures himself of the lack of equilibrium between the RaBC and the inferred Ra-226), and the additional inconvenience and community upset resulting from the performance of the additional analyses.

R. J. Bores
Radiation Specialist

cc:
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Attachment 1 -

TABLE 1

Identified Cs-137 in TMI Residents (Broken into groups of about 100 each to show fluctuations.)

File Nos.	No Cs	Positive Cs	% Positive
1-100	51	19	49%
101-200	62	37	37%
201-300	84	15	15%
301-400	80	14	15%
401-500	76	24	24%
501-600	71	29	29%
601-700	74	24	24%
701-765	36	20	36%
Totals	534	212	28%

TABLE 2

Identified Ra-226 in TMI Residents (Broken into the same grouping.)

No Ra	Positive Ra.	% Positive
33	67	67%
31	68	69%
23	76	77%
48	46	49%
64	36	36%
35	65	65%
36	62	63%
18	38	68%
288	458	61%

TABLE 3

Distribution of Ra-226 Levels (nanocuries)

File Nos.	0	1-5	6-10	11-15	16-20	21-25	25-30	730
1-100	33	11	31	20	3	2	0	0
101-200	31	4	12	20	11	11	4	6
201-300	23	11	39	16	6	4	0	0
301-400	48	6	25	8	3	2	1	1
401-500	64	8	16	9	1	1	0	1
501-600	35	7	30	18	4	1	2	3
601-700	36	6	22	20	9	3	0	2
700-765	18	7	12	10	6	1	0	2
Totals	288	60	187	121	43	25	7	15
Percent	39%	8%	25%	16%	6%	3%	1%	2%
Accumulative Percent	39%	47%	72%	88%	94%	97%	98%	100%

Attachment 2

Recount Data for TMI Residents

		SEX	AGE	RaBC	Ra-226	Cs-137	Date
Original Count	File 383	M	8	14±3	47±8	2±2	4/14/7[illegible]
Recount	File 720	M	8	5±2	16±5		4/26/79
Original Count	File 429	F	56	24±3	78±9	2±2	4/14/7[illegible]
Recount	File 725	F	56	4±2	13±8		4/26/7[illegible]
Original Count	File 150	M	42	19±3	62±9	2±2	4/11/7[illegible]
Recount	File 727	M	42	1±2	5±6	1±1	4/26/[illegible]
Original Count	File 534	F	11	14±2	48±8	2±2	4/16/7[illegible]
Recount	File 742	F	11	2±2	5±5		4/26/[illegible]
Original Count	File 535	M	41	17±3	56±11		4/16/7[illegible]
Recount	File 739	M	41	1±2	5±7	2±2	4/26/[illegible]
* Original Count	File 736	F	69	58±5	192±17	7±4	4/26/[illegible]
Recount	File 744	F	69	7±2	24±7		5/17/7[illegible]
Original Count	File 625	F	26	25±3	84±10	2±2	4/17/7[illegible]
Recount	File 740	F	26	5±2	16±7		4/26/[illegible]
Original Count	File 109	M	81	10±3	32±9		4/11/7[illegible]
Recount	File 746	M	81	16±3	53±9		4/21/[illegible]

* awaiting reexamination of these results – File 736 indicated 1.4 [illegible] of Ra-226, however, [illegible] problems were apparent.

Attachment 3q

TMI WHOLE BODY COUNTING

Time	Serial	File	Sex	Age	nanocuries Ra BC	Ra-226	Cs-137	wind speed stability
4/11/79 1619	126	126	F	15	4±2	12±7		5.0 D
1731	127	127	M	41	7±2	23±6		4.5 D
1740	128	128	M	15	5±2	17±7	1±2	
1749	129	129	F	11	4±2	12±7		
1759	130	130	M	49	4±2	13±6	1±1	
1811	131	131	M	6	2±2	7±7		3.1 E
1820	132	132	M	10	3±2	11±7		
1830	133	133	F	36	7±2	22±8	2±2	
1843	134	134	F	7	3±2	9±6		
1852	135	135	F	53	8±2	25±8		
1907	136	136	F	22	8±3	28±9		4.6 F
1646	137	137	M	25	6±3	18±9	2±2	5.0 D
1655	138	138	F	12	7±2	22±7		
1709	139	139	F	19	7±2	13±8		4.5D
1713	140	140	F	10	6±2	19±7		
1722	141	141	M	46	5±2	17±6	1±1	
1942	142	142	F	9				4.6 F
1952	143	143	M	59			2±1	
2001	144	144	M	31			1±2	2.3 G
2017	145	145	M	31	2±2	7±6	3±2	
2036 *	146	146	M	29	7±2	22±7	1±2	
2035	147	147	M	4	4±2	13±7		
2044	148	148	F	13	3±2	11±6		
2053	149	149	F	49				
2101	150 (1)	150	M	42	19±3	62±9	2±2	4.2 G

* 2026 ?

(1) Recounted on 4/26/79 - File 727

Attachment 3b

TMI WHOLE BODY COUNTS

Time 4/12/79	File	Sex	Age	RaBC (nanocuries)	Ra-226 (nanocuries)	Cs-137 (nanocuries)	Wind speed / stability
1334	201	F	67	–		2±2	3.8 E
1406 ← bkg	202	M	31	4±2	12±7		6.4 E
1417	203	M	14	2±2	7±7		
1428	204	M	67				
1441	205	M	10	2±2	8±6		
1455	206	M	54	2±2	5±7		
1521	207	F	8	2±2	6±7		1.6 E
1536	208	F	75	3±2	10±8		
1547	209	F	4	3±2	9±7		
1603	210	M	37	2±2	8±7		3.4 E
1615	211	M	46	3±2	9±7		
1627	212	M	9	1±2	3±6		
1639	213	F	24	2±2	6±7		
1655	214	F	8	5±2	16±7		
1708	215	M	64	1±2	4±6		4.5 F
1720	216	M	13	3±2	9±7		
1732	217	M	53				
1744	218	F	33	3±2	9±5		
1756	219	M	12	1±2	4±6		
1808	220	F	29	3±2	12±7		3.2 E
1818	221	F	10	3±2	9±6		
1830	222	M	19	3±2	8±7		
1840	223	F	27	2±2	8±6		
1853	224	F	7	7±2	22±8		
1905	225	M	5	5±2	16±6		2.5 E

Margin notes (left): .03" rain (through 1334); 0.01" rain (1521–1655); Trace rain (1708–1756)

Attachment 3c

TMI WHOLE BODY COUNTS

Time 4/13/79	File	Sex	Age	Nanocuries Ra BC	Ra-226	Cs-137	
0018	251	F	29	3±2	9±7		4.3 G
0026	252	F	47	4±2	13±7		
0035	253	M	37	1±2	4±8	2±2	
0046	254	M	68	6±3	21±8		
0054	255	M	33				
0107	256	M	17				1.6 F
0118	257	F	10	2±2	7±7		
0127	258	F	29	2±2	8±6		
0136	259	M	32	4±2	15±8		
0146	260	F	52	2±2	8±7		
0155	261	M	49	2±2	5±8		
bkg → 0631	262	M	32				16.3 E
0643	263	F	11			1±2	
0654	264	F	67				
0704	265	M	50	1±2	4±6		14.8 D
0718	266	M	73			2±2	
0734	267	M	41			5±2	
0746	268	F	48	2±2	7±8	1±2	
0754	269	F	10			1±2	
0804	270	M	26				12.0
0813	271	F	20				
0822	272	M	38	2±2	8±8	1±2	
0841 ← bkg	273	M	10	2±2	6±7		
0850	274	F	21	3±2	9±8		
0722	275	M	9				14.9 C

Attachment 4

HARRISBURG,PA
3 MILE ISL 4

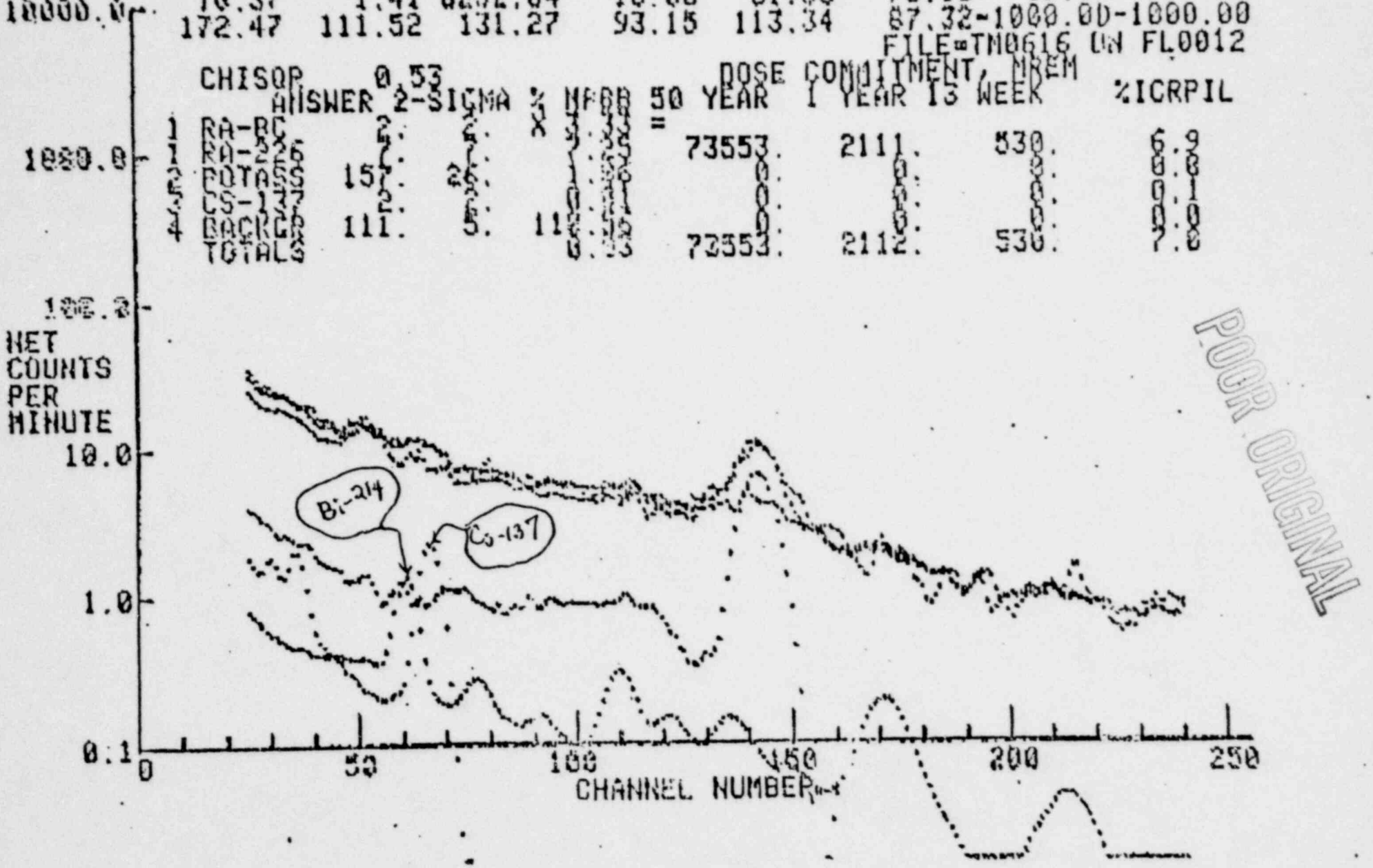
04/17/79 RT 0844 (6.33 MIN. COUNT)
SEX=M HT=5 10 AGE=30 WT=185 ANALYST=VM

	6.98	140.02	10.53	1.31	7.16	142.22	34.70	10.88
	10.37	1.41	6252.64	16.00	81.65	70.10	59.59	115.29
	172.47	111.52	131.27	93.15	113.34	87.32	-1000.00	-1000.00

FILE=TM0616 ON FL0012

CHISQR 0.53

	ANSWER	2-SIGMA	% MDA	DOSE COMMITMENT, MREM 50 YEAR	1 YEAR	13 WEEK	%ICRPIL
1	RA-BC	52.	4.	73553.	2111.	530.	6.9
2	RA-226			0.	0.	0.	0.0
3	POTASS	15.	2.	0.	0.	0.	0.0
4	CS-137	2.		0.	0.	0.	0.0
5	BACKGR	111.	5.	11.	0.	0.	0.0
	TOTALS			73553.	2112.	530.	7.0



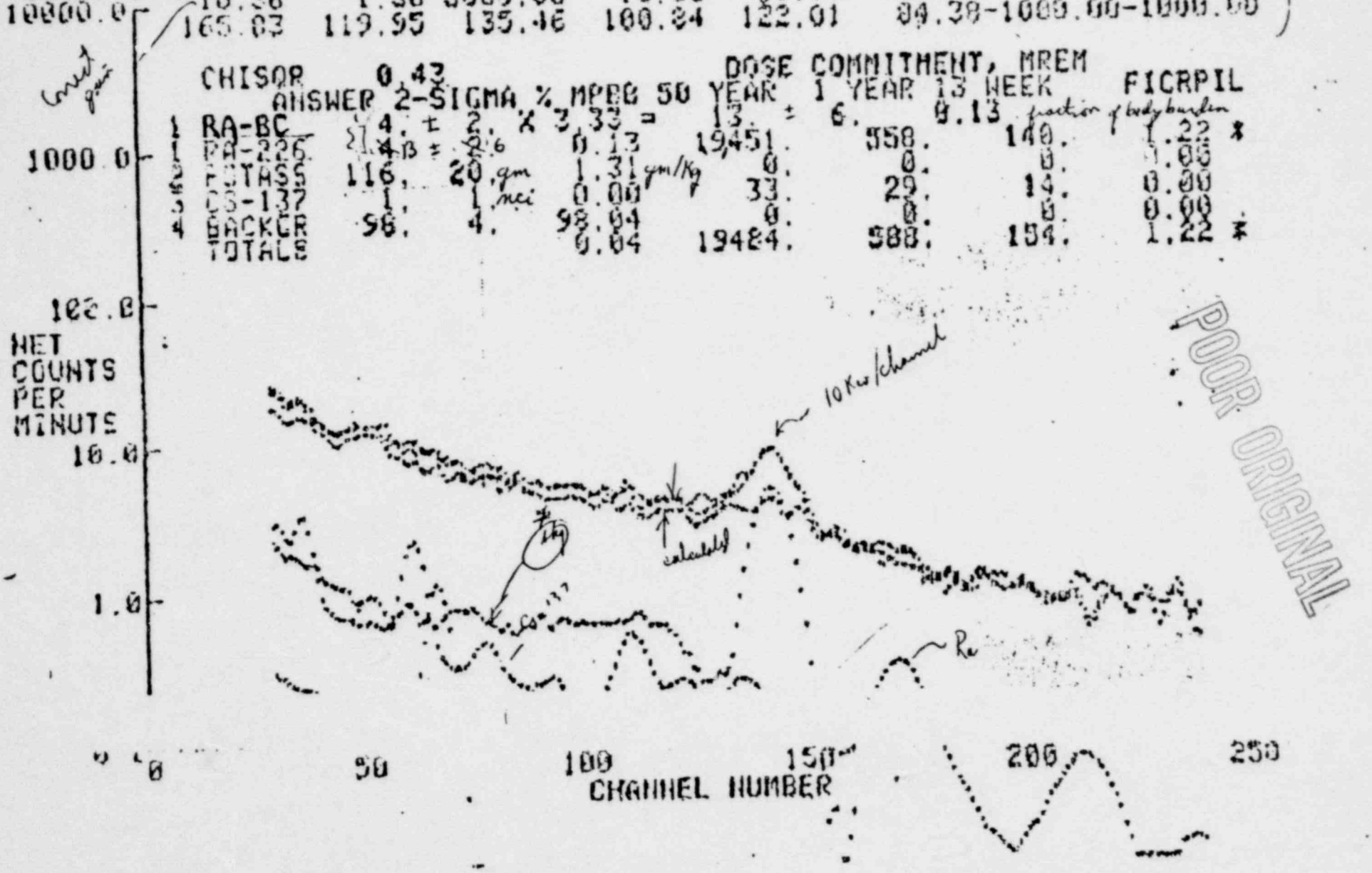
Am-241 K-40 fatigue TM cervical Am. K-40

ABRAHAM, KARL 075-22-2543 04/11/79 AT 7?? (6.10 MIN COUNT)
3 MILE ISL 4 NRC PUB AFF SEX=M HT=5 8 AGE=49 WT=195 ANALYST=JH

FILE TH0130	6.70	135.15	10.91	1.32	7.05	142.26	36.08	8.30	
	10.36	1.38	5605.68	16.68	66.61	68.90	56.14	123.23	
10000.0	165.83	119.95	135.46	100.84	122.01	84.38	-1000.00	-1000.00	

CHISQR 0.43 DOSE COMMITMENT, MREM

	ANSWER	2-SIGMA	% MPBB	50 YEAR	1 YEAR	13 WEEK	FICRPIL
							fraction of body burden
1 RA-BC	14.	± 2.	X 3.33 =	13.	± 6.	0.13	
2 RA-226	14.	± 2.6	0.13	19,451.	558.	140.	1.22 *
3 POTASS	116.	20. gm	1.31 gm/Kg	0.	0.	0.	0.00
4 CS-137	1.	1. nci	0.00	33.	29.	14.	0.00
BACKGR	96.	4.	98.04	0.	0.	0.	0.00
TOTALS			0.04	19484.	588.	154.	1.22 *



april 11, 1979
Middletown, Pa.