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April 10, 2006

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Mr. Steven Courtemanche
Health Physicist
Mail Control No. 138394
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, Pennsylvania 19406-1415

Re: SUB-1551 04009007

Dear Mr. Courtemanche:

Please find enclosed the Final Status Survey for the portion of Neutron Products' facility at 416 North Fairfax Boulevard, Ranson, West Virginia to be released for unlicensed/unrestricted use.

Any questions may be addressed to me, however, technical questions related to the survey should be directed to Jeffrey Williams. He can be reached at 301-349-5001 or at neutronprod@erols.com. I can be reached at 304-725-7041 or through the Dickerson switchboard. Thank you for your attention in this matter.

Sincerely,

NEUTRON PRODUCTS, INC.

Jerry Fogle,
Radiation Safety Officer, SUB-1551

138394

NMSS/RGN1 MATERIALS-002

FINAL STATUS SURVEY

Neutron Products, Inc.
Facility at
416 North Fairfax Boulevard
Building No. 8
Ranson, West Virginia 25438

Portion of Facility to be Released for Unlicensed/Unrestricted Use

SUB-1551

March 22, 2006

Conducted by:
C. Bupp
J. Fogle
L. Forrest
J. Williams

FINAL STATUS SURVEY

Neutron Products, Inc.
Ranson, West Virginia
Portion of Facility to be Released for Unlicensed/Unrestricted Use
SUB-1551

Background

Neutron Products, Inc. headquartered at Dickerson, Maryland is, in part, engaged in the business of servicing, repairing, removing, fueling, and remanufacturing cobalt-60 teletherapy units for worldwide markets. Service and cobalt-60 transfer operations are performed under Agreement State Materials License MD-31-025-03.

Teletherapy unit remanufacturing and warehousing of spare parts has been housed since June 1992 at the referenced address in Ranson, West Virginia, a leased facility. Integral to these operations is the storage of articles made in whole or in part of depleted uranium (DU). Owing to its high density and atomic number DU is used extensively in teletherapy machines both as a primary shielding material and for parts such as trimmer bars, and beam definers. The DU is in metallic form and is either encapsulated or otherwise sealed. The receipt, storage, and transfer of teletherapy articles containing DU is authorized under Nuclear Regulatory Commission License SUB-1551, first issued in 1992 and subsequently renewed and amended in 2002. Under Condition 14 the chemical, physical, or metallurgical treatment or processing of DU is not authorized and has not been performed at the Ranson site.

The building which Neutron occupies has been sold to a new owner, who has agreed to continue our rental arrangement. However, he has requested that we temporarily relinquish a portion of our existing leased space to a new (unlicensed) occupant while a new building is constructed elsewhere on the property. The new owner has indicated that he will require its use until sometime around October 2006. Afterwards, the space may revert to Neutron's control and licensed use, or it is possible that we will no longer need the area.

Historical Site Assessment

The L-shaped area to be ceded to the new landlord lies at the southwestern corner of the structure. It is approximately 3000 ft^2, or about 21% of our 14,000 ft^2 facility. The space, includes exterior doorways and will be physically separated from the portion of the building which Neutron will continue to occupy.

Figure 1 shows a plan view of the space. The room has a poured concrete floor and a steel truss roof. The outside walls on the south, west, and north sides are concrete block. The southern wall has two truck docks and a single personnel door. On the east side, a plywood partition extends 52 ft. from the north wall. A small 17 ft x 12½ ft space to the southeast of this wall will be enclosed to allow access to the eastern truck dock. A small restroom occupies the northeast corner. In the southwest corner lies an enclosed area of approximately 500 ft^2, constructed mostly of plywood (see Figure 2), which is to be removed.

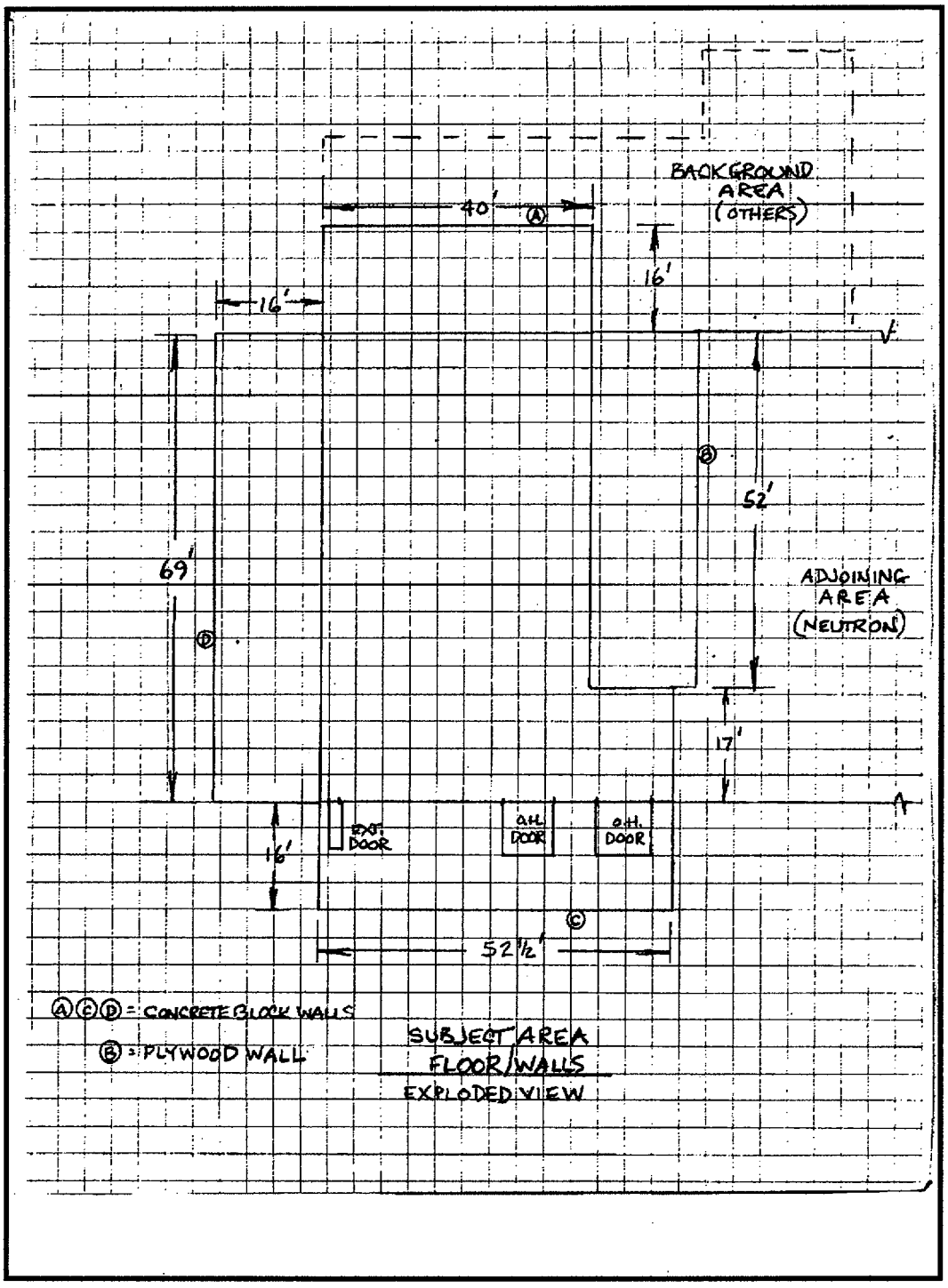

Figure 1 - Plan of affected space, exploded view (plywood structure at southwest not shown)

The room was used by Neutron to warehouse radiation teletherapy equipment parts, and components including, but not limited to those containing DU. Depleted uranium has the highest linear absorption coefficient for gamma photons of any readily available material. For this reason it is used as a superior shielding material, despite its radioactivity, where

Figure 2 - Plywood enclosure to be removed

a high degree of attenuation is required in limited spaces. Cobalt-60 teletherapy is one of these applications. DU is used:

To augment lead as shielding in teletherapy heads,

For collimator trimmer bars and primary beam definers, and

As shielding in source wheels and drawers.

SUB-1551 licenses Neutron to receive and store up to 20,000 kg of DU at Ranson, and to transfer DU to authorized licensees. As noted, DU was never processed, treated, or removed from its encapsulation or sealant. No accidental releases are known to have occurred, and, after thirteen years of semiannual random wipe tests, there have been no detected contamination events at the facility. Therefore, we concluded that the facility remained, to a high degree of probability, uncontaminated.

All DU and everything else has been removed from the area (as is documented by Figures 3 and 4) and relocated elsewhere within the facility. The floors have been swept clean and washed with an industrial floor washer. The swept debris was surveyed using a Bicron micro rem meter and with a large multichannel analyzer. No activity was detected. A drum containing wash water from the floor scrubber was surveyed with the Bicron and was background on contact. Additionally, the wash water was sampled and analyzed by gamma spectroscopy. No activity was detected. No additional decontamination measures were employed or deemed necessary.

Figure 3 - View to north of emptied room

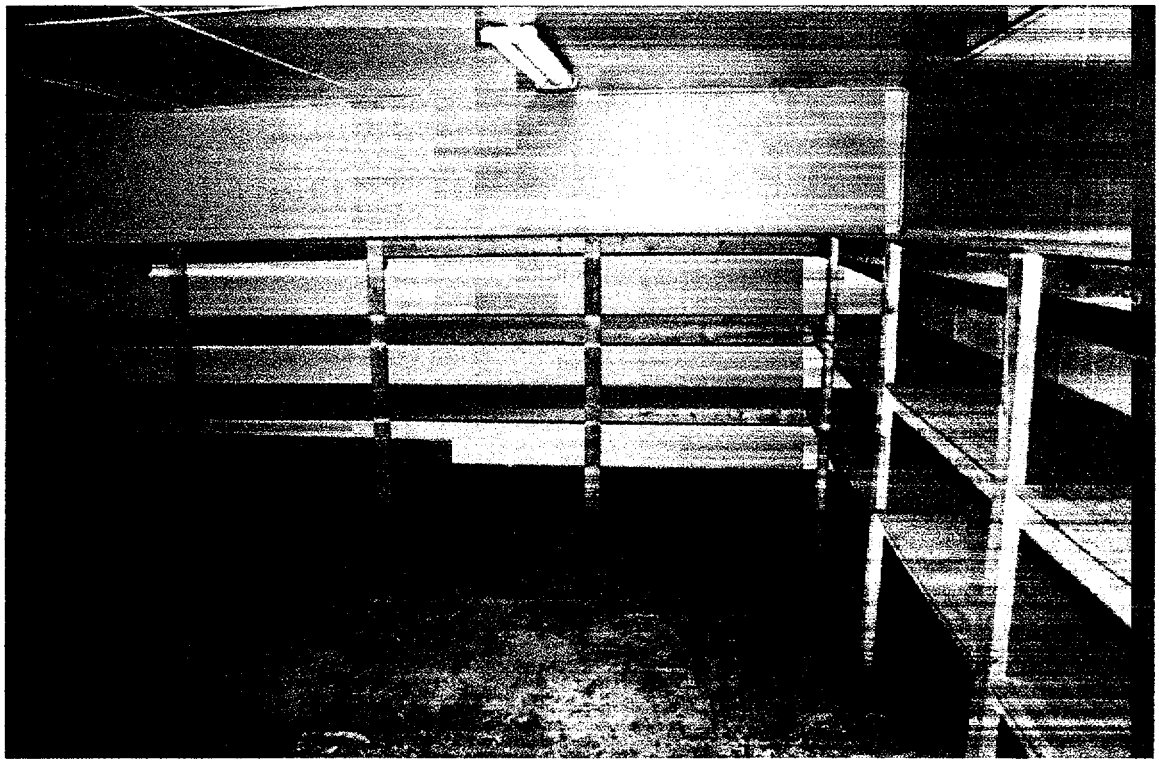

Figure 4 - Emptied southwest enclosure

Instrumentation and Methods

Direct radiation measurements were conducted using the Bicron micro rem™ radiation survey meter. As its name implies, this instrument is sensitive to dose rates in the µrem/hr range. The meter was last calibrated on December 29, 2005 by AM Calibration Services of Gaithersburg, Maryland.

The plywood partition was scanned using an Eberline E-600 equipped with an SPA-6 scintillator in the ratemeter mode in order to rule out localized areas of higher radiation emanating from the teletherapy heads stored on the opposite side.

Uranium-238, the principal component of DU, is in equilibrium with its first two progeny, Thorium-234 (half-life, 24.1 days) and Protactinium-234m (half-life, 1.17 minutes). Both are beta emitters. U_{238} was measured indirectly by detecting the betas from its daughters. *In situ* sampling and scanning where conducted using a large Helgeson Scientific Services gas proportional detector (HSS 1220) with the Eberline E-600 operating on the beta plateau (HV=1850 V). The detector has a working surface area of 19½" x 12" (1470 cm^2). With the E-600 set to rate meter mode this instrument was used for scanning. Using the E-600 in integrate mode it was used for sampling. Figure 5 shows the equipment used during sampling the reference area

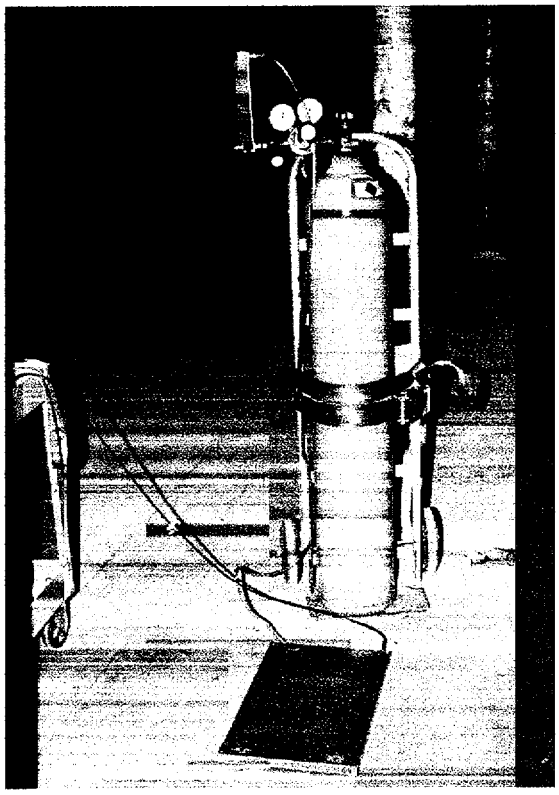

Figure 5 - Gas proportional detector with P-10 supply

The background count rate for this instrument in Neutron's counting lab at its Dickerson, Maryland facility was 1779 cpm. Calibration with a 3 nCi (based on U_{238}) DU source gave an efficiency of 784 ncpm/nCi or 0.356 ncpm/dpm. Based on this data the MDCR for a 10 minute background count and a 5 minute sample count was 76 ncpm at the 95% confidence level. This corresponds to a MDA of 0.097 nCi and a MDC of 15 dpm/100 cm^2.The background count rate at Ranson was 1238 cpm, which reduces the MDC to 12 dpm/100 cm^2.

Prior to the final status survey, a chi-square test was conducted on the instrument with twenty 1-minute counts using a thorium gas mantle as a source. The resulting value for

χ^2 was 21.9 which lies within the satisfactory range, p = 0.348. See Appendix 1 for complete chi-square data.

For *in situ* sampling the E-600 was operated in the integrate mode and the count was timed with a NIST traceable stopwatch.[1] The procedure used for sampling is given in Appendix 2.

For floor and wall scanning the E-600 was operated as a ratemeter or in the peak hold[2] mode with the display set in units of cps. The detector was moved in the direction of its longer dimension at an approximate rate of 0.5 ft/s which allows for an observation interval of about 3 seconds. A 3 second time constant was used to average the rate to avoid spurious high counts. Under these conditions, assuming a surveyor efficiency of 0.5, an instrument efficiency of 0.3, and a surface efficiency of 0.54, the MDCR for 0.95 true positive proportion and a 0.60 false positive proportion is 17.1 cps and the Scan MDC is 10 cps. An investigation limit of 36 gcps (13 ncps) which corresponds to 147 dpm/100 cm^2 was chosen. The procedure used for floor and wall scans is given in Appendix 3.

Survey Planning and Design

On the basis of the site assessment, the entire area was characterized in accordance with the *Multi-Agency Radiation Survey and Site Investigation Manual* (MARSSIM) as Class 3, which allows for unlimited survey unit areas. However, the survey was divided into three survey units on the basis of materials of construction: the concrete floor, the concrete block walls, and the plywood divider. Both the concrete floor and block walls were assumed to contain U_{238} and other beta emitters in the background. The Wilcoxon Rank Sum test was selected as the appropriate statistical test as recommended in MARSSIM. The plywood wall, along with plywood shelves built along its northern end was considered to have negligible radioactivity, therefore the Sign Test was selected for evaluation of the data. Table 1 summarizes the survey units.

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1 The E-600 has a scalar mode, however, it would not allow for count times longer than 10 seconds.

2 In the peak hold mode the E-600 displays the highest count rate detected over a given scan interval thereby decreasing the chance of missing a count rate above the investigation limit through surveyor inattention, The scan area is divided into discrete smaller portions to limit the surface area which must be rescanned in the event the peak count rate exceeds the investigation limit.

TABLE 1 - SURVEY UNITS

Survey Unit	U_{238} in background	Area (m^2)	Test Applied	Notes
Concrete floor	Yes	276	WRS	
Concrete block walls	Yes	68	WRS	Lower 8 ft
Plywood wall	No	50	Sign	Lower 8 ft, includes shelves

Wall sampling and scanning was provisionally limited to the area below an 8 foot height. The rationale for this decision was that the highest shelf height at which DU was stored was about 8 feet, and the absence of any airborne activity made contamination above 8 ft extremely improbable. Should sampling or scanning detect significant contamination below eight feet, the areas would be reclassified as Class 1 and the survey extended to the upper half of the walls. The walls of the plywood enclosure at the southwest corner were ignored, because it is to be demolished and removed, and therefore, would not contribute to the exposure of future occupants. Findings of significant contamination elsewhere in the area would have been probable cause to reverse that decision.

An adjoining, but separated, structure, assumed to be unimpacted, is located to the north of, and shares a common wall with, the survey area. To all appearances this structure was constructed at the same time as the survey area and of identical materials. The floor and walls of this space, which once held an animal feed store, were selected as reference areas for the Wilcoxon Rank Sum test. The reference area is pictured in Figure 6.

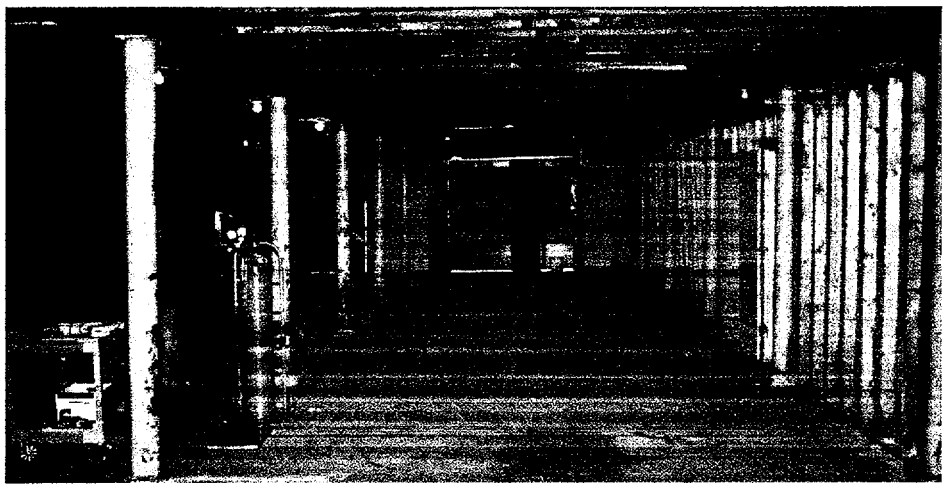

Figure 6 - Reference area

A $DCGL_w$ for U_{238} of 220 dpm/100 cm^2 was selected from published D&D screening values. This corresponds to an instrument output of 1152 ncpm. An LGBR of one-half the $DCGL_w$ was applied.

A series of scoping counts, each of five minute duration, were conducted in random locations of the three survey units and two reference units in order to determine the relative shift and the number of data points required for the selected statistical tests. This data is given in Table 2.

The scoping counts revealed that a small 8 ft by 7 ft portion of the north wall, which appears to be a blocked in portal to the reference area and is constructed of a visibly different type of material than the rest of the wall (see Figure 7) had substantially higher background count rates than the surrounding block. This was true for both the survey and reference area sides of the wall. A single tailed Student's t-Test applied to data pooled from both reference and survey areas shows the difference is significant (t=5.8, p=0.00033). The elevated count rate ($\bar{x}$ = 2030 cpm vs. $\bar{x}$ = 1340 cpm) is believed to result from higher concentrations of background beta emitters in the block material. This relatively small area was excluded from the survey unit for the purpose of sampling but not from scanning.

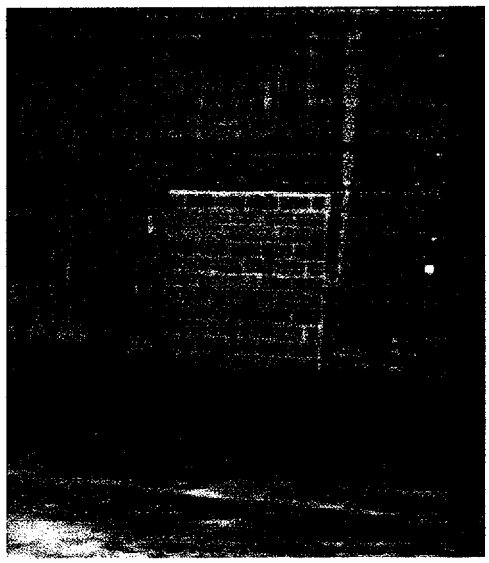

Figure 7 - Blocked portal of alternate material

TABLE 2 - SCOPING COUNT DATA

Unit	N	Data (cpm)	$\bar{x}$ (cpm)	s (cpm)
Survey, floor	5	1580, 1390, 1436, 1580, 1402	1478	95
Survey, block wall	4	1484,1432, 1556, 1460	1458	93
Survey, plywood	5	1204, 1198, 990, 986, 886	1053	142
Reference, floor	5	1110, 1516, 1390, 1488,1260	1353	167
Reference, wall	3	1208, 1192, 1178	1193	15

In accordance with MARSSIM, the number of samples required for the Wilcoxon Rank Sum test for both the concrete floor and the concrete block wall was 9 each in the survey and reference units. The number of data point required for the Sign Test on the plywood wall and shelves was 14. As recommended for Class 3 areas, all sample and reference locations were randomized as opposed to a random starting point grid used for Class 1 and 2 areas. The Microsoft Excel RAND() function was used to generate random numbers between 0 and 1 which were multiplied by x- and y-axis dimensions. Points which were obstructed or essential duplicates were discarded and replaced. The random sampling locations are given in Appendix 4.

Scans were conducted for 100% of the affected floor surface and the affected wall surfaces below eight feet. As noted, an investigational limit of 36 cps was established corresponding to 67% of the $DCGL_w$.

Results of Gamma Surveys

The principal objective of the gamma survey was to establish ongoing compliance with 10 CFR 20.1301, "Dose limits for individual members of the public." A dose mapping of the area at 1 m height was made using the Bicron mirco rem™ meter on March 6, 2006. Results are shown in Figure 8. The outside background ranged from 3 to 4 µrem/hr. Background in the reference area ranged from 4 to 5 µrem/hr. Approximately 75% of the floor space had dose rates ranging between 5 and 9 µrem/hr. However, the southeast corner, particularly the 212 ft^2 area east of the plywood divider, showed elevated dose rates from 10 to 40 µrem/h. Were a member of the public to occupy the general area of the space for 60 hours a week, 50 weeks per year they should be exposed to about 12 mrem/y above background from radiation primarily emanating from the adjacent warehouse space directly to the east. Should they occupy a less shielded area, say at 30 µrem/hr for the same period of time their annual exposure increases to 78 mrem. Under these conservative assumptions demonstration with §20.1301 is demonstrated as there are no airborne or waterborne radioactive effluents involved. Presumably the construction of a wall separating the space from that housing DU would provide some shielding which might even be significant depending on the materials of construction.

The primary sources of elevated radiation levels were determined to be crates containing unshielded DU components. Roughly two-thirds of the DU inventory is in heavily shielded components such as teletherapy heads, source wheels, and drawers. Contact dose rates with these components are negligible, and the heads stored east of the plywood divider actually provide significant shielding. Contact dose rates with boxes containing unshielded DU parts such as trimmer bars are about 10 mrem/h, although the dose rate diminishes significantly with distance. These boxes do not contribute significantly to occupational exposure, but obviously, if left in their original location, could potentially raise public

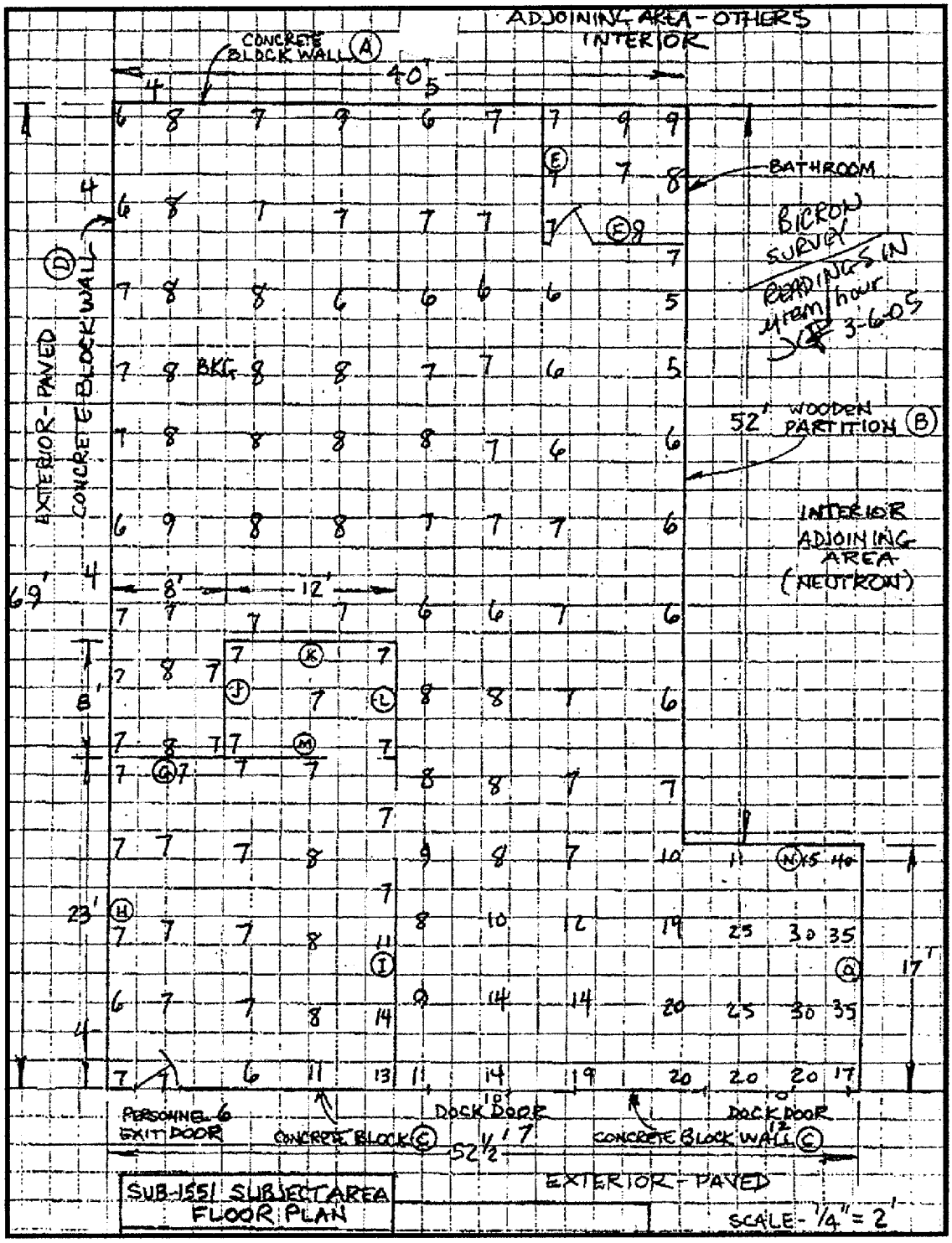

Figure 8 - Initial gamma radiation survey conducted March 6, 2006. Units are in µrem/hr.

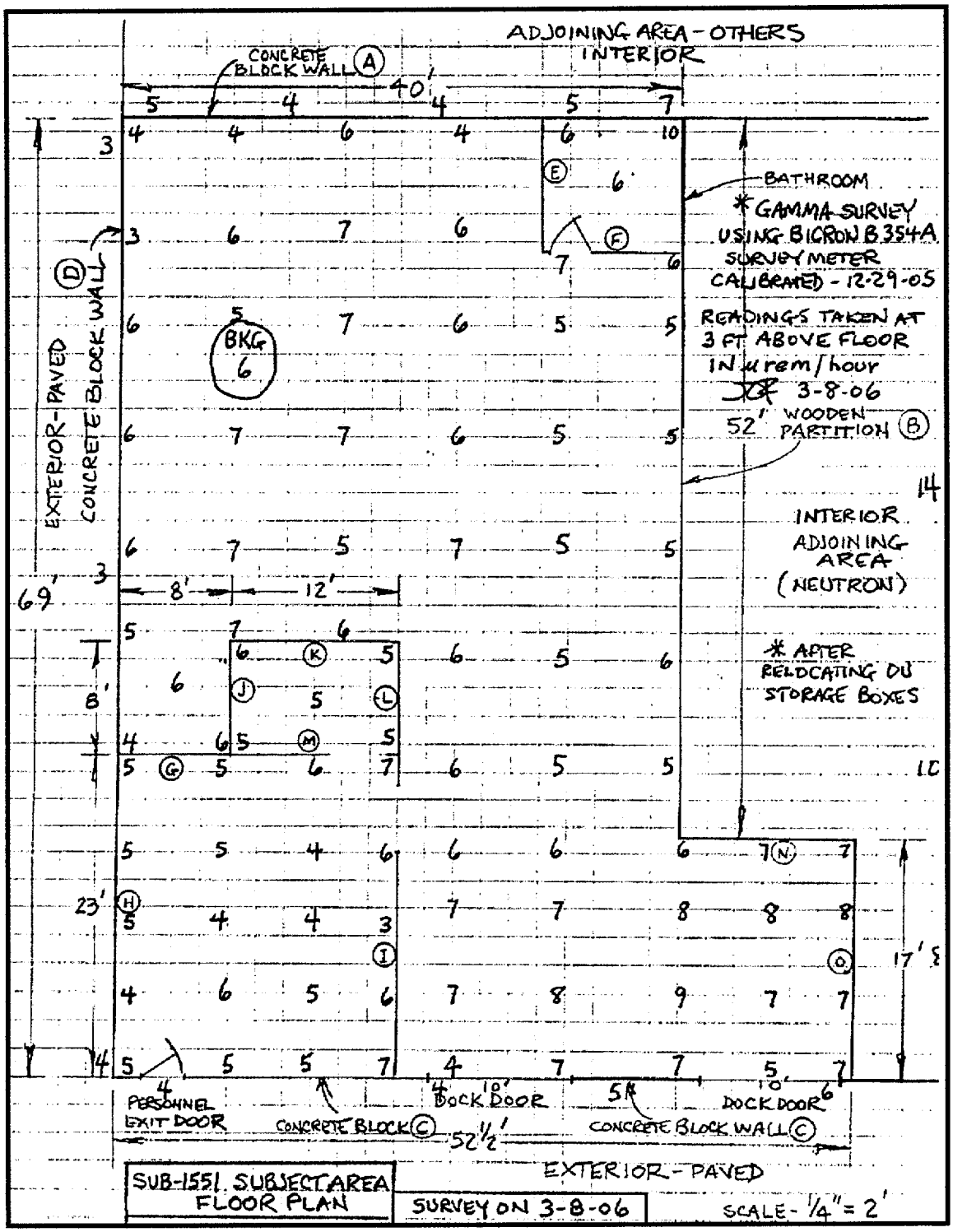

Figure 9 - Follow-up gamma survey conducted on March 8, 2006 after relocation of unshielded DU components. Units are in μrem/hr.

exposure under certain conditions by a large fraction of the regulatory limit. Thus, given the minimal cost of relocating this DU to areas not proximal to those to be occupied by members of the public, it was deemed that to do so would meet ALARA objectives. Accordingly, the boxes were relocated, and a second survey was conducted on March 8, 2006. Results are shown in Figure 9. As is readily apparent, the dose rates in the elevated area have been reduced by a substantial fraction, while they are somewhat lower elsewhere in the area. Under present conditions, a member of the public occupying the space for 3000 hours a year would be exposed to an annual dose from ongoing operations of about 6 to 9 mrem, less than 10% of the annual limit. Thus compliance with both §20.1301 and §20.1101(b) is demonstrated. Depending on materials used to construct the partition public exposure would be further reduced by a modest to substantial extent. Administrative controls have been established to ensure that exposure to members of the public from ongoing operations at Ranson remain ALARA.

The Eberline E-600 with an SPA-6 scintillator was used to scan the plywood partition to rule out small areas of elevated gamma radiation levels which might adversely affect the validity of gas proportional beta sampling and scans. No elevated count rates were found.

Results of Gas Proportional Sampling

In situ gas proportional sampling was conducted in accordance with the survey plan on March 13, 2006 (reference area walls and floor, survey area floor) and March 14, 2006 (survey area walls). Data and calculations for the Wilcoxon Rank Sum and Sign tests are given in Tables 3,4, and 5.

For the concrete floor the reference area rank sum is 126, i.e., no sample area point exceeded any reference area point by the $DCGL_w$. For nine reference and nine sample point, and α=0.001, the critical value for the WSR test is 118. Thus, the null hypothesis is rejected and the alternative hypothesis, that the median concentration in the survey area exceeds the reference area by less than the $DCGL_w$ is accepted. The mean of the sample data, 1679 cpm, does exceed the mean of the reference data, 1389 cpm, by 290 cpm. This difference is significant at the 95% confidence level (t=3.8), but is most likely attributed to higher gamma radiation background in the survey area versus the reference area.

The WSR test for the concrete walls gave results similar to that for the floor, the reference area rank sum was 126 and the null hypothesis was rejected.

For 17 data points sampled on the plywood wall or attached wooden shelves the number of positive signs, S+, was 17, i.e. no point exceeded the $DCGL_w$. For N=17 and α=.05, the critical value is 12, therefore the null hypothesis is rejected.

TABLE 3 - *IN SITU* SAMPLING - CONCRETE FLOOR

Point	Area	Gross Counts	Time (min)	gcpm	Adjusted Data	Ranks	Reference Area Ranks
1	R	6360	5	1272	2424	10	10
2	R	6860	5	1372	2524	12	12
3	R	7550	5	1510	2662	18	18
4	R	7000	5	1400	2552	14	14
5	R	7020	5	1404	2556	15	15
6	R	7220	5	1444	2596	17	17
7	R	7090	5	1418	2570	16	16
8	R	6510	5	1302	2454	11	11
9	R	6880	5	1376	2528	13	13
1	S	8940	5	1788	1788	7	0
2	S	8850	5	1770	1770	6	0
3	S	9510	5	1902	1902	9	0
4	S	7990	5	1598	1598	3	0
5	S	5940	5	1188	1188	1	0
6	S	9420	5	1884	1884	8	0
7	S	8480	5	1696	1696	4	0
8	S	8640	5	1728	1728	5	0
9	S	7780	5	1556	1556	2	0
Sum						171	126

TABLE 4 - *IN SITU* SAMPLING - CONCRETE WALLS

Point	Area	Gross Counts	Time (min)	gcpm	Adjusted Data	Ranks	Reference Area Ranks
1	R	5870	5	1174	2326	11	11
2	R	5970	5	1194	2346	13	13
3	R	5930	5	1186	2338	12	12
5	R	6450	5	1290	2442	18	18
5	R	6110	5	1222	2374	14	14
6	R	5820	5	1164	2316	10	10
7	R	6230	5	1246	2398	15	15
8	R	6300	5	1260	2412	16	16
9	R	6440	5	1288	2440	17	17
1	S	7760	5	1552	1788	7	0
2	S	7020	5	1404	1188	1	0
3	S	8050	5	1610	1884	8	0
4	S	6420	5	1284	1598	3	0
5	S	6900	5	1380	1696	4	0
6	S	6410	5	1282	1556	2	0
7	S	6480	5	1296	1728	5	0
8	S	7430	5	1486	1770	6	0
9	S	6530	5	1306	1902	9	0
Sum						171	126

TABLE 5 - *IN SITU* SAMPLING - PLYWOOD WALL

Point	gross counts	time (min)	gcpm	ncpm	$DCGL_w$-ncpm	Sign
1	5520	5	1104	-4	1156	1
2	5760	5	1152	44	1108	1
3	5580	5	1116	8	1144	1
4	5790	5	1158	50	1102	1
5	4930	5	986	-122	1274	1
6	5360	5	1072	-36	1188	1
7	5770	5	1154	46	1106	1
8	6420	5	1284	176	976	1
9	6980	5	1396	288	864	1
10	5140	5	1028	-80	1232	1
11	4830	5	966	-142	1294	1
12	5590	5	1118	10	1142	1
13	6820	5	1364	256	896	1
14	5280	5	1056	-52	1204	1
15	5320	5	1064	-44	1196	1
16	5500	5	1100	-8	1160	1
17	5870	5	1174	66	1086	1
S+						17

Results of Gas Proportional Scanning

Gas proportional scans of the floor and walls were conducted in accordance with the survey plan on March 16 and 17. The peak hold method (see Appendix 3) was used except for the area of elevated background on the north wall. The count rate did not exceed the investigation limit of 36 cps anywhere but that portion of the north wall where it was 36-42 cps. The scan results are shown in Figure 10 for the floor and Figure 11 for the walls.

Conclusion

The results of the gas proportional sampling and scans support the characterization of the survey area as Class 3. Furthermore, the data shows that U_{238} is extremely unlikely to be present at levels exceeding 220 dpm/100 cm^2 above background. Therefore, we conclude that doses to members of the public occupying the released portion of the Ranson facility will not exceed the 25 mrem per year limit from residual activity established by the Final Decommissioning Rule. Gamma radiation surveys establish that doses to members of the public from ongoing operations are not likely to exceed 10 mrem or 10% of the annual limit.

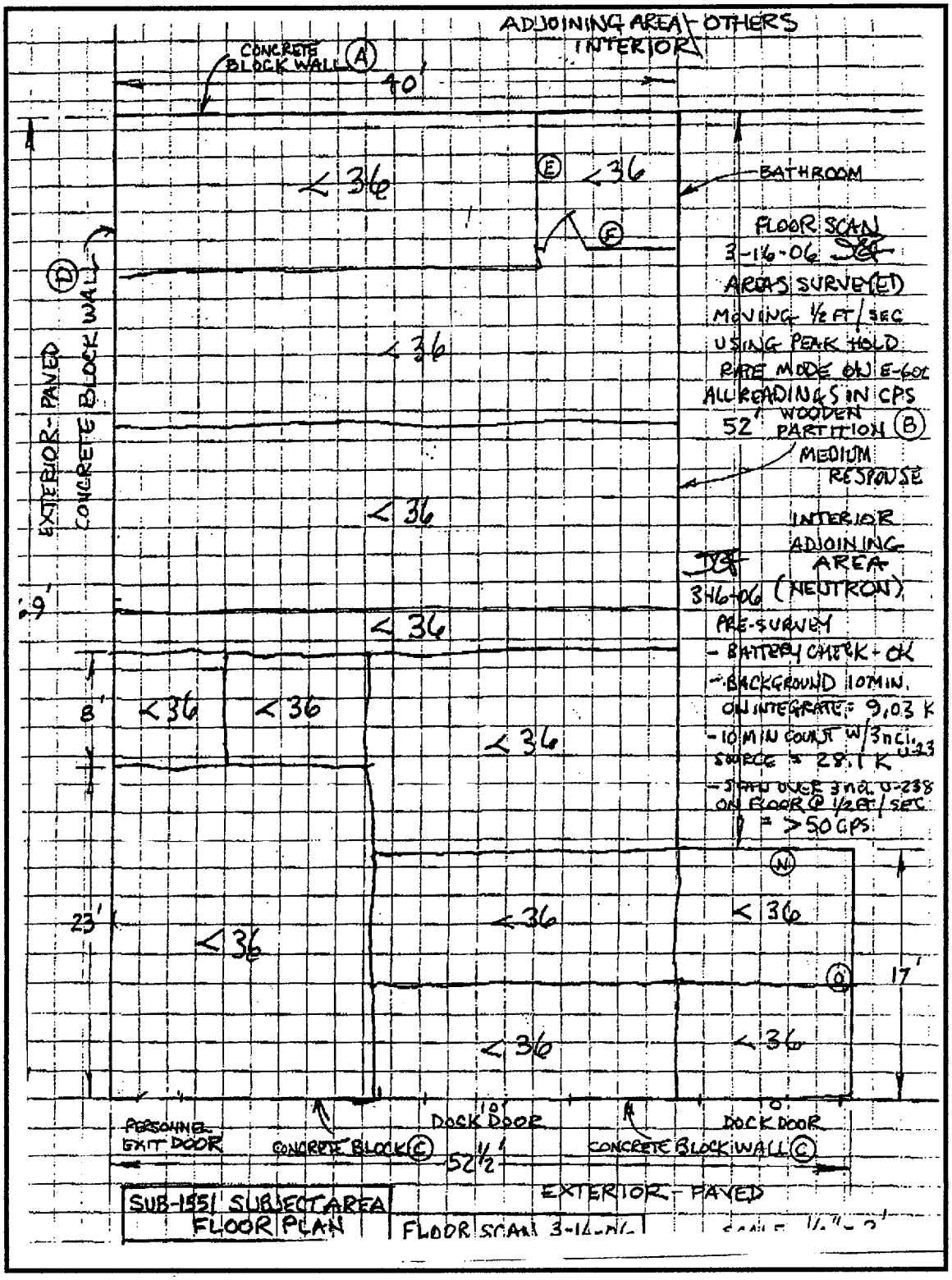

Figure 10 - Floor scan results

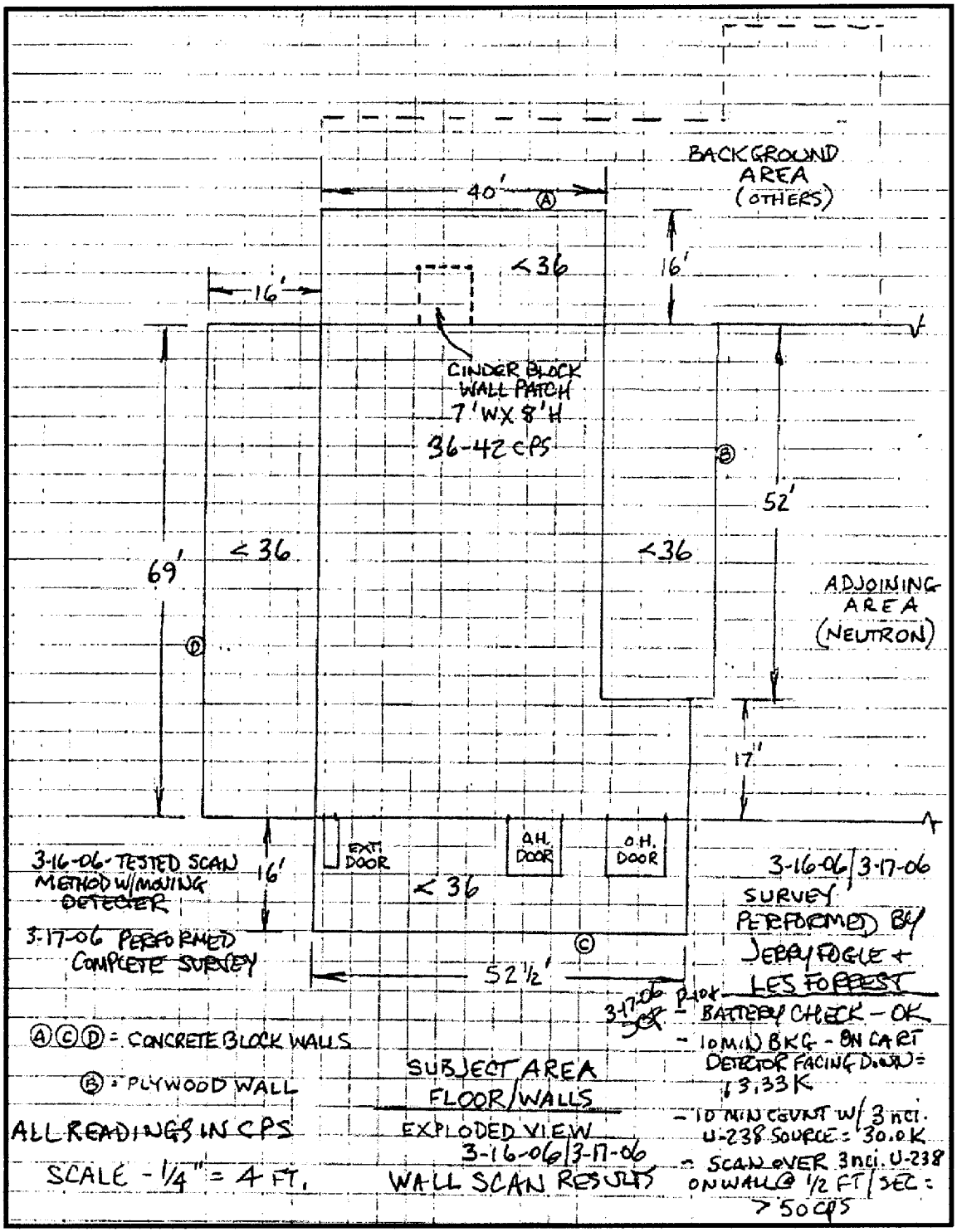

Figure 11 - Wall scan results

Appendix 1
Chi-Square Test

Eberline E-600
Channel 1
HSS 1220 Gas Proportional Detector
High voltage at 1850V
1 minute counts with Coleman gas mantle (thorium)

	x	$(x - \bar{x})^2$
1	14840	1357
2	15000	15168
3	15150	74615
4	14870	47
5	14750	16089
6	14810	4468
7	15150	74615
8	14930	2826
9	14770	11415
10	14870	47
11	14920	1863
12	14810	4468
13	15040	26620
14	14800	5905
15	14680	38747
16	14710	27836
17	14750	16089
18	14930	2826
19	14880	10
20	14820	2916
	$\bar{x}$ = 14877	χ^2 = 21.9

For N = 20 and χ^2 = 21.9, p = 0.348

Appendix 2

Procedure for *In Situ* Sampling with Gas Proportional Beta Detector

1. Purpose

This document provides a procedure for collecting *in situ* beta counting data to be used for the Wilcoxon Rank Sum Test or Sign Test to evaluate surface concentrations of residual depleted uranium (DU) against the Derived Concentration Guideline Level.

2. Scope

This procedure is applicable to the final status survey for the Ranson, West Virginia facility portion to be released.

3. Basis

3.1 The principal isotope present in DU is uranium-238 (half-life, 4.468×10^9 y). U_{238} alpha decays to thorium-234(half-life, 24.1 d) which beta decays to protactinium-234m (half-life, 1.17 m) which beta decays to U_{234} (half-life, 2.454×10^5 y). U_{238} exists in equilibrium with its first two daughters and can be indirectly detected and measured from their beta emissions.

4. Equipment and Materials

4.1 Eberline E-600 portable radiation survey meter
4.2 Helgeson Scientific Services HSS-1220 gas proportional detector
4.3 Eberline smart to conventional coaxial cable, C to BNC adapter, and HSS detector cable
4.4 P-10 cylinder with low pressure regulator and low flow rotometer
4.5 Stopwatch, NIST traceable
4.6 3 nCi DU calibration source, North American Scientific, Inc., Model No. CAL2501, S/N 68007
4.7 Coleman Gas Mantle (thorium source)

5. Equipment Setup

5.1 E-600 to be set at Dickerson with the E-600 Interface Program
Channel - 1
High Voltage - 1850 V
Display - β, cps
Mode - Integrate
Gross/Net - gross

5.2 P-10
Regulator pressure - 2 psig
Rotometer - 50 ml/m

6. Calibration

6.1 With the detector removed from any source of beta radiation take a 10-minute background count in accordance with Step 7.3.

6.2 Place the 3 nCi DU source, active side up, under the detector and take a 10-minute count.

6.3 Determine the efficiency in ncpm/dpm and the MDC for a 5-minute sample count and 10-minute background count in dpm/100 cm^2.

6.4 Take twenty 1-minute counts of the thorium gas mantle and determine the value for chi-square, verify that it is in the satisfactory range, 12 - 27

7. Procedure

7.1 Turn on P-10 flow to detector and allow to purge for 45 minutes.

7.2 Conduct battery check on E-600 (selector switch to check) and verify adequate P-10 pressure (about 100 psi per 6 hours of operation).

7.3 To count:

7.3.1 Set selector switch to integrate

7.3.2 Zero stopwatch

7.3.3 Simultaneously start timer and press the * button on the E600 to zero the display and start the count.

7.3.4 When the stopwatch reaches the desired count time press the Log button on the E600 and record the integrated count. Note: Pressing the Log button will freeze the display for about 10 seconds.

7.4 With the detector face down on the metal cart and away from any beta radiation source take a 10-minute background count and record result.

7.5 Place the 3 nCi DU source, active side up, under the detector and take a 10-minute count.

7.6 Repeat steps 7.1, 7.2, 7.4, and 7.5 at the beginning of each day of sampling.

7.7 Count each random sampling and reference point identified in the survey plan by placing the detector face against the floor or wall at the desired location, counting for 5 minutes, and record results.

Appendix 3

Procedure for Scanning with Gas Proportional Beta Detector

1. Purpose

This document provides a procedure for scanning building surfaces to detect localized areas of elevated residual depleted uranium (DU).

2. Scope

This procedure is applicable to the final status survey for the Ranson, West Virginia facility, portion to be released.

3. Basis

3.1 The principal isotope present in DU is uranium-238 (half-life, 4.468×10^9 y). U_{238} alpha decays to thorium-234(half-life, 24.1 d) which beta decays to protactinium-234m (half-life, 1.17 m) which beta decays to U_{234} (half-life, 2.454×10^5 y). U_{238} exists in equilibrium with its first two daughters and can be indirectly detected and measured from their beta emissions.

3.2 With the instrument operated according to this procedure the detection interval is 3 seconds. Theoretically this should allow detection of 8 ncpm with a 95% probability.

3.3 Using the mean of the reference area floor counts converted to cps, the background is 23.1 cps. A $DCGL_w$ of 220 dpm/100 cm^2 corresponds to 19.2 ncps. Using 67% of the $DCGL_w$ as an action limit gives 12.9 ncps or 36.0 gcps. The probability of detecting a true positive is greater than 95%.

4. Equipment and Materials

4.1 Eberline E-600 portable radiation survey meter
4.2 Helgeson Scientific Services HSS-1220 gas proportional detector
4.3 Eberline smart to conventional coaxial cable, C to BNC adapter, and HSS detector cable
4.4 P-10 cylinder with low pressure regulator and low flow rotometer
4.5 3 nCi DU calibration source, North American Scientific, Inc., Model No. CAL2501, S/N 68007

5. Equipment Setup

5.1 E-600 to be set at Dickerson with the E-600 Interface Program
Channel - 1

High Voltage - 1850 V
Display - β, cps
Mode - Ratemeter or Peak hold
Gross/Net - gross
Response - medium set to 3 second time constant

5.2 P-10 Regulator pressure - 2 psig
Rotometer - 50 ml/m

6. Calibration

6.1 The investigation level given here is based on a calibration conducted on March 9, 2006 in accordance with the *Procedure for In Situ Sampling with Gas Proportional Beta Detector*, Sec. 6. and is valid for scans conducted within 1 month of the calibration. For scans conducted after April 9, 2006, the instrument should be recalibrated and the efficiency, MDCR, and scan MDC recalculated.

7. Procedure

7.1 Preliminary - To be conducted at the beginning of each day of scanning.

7.1.1 Turn on P-10 flow to detector and allow to purge for 45 minutes.

7.1.2 Conduct battery check on E-600 and verify adequate P-10 pressure (about 100 psi per 6 hours of operation).

7.1.3 Put the E-600 in integrate mode and with detector on the cart take a 10 minute background count. Result should be between 8860 and 13300 counts.

7.1.4 Place the 3 nCi DU source active side up under the detector and take a 10-minute count. Results should be between 23900 and 43200 counts.

7.1.5 Mount detector for floor or wall scan.

7.1.6 Set E-600 response to "Med" and verify audio is on.

7.1.7 With the E-600 in rate meter mode, move the detector at ½ ft/s over the 3 nCi DU source and verify it can be detected. Count rate should spike >40 cps and an audible increase in the click rate should be discerned.

7.2 Alternative #1

7.2.1 Set E-600 to rate meter mode, the response to "Med" and verify audio is on.

7.2.2 Scan the detector across the floor or wall area at ½ ft/s along its longer axis.

7.2.3 Observe the count rate and listen for any increase in the audible response.

7.2.4 If the count rate exceeds the action limit (36 cps) place the detector over the suspect area and:

A: Set response to "Slow" and observe count rate for at least 15 seconds, or

B: Set E-600 to integrate mode an count for at least 15 seconds, convert gross counts to gcps

7.2.5 If the results for 7.2.4A or B exceed 42 gcps, record the count rate and mark the spot with spray paint, or equivalent, for further analysis.

7.3 Alternative #2 (Allows for somewhat less diligence in the surveyor's observation of the count rate but may result in having to resurvey an area.)

7.3.1 Set E-600 to peakhold mode, the response to "Med" and verify audio is on.

7.3.2 Scan the detector across the floor or wall area at ½ ft/s along its longer axis while listening for any increase in the audible response.

7.3.3 Confine a scan segment to a relatively small areas, e.g. <100 sq. ft. Upon completion of a segment observe the maximum count rate.

7.3.4 If maximum count rate exceeds 36 cps, or a significant increase in the audible response is discerned, resurvey affected area using Alternative #1.

8. Records

Create and maintain the following records

8.1 Name of surveyor(s) and date(s) of scan

8.2 Results of Preliminary steps 2, 3, 4, and 8 for each day of scanning

8.3 Results and location (marked on floor plan or wall elevation) of any area exceeding 42 gcps

8.4 The area(s) surveyed on floor plan or wall elevation

8.5. If using Alternative #1, map count rate on floor plan or wall elevation approximately every 10 linear ft in each axis, or

If using Alternative #2, show approximate location of each scan segment on floor plan or wall elevation, and indicate where maximum count rate is <36 gcps.

Appendix 4

Randomized Survey Locations

1. Reference Area Floor

A 30' x 80' ft area of the concrete floor was used. The x-axis ran west to east; the y-axis ran south to north. The origin was the southwestern corner.

Point	Random Number	x-coordinate (ft)	Random Number	y-coordinate (ft)
1	0.367271	11	0.399085	32
2	0.383720	11	0.148069	12
3	0.725206	21	0.028504	2
4	0.454700	13	0.345669	27
5	0.821356	24	0.255385	20
6	0.746362	22	0.200290	16
7	0.228149	7	0.688218	54
8	0.867174	25	0.761275	60
9	0.725502	21	0.177940	14

2. Reference Area Concrete Walls

Three regions of exposed concrete block of the same type used in the survey area were selected. The x origin is the southwest corner of the reference area. The x coordinate is linear feet from the origin in a clockwise direction as if the regions were contiguous. The y coordinate is height.

Point	Random Number	x-coordinate (ft)	Random Number	y-coordinate (ft)	Region
1	0.554657	26	0.114206	1	2
3	0.918600	43	0.337761	2	3
4	0.778785	37	0.365872	3	3
5	0.662391	31	0.443536	3	2
7	0.056286	3	0.944450	7	1
8	0.996873	47	0.652238	5	3
9	0.498659	23	0.845464	6	2
10	0.538982	25	0.512356	4	2
11	0.557417	26	0.059207	0	2

3. Survey Area Concrete Floor

The x-axis ran west to east; the y-axis ran south to north. The origin was the southwestern corner.

Point	Random Number	x-coordinate (ft)	Random Number	y-coordinate (ft)
1	0.646249	34	0.440693	23
2	0.023607	1	0.258949	14
3	0.906404	48	0.116939	6
4	0.435063	23	0.686282	36
5	0.962976	51	0.187674	10
6	0.597735	31	0.362503	19
7	0.052026	3	0.698568	37
8	0.159160	8	0.847695	45
9	0.549053	29	0.951041	50

4. Survey Area Concrete Walls

The x origin is the beginning of the exposed concrete block on the south wall. The x coordinate is linear feet from the origin in a clockwise direction. The y coordinate is height to a maximum of 8 ft.

Point	Random Number	x-coordinate (ft)	Random Number	y-coordinate (ft)	Wall
1	0.246286	19	0.049381	0	west
2	0.989444	77	0.183793	1	north
3	0.538682	42	0.243480	2	west
4	0.626214	49	0.497670	4	north
5	0.261642	20	0.823751	7	west
6	0.867996	68	0.963799	8	north
7	0.385976	30	0.524368	4	west
8	0.880954	69	0.029838	0	north
9	0.062561	5	0.248021	2	west

5. Survey Area Plywood Wall

The x origin is the northeast corner of the bathroom wall. The x coordinate is linear feet from the origin in the southerly direction. The y coordinate is height to a maximum of 8 feet.

Point	Random Number	x-coordinate (ft)	Random Number	y-coordinate (ft)
1	0.391600	20	0.596780	5
2	0.185054	10	0.471401	4
3	0.628644	33	0.841902	7
4	0.124876	6	0.534462	4
5	0.614237	32	0.166901	1
6	0.631510	33	0.349136	3
7	0.271743	14	0.080177	1
8	0.994485	52	0.628494	5
9	0.049078	3	0.654910	5
10	0.503598	26	0.248283	2
11	0.402147	21	0.071961	1
12	0.701343	36	0.939791	8
13	0.097244	5	0.898161	7
14	0.584112	30	0.604462	5
15	0.777782	40	0.627766	5
16	0.810270	42	0.500525	4
17	0.871190	45	0.867669	7