Long
Island
Power
Authority

Shoreham Nuclear Power Station
P.O. Box 628
North Country Road
Wading River, N.Y. 11792

LSNRC-2165

APR 21994

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, DC 20555

Attn: C. L. Pittiglio

Request for Modification of Facility Release Criteria;
Application to Low Energy Beta Emitters and Electron Capture Nuclides
Shoreham Nuclear Power Station - Unit 1
Docket No. 50-322

Ref: (1) Long Island Power Authority Letter LSNRC-2133, dated January 10, 1994; subject: Shoreham Decommissioning Project Termination Survey Plan - Revision 2

(2) Telecon between D. Fauver (NMSS) and S. Schoenwiesner, F. Petschauer, M. Tucker (LIPA) dated April 12, 1994; subject: Termination Survey Concerns for Bioshield Blocks and Limitations on Post-License Termination Activities

Ladies & Gentlemen:

As provided by Reference 1, present plans for performing the termination survey of the Shoreham facility include certain provision to account for the presence of isotopes which are not typically detected with field survey instruments. Specifically, a scaling factor of 1.2 has been developed from samples of typical corrosion product deposits at the facility, to account for the potential presence of undetected Iron-55. As described in the Termination Survey Plan, this factor is applied to all termination survey measurements where results are statistically greater than background.

NRC

As a result of continuing decommissioning activities, it has become necessary for LIPA to include surveys of blocks containing potentially activated concrete and steel from the biological shield wall in the final termination survey. In approaching the block surveys, LIPA has determined that the previously described scaling factor may not account for all isotopes present in the concrete or steel, nor will that factor provide the correct adjustment for the calculated ratios of the undetected isotopes to the detectable isotopes. This matter was discussed with the NRC staff, as noted in Reference 2. During the discussion it was recognized that application of an increased scaling factor to account for the undetected presence of both Iron-55 and tritium (H-3) in neutron activated biological shield wall materials would, under the limitations of Regulatory Guide 1.86 as presently implemented in the Shoreham Decommissioning Project Termination Survey Plan, severely limit LIPA's options regarding the proper disposition of this or any similar materials.

Attachment 1 provides technical information on the biological shield wall blocks which are to be surveyed. From this information it can be seen that if the present release criteria for release for unrestricted use is applied to the expected survey results from this concrete, the concrete will not meet the criteria solely because of the high Iron-55 and tritium scaling factors. This would thus necessitate the shipment and burial of the concrete, at a cost of approximately $1,000,000, without a clear benefit as evidenced by the absence of any appreciable dose rate or health risk from the concrete.

It is clear that Iron-55 and tritium pose significantly lower risks to the health and safety of the public than other beta-gamma emitting isotopes which are appropriately restricted by the limitations imposed by Regulatory Guide 1.86, Table 1. LIPA understands that the NRC is considering to address this issue for certain other decommissioning projects by revising the allowable levels of residual contamination which result from certain low energy beta-gamma emitters such as the Iron-55 and tritium calculated to be present at the Shoreham facility. LIPA therefore requests the NRC to consider application of these revised release criteria to the Shoreham decommissioning effort. Although the precise release criteria have yet to be established, LIPA understands the current average limit of 5,000 dpm/100 cm^2 for beta-gamma emitters could be increased to levels of between 100,000 to 150,000 dpm/100 cm^2 for weak beta emitters or electron capture nuclides such as tritium and Iron-55. Were such increased limits to be applied to the surveys of the activated concrete and steel at Shoreham, in the manner described by draft NUREG/CR-5849, Appendix A, it is likely the biological shield wall blocks would meet the release criteria for unrestricted use and avoid the tremendous cost of shipment and burial. The environmental impacts and industrial safety risks associated with the handling of these blocks would also be avoided.

Should the above request for modification of the facility release criteria be granted, LIPA intends to apply the revised guideline values only to survey units where the most probable source of potential residual contamination is neutron activated materials.

These survey areas include the biological shield wall blocks themselves and other areas where residual contamination from block cutting and handling may exist. It may also include surveys of areas containing activated metal or metal residues within the plant dryweli and in the Dry Cutting Station. The remainder of the facility will continue to be surveyed and reported in the manner described in Reference 1, utilizing the scaling factor for Iron-55 which is appropriate for residual contamination resulting from the deposition of corrosion product materials.

Please do not hesitate to contact me if you have any questions or require any additional information in this matter.

Very truly yours,

A.J. Bortz
Resident Manager

cc: D. Fauver
R. Nimitz
R. Bernero, Director
Office of Nuclear Material Safety and Safeguards

bcc:

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TERMINATION SURVEY MEASUREMENTS WHERE HIGH FRACTIONS OF HARD-TO-MEASURE NUCLIDES MAY BE PRESENT

INTRODUCTION

The Shoreham Decommissioning Termination Survey Plan indicates that the major source of residual contamination (from licensed facility operations) is activated corrosion products deposited in piping systems. These deposits were characterized as predominantly Co-60 and Fe-55 with an Fe-55:Co-60 ratio of 0.19, adjusted for radioactive decay to June, 1994. Application of this ratio (rounded to 0.2) leads to an adjustment factor of 1.2 applied to measurements of surface beta-gamma activity (direct and removable) to account for the unmeasured fraction (Fe-55) on gross activity measurements determined to be "above background".

However, in some instances the potential source of contamination may be of different origin than piping system corrosion product deposits. For example, portions of the Reactor Biological Shield (poured concrete and steel) which were neutron activated remain in the facility. Shoreham Site Characterization results indicate that the isotopic composition and ratios of hard-to-detect species to Co-60, e.g., Fe-55:Co-60 for these materials are significantly different from plant corrosion product deposits. The ratios of hard-to-measure species to Co-60 concentration are calculated to be as high as 25 to 1. Given these circumstances, two options are identified: 1) all bioshield wall materials with "detectable" activity are disposed of as radioactive waste as they do not meet the release criteria when material specific adjustment factors are applied to direct surface activity measurements; or, 2) special guideline values are applied to termination survey measurements on potentially contaminated materials with large fractions of hard-to-measure nuclides.

CHARACTERIZATION OF NEUTRON IRRADIATED STEEL AND CONCRETE

The Bioshield wall materials of concern are blocks produced by diamond wire sawing to facilitate dismantling of the wall and disposal of the wall region where calculations have shown that the 5 μR/hr gamma exposure rate release criterion is not satisfied. Two layers of blocks from the upper portions of the Bioshield wall which were removed to gain access to the most highly activated portions remain on site. These upper portions are identified as the "C" and "D" rings of the wall. Gamma dose rate measurements indicate that all the C and D ring blocks satisfy the 5 μR/hr criterion. Figure 1 shows a view of a typical block, comprised of poured concrete with carbon steel plates lining the inner and outer surfaces of the former Bioshield wall structure. The isotopic composition of these materials as derived from neutron activation calculations is summarized in Table 1.

Table 1

Radionuclide Composition of Neutron Irradiated Bioshield Wall Materials

Material	Nuclide	Ratio to Co-60[1]	Fraction of total[2]
Concrete	H-3	23.1	0.64
"	Fe-55	12.2	0.34
"	Co-60	1	0.03
Steel	Fe-55	24.7	0.96
"	Co-60	1	0.04

Table 1 Notes:
(1) Ratio of nuclide to Co-60 for specified material.
(2) Fraction of total activity in specified material.

These results are obtained from Shoreham Site Characterization Report data corrected for radioactive decay and normalized to the concrete and steel mass in the Bioshield wall (See Appendix 1, April 11, 1994 Memorandum from N. Lizzo to M. Tucker). Minor constituents identified in the activation analysis, such as C-14, Ni-59, Ni-63, and Mn-54 are neglected as together they comprise less than one per cent of the total activity and may have already been included as part of the Co-60 equivalent activity estimate/survey.

RESULTS OF PRELIMINARY TERMINATION SURVEY MEASUREMENTS

Direct surface activity measurements from exposed steel and concrete surfaces were taken on 25 blocks from the C and D rings, on or about April 11, 1994. Each measurement was converted to dpm/100 cm^2 using the detector efficiency developed for the Termination Survey and a background value obtained for the detector and material in accordance with Termination Survey Procedures.

From these measurements, two populations are obtained, one comprising measurements on steel surfaces (50 measurements) and one of measurements on concrete surfaces (38 measurements). It is concluded from a review of these data and supporting investigations, that no detectable activity is present on concrete surfaces, but detectable surface activity is present in the inner steel liners on several of the blocks. The results of the measurements on steel and concrete are displayed graphically in Figures 2 and 3. In these figures, the calculated results in dpm/100 cm^2 are plotted vs the survey location code.

The critical level [1] is also plotted to identify those measurements which are considered to be above the background value, indicating the presence of detectable activity. Figure 2, the steel measurement graph, shows that several measurements exceed the critical level. Figure 3, for the concrete measurements, shows no evidence of detectable activity. The measurement data and the calculated activity results for each of the steel measurements is shown in Table 2. Qualitative gamma spectroscopy measurements taken with a portable NaI scintillator on exposed surfaces confirm the presence of Co-60 activity in the steel liners on two of four blocks evaluated by this method. Gamma spectroscopy measurements at four concrete surface locations with the highest direct measurement results showed no detectable Co-60.

The measurements described above were all treated according to the current termination survey data evaluation procedure, whereby all measurements above the critical level were multiplied by the present factor of 1.2 to account for Fe-55. Under this treatment, none of the measurements exceed the guideline value of 5,000 dpm/100 cm^2. However, if the steel measurements above the critical level were to be adjusted based upon the Fe-55:Co-60 ratio in Table 1, i.e., multiplied by a factor of 25.7 in Table 4, 16 of the 50 measurements would be above the current 15000 dpm/100 cm^2 elevated area guideline value. The 16 measurement values when so adjusted, range from 15700 up to 34,000 dpm/100 cm^2. The resulting sample average for the 50 measurements is 7980 dpm/100 cm^2, well above the 5000 dpm/100 cm^2 guideline value.

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[1] In the Shoreham Decommissioning Termination Survey Plan, the critical level for surface activity measurements is defined as... the upper confidence limit, at the 95 % confidence level of the observed net count distribution whose mean value is zero (converted to dpm/100 cm^2). It is calculated as:

$$L_c = 1.96 \frac{\sqrt{S_s^2 + S_b^2}}{E(\frac{A}{100})}$$

where:

L_c = the Critical level, used to identify measurements most likely to be "above" background.

S_s = the counting error in the measurement,

S_b = the counting error associated with the assigned background,

E = detector efficiency in counts per disintegration, and

A = area of detector sensitive region (cm^2), and

1.96 = 97th percentile value of a one-tailed normal distribution.

DISPOSAL COST ESTIMATE FOR BIOSHIELD RING BLOCKS

If required to be disposed of as radioactive waste, each block containing detectable activity will cost $21,000 to dispose of, exclusive of transportation costs which are about $5,000 per shipment. The cost estimate is as follows: burial cost of $300 per cubic foot and the volume of a typical block is 70 cubic feet. As an upper limit estimate for C and D ring disposal costs, it is assumed that all 25 blocks are found to contain detectable Co-60 activity and are disposed of as radioactive waste. The total cost is approximately $ 600,000, assuming two blocks per shipment.

After removal of the most highly activated portions of the Bioshield wall, the E and F rings, the remaining Bioshield wall will be evaluated in place. If the G ring is found to contain detectable Co-60, this material may also have to be disposed of as radioactive waste under the current release criteria guideline values. This adds approximately $ 300,000 to the estimated burial cost.

In addition, this extra volume may cause LIPA to incur a thirty percent penalty factor at the burial site if our present space allocation is exceeded.

APPLICATION OF REVISED GUIDELINE VALUES

An alternative has been proposed whereby special release criteria guideline values are utilized which take into account the relative biological risk posed by the various hard-to-measure radionuclides. To illustrate, gross activity guideline values are developed for steel and concrete materials of radioactivity composition shown in Table 1. The example used here utilizes individual nuclide guideline values of 150,000 dpm/100 cm^2 for the hard-to-measure species calculated to be present in neutron irradiated Bioshield wall materials at Shoreham.

The method outlined in NUREG/CR-5849, Appendix A is used to derive gross activity guideline values for irradiated Bioshield steel and concrete. The gross activity guideline value is defined as:

$$GAG = \frac{1}{\frac{f_1}{G_1} + \frac{f_2}{G_2} + \ldots \frac{f_n}{G_n}}$$

where:

GAG = gross activity guideline value in dpm/100 cm^2,

f_1 = fraction of total activity represented by nuclide 1, etc and

G_1 = guideline value for the first nuclide, etc in dpm/100 cm^2.

To illustrate, the gross activity guideline value calculation for Bioshield steel liner material is:

The calculated special gross activity guideline values for Bioshield wall concrete and steel are summarized in Table 3 below.

$$GAG = \frac{1}{\frac{0.96}{150{,}000} + \frac{0.04}{5{,}000}} = 69{,}000 \ dpm/100 cm^2.$$

Table 3

Summary of Material-Specific Guideline Value Derivation
(Assuming GLV = 150,000 dpm/100 cm^2 for H-3, Fe-55)

Material	Nuclide	Fraction of total[1]	Individual Nuclide GLV[2]	Gross Activity GLV for Material[2]
Concrete	H-3	0.64	150,000	80,000
"	Fe-55	0.34	150,000	"
"	Co-60	0.03	5,000	"
Steel	Fe-55	0.96	150,000	69,000
"	Co-60	0.04	5,000	"

Table 3 Notes:

(1) Fraction of total activity in specified material.

(2) Units are dpm/100 cm^2.

The application of these special gross activity guideline values is illustrated by the 50 measurements on Bioshield steel reported in Table 2 and Figure 2. The revised adjustment factor of 25.7 is applied to all measurements above the critical level. The results are shown in Table 4. Individual measurement results are well below the 69,000 dpm/100 cm^2 gross activity guideline value. If the data were to be evaluated in accordance with current procedures for evaluating compliance with release criteria, each measurement would be compared to an elevated area guideline value as well (three times 69,000 = 207,000 dpm/100 cm^2). Such a provision does not seem warranted, based upon the present example. Assuming the 50 measurements represent a suitable sample of the "population" defined by the concrete portion of the Bioshield C and D ring blocks, the upper limit of the confidence interval about the sample mean is also calculated. As seen in Table 4, the UCL value of 10816 dpm/100 cm^2, is also well below the special gross activity guideline value.

FIGURE 1
BIOSHIELD BLOCKS (Typical)
(Two Views)

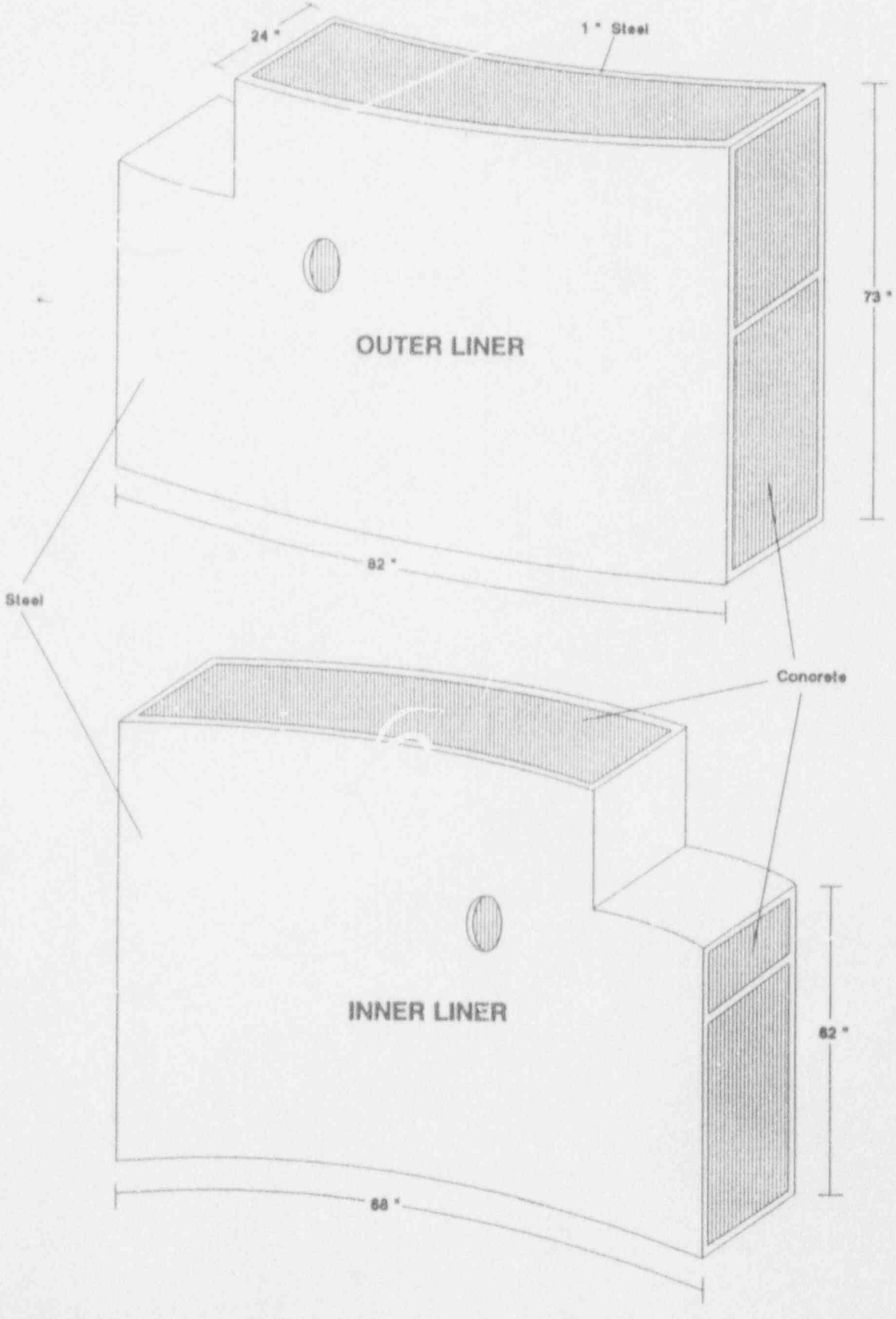


Figure 2

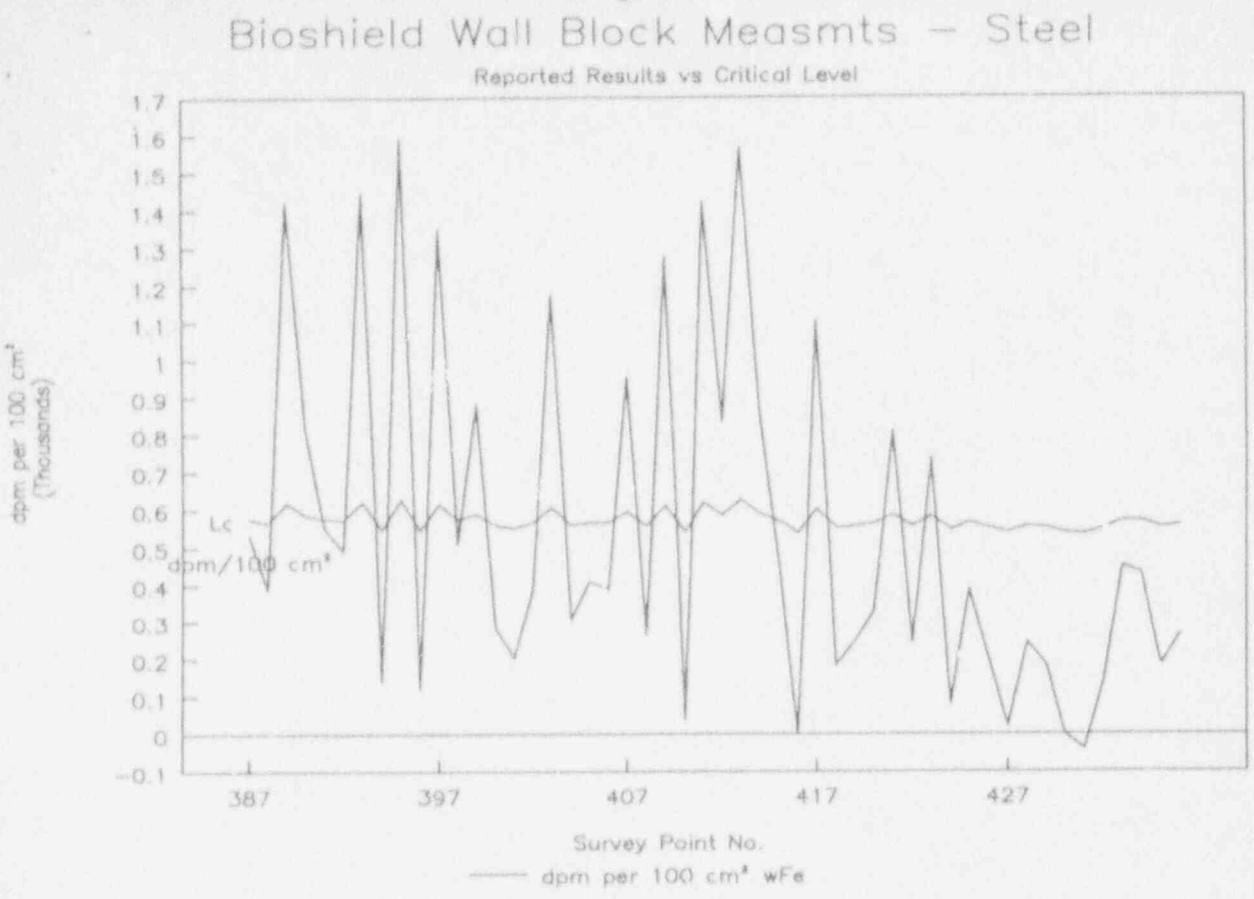
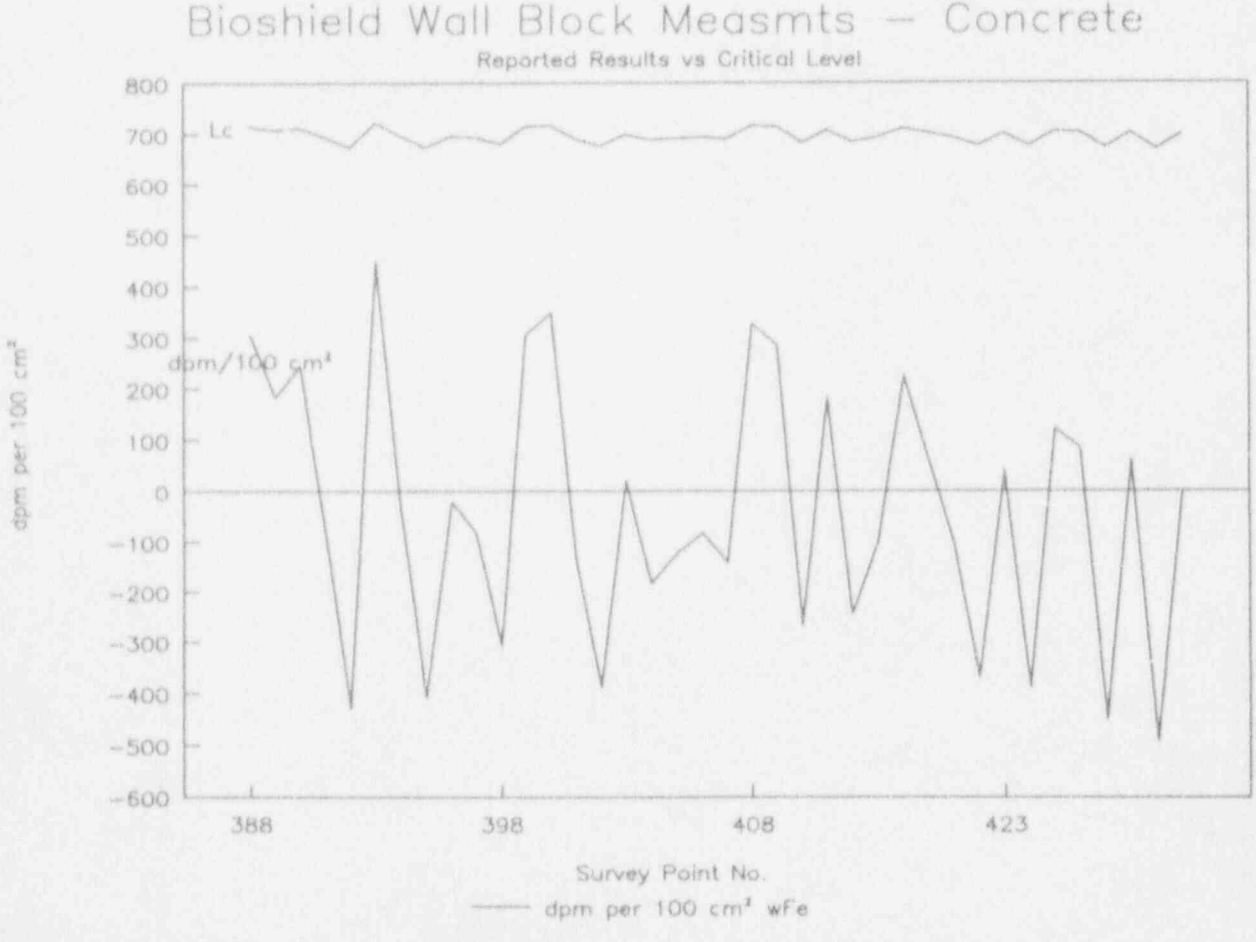


Figure 3



Bioshield Wall Block Measurements - Steel With 1.2 Fe-55 Adjustment Factor

RW073F2	type3		mean	544.8	dpm/100 cm²	Type 3 Bkg Fit Check	
count	50		std D	464.3	dpm/100 cm²		FT126
neg count	1		UCL	655.1	dpm/100 cm²	No. > Lc	16
min	-40.8	dpm/100 cm²	GL val	5000	dpm/100 cm²	No. < Lc	34
max	1591.8	dpm/100 cm²	Range	1633	dpm/100 cm²	Avg gcpm	103.0

type	point_no	gcpm	bcpm	eff	dpm/100 cm²	Lc	+Fe
3	387	116	90	0.049	530.6	574.1	530.6
3	388	109	90	0.049	387.8	564.3	387.8
3	389	148	90	0.049	1183.7	617.1	1420.4
3	390	123	90	0.049	673.5	583.8	808.2
3	391	117	90	0.049	551.0	575.5	551.0
3	392	114	90	0.049	489.8	571.3	489.8
3	393	149	90	0.049	1204.1	618.4	1444.9
3	394	97	90	0.049	142.9	547.0	142.9
3	395	155	90	0.049	1326.5	626.1	1591.8
3	396	96	90	0.049	122.4	545.5	122.4
3	397	145	90	0.049	1122.4	613.2	1346.9
3	398	115	90	0.049	510.2	572.7	510.2
3	399	126	90	0.049	734.7	587.9	881.6
3	400	104	90	0.049	285.7	557.1	285.7
3	401	100	90	0.049	204.1	551.4	204.1
3	402	109	90	0.049	387.8	564.3	387.8
3	403	138	90	0.049	979.6	604.0	1175.5
3	404	105	90	0.049	306.1	558.6	306.1
3	405	110	90	0.049	408.2	565.7	408.2
3	406	109	90	0.049	387.8	564.3	387.8
3	407	129	90	0.049	795.9	591.9	955.1
3	408	103	90	0.049	265.3	555.7	265.3
3	409	142	90	0.049	1061.2	609.3	1273.5
3	410	92	90	0.049	40.8	539.6	40.8
3	411	148	90	0.049	1183.7	617.1	1420.4
3	412	124	90	0.049	693.9	585.1	832.7
3	413	154	90	0.049	1306.1	624.8	1567.3
3	414	125	90	0.049	714.3	586.5	857.1
3	415	112	90	0.049	449.0	568.5	449.0
3	416	90	90	0.049	0.0	536.7	0.0
3	417	135	90	0.049	918.4	600.0	1102.0
3	418	99	90	0.049	183.7	549.9	183.7
3	419	102	90	0.049	244.9	554.3	244.9
3	420	106	90	0.049	326.5	560.0	326.5
3	421	123	90	0.049	673.5	583.8	808.2
3	422	102	90	0.049	244.9	554.3	244.9
3	423	120	90	0.049	612.2	579.7	734.7
3	424	94	90	0.049	81.6	542.6	81.6
3	425	109	90	0.049	387.8	564.3	387.8
3	426	100	90	0.049	204.1	551.4	204.1
3	427	91	90	0.049	20.4	538.1	20.4
3	428	102	90	0.049	244.9	554.3	244.9
3	429	99	90	0.049	183.7	549.9	183.7
3	430	90	90	0.049	0.0	536.7	0.0
3	431	88	90	0.049	-40.8	533.7	-40.8
3	432	97	90	0.049	142.9	547.0	142.9
3	433	112	90	0.049	449.0	568.5	449.0
3	434	111	90	0.049	428.6	567.1	428.6
3	435	99	90	0.049	183.7	549.9	183.7
3	436	103	90	0.049	265.3	555.7	265.3

Bioshield Wall Block Measurements - Steel With 25.7 Fe-55 Adjustment Factor

RW073F3			mean	7984.8	dpm/100 cm²	Type 3 Bkg Fit Check	
count	50		std D	11914.9	dpm/100 cm²		FT126
neg count	1		UCL	10815.7	dpm/100 cm²	No. > Lc	16
min	-40.8	dpm/100 cm²	GL val	69000	dpm/100 cm²	No. < Lc	34
max	34091.8	dpm/100 cm²	Range	34133	dpm/100 cm²	Avg gcpm	103.0

type	point_no	gcpm	bcpm	eff	dpm/100 cm²	Lc	+Fe
3	387	116	90	0.049	530.6	574.1	530.6
3	388	109	90	0.049	387.8	564.3	387.8
3	389	148	90	0.049	1183.7	617.1	30420.4
3	390	123	90	0.049	673.5	583.8	17308.2
3	391	117	90	0.049	551.0	575.5	551.0
3	392	114	90	0.049	489.8	571.3	489.8
3	393	149	90	0.049	1204.1	618.4	30944.9
3	394	97	90	0.049	142.9	547.0	142.9
3	395	155	90	0.049	1326.5	626.1	34091.8
3	396	96	90	0.049	122.4	545.5	122.4
3	397	145	90	0.049	1122.4	613.2	28846.9
3	398	115	90	0.049	510.2	572.7	510.2
3	399	126	90	0.049	734.7	587.9	18881.6
3	400	104	90	0.049	285.7	557.1	285.7
3	401	100	90	0.049	204.1	551.4	204.1
3	402	109	90	0.049	387.8	564.3	387.8
3	403	138	90	0.049	979.6	604.0	25175.5
3	404	105	90	0.049	306.1	558.6	306.1
3	405	110	90	0.049	408.2	565.7	408.2
3	406	109	90	0.049	387.8	564.3	387.8
3	407	129	90	0.049	795.9	591.9	20455.1
3	408	103	90	0.049	265.3	555.7	265.3
3	409	142	90	0.049	1061.2	609.3	27273.5
3	410	92	90	0.049	40.8	539.6	40.8
3	411	148	90	0.049	1183.7	617.1	30420.4
3	412	124	90	0.049	693.9	585.1	17832.7
3	413	154	90	0.049	1306.1	624.8	33567.3
3	414	125	90	0.049	714.3	586.5	18357.1
3	415	112	90	0.049	449.0	568.5	449.0
3	416	90	90	0.049	0.0	536.7	0.0
3	417	135	90	0.049	918.4	600.0	23602.0
3	418	99	90	0.049	183.7	549.9	183.7
3	419	102	90	0.049	244.9	554.3	244.9
3	420	106	90	0.049	326.5	560.0	326.5
3	421	123	90	0.049	673.5	583.8	17308.2
3	422	102	90	0.049	244.9	554.3	244.9
3	423	120	90	0.049	612.2	579.7	15734.7
3	424	94	90	0.049	81.6	542.6	81.6
3	425	109	90	0.049	387.8	564.3	387.8
3	426	100	90	0.049	204.1	551.4	204.1
3	427	91	90	0.049	20.4	538.1	20.4
3	428	102	90	0.049	244.9	554.3	244.9
3	429	99	90	0.049	183.7	549.9	183.7
3	430	90	90	0.049	0.0	536.7	0.0
3	431	88	90	0.049	-40.8	533.7	-40.8
3	432	97	90	0.049	142.9	547.0	142.9
3	433	112	90	0.049	449.0	568.5	449.0
3	434	111	90	0.049	428.6	567.1	428.6
3	435	99	90	0.049	183.7	549.9	183.7
3	436	103	90	0.049	265.3	555.7	265.3

April 11, 1994

MEMORANDUM

To: Mike Tucker
Termination Survey Section Head

From: Nick Lizzo
Radwaste Engineer

Subject: **Scaling Factors for Isotopes Present in Biowall Materials**

The isotopic ratios listed below will be used to classify the bioshield wall materials in accordance with 10 CFR 61.56.

Isotope	Liner (Ci/gm)	Co-60 Normalized	Concrete (Ci/gm)	Co-60 Normalized
H-3	2.1E-13	0.0279	6.2E-11	23.1581
C-14	2.4E-15	0.0003	1.5E-14	0.0056
Fe -55	1.9E-10	24.7392	3.3E-11	12.2530
Co-60	7.5E-12	1.0000	2.7E-12	1.0000
Mn-54	7.5E-13	0.0993	NP	-
Ni-59	5.5E-15	0.0007	1.4E-16	0.0001
Ni-63	7.4E-13	0.0982	1.9E-14	0.0070
Nb-94	1.4E-17	0.0000	1.5E-17	0.0000
Tc-99	1.3E-18	0.0000	1.1E-20	0.0000
Sn-119m	NP	-	2.9E-18	0.0000
Sb-125	NP	-	1.7E-16	0.0001
Te-125m	NP	-	7.4E-24	0.0000
Eu-152	NP	-	1.4E-12	0.5204

The following information is included for completeness:

		Percentage
Primary Wall Concrete mass:	1.35E+08	60.7355%
Primary Wall Steel Liner mass:	8.70E+07 gms.	39.2645%
Total Mass concrete & steel:	2.22E+08	100.0000%

cc: F. Petschauer
A. Capristo
C. Adey
S. Moss