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Energy Systems Environmental Restoration Program
ORNL Decontamination and Decommissioning Program

**Decontamination Project for Cell G of the Metal Recovery Facility at
Oak Ridge National Laboratory, Oak Ridge, Tennessee**

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Oak Ridge, Tennessee 37831-6285
managed by
MARTIN MARIETTA ENERGY SYSTEMS, INC.
for the
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MASTER

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ABBREVIATIONS

ATG	Allied Technology Group
CRZ	contamination reduction zone
D&D	decontamination and decommissioning
DAC	derived air concentration
DOE	U.S. Department of Energy
Energy Systems	Martin Marietta Energy Systems, Inc.
HEPA	high-efficiency particulate air
HP	Health Physics
MRF	Metal Recovery Facility
ORNL	Oak Ridge National Laboratory
PPE	personnel protective equipment
RP	Radiation Protection
TCLP	toxicity characteristic leaching procedure

EXECUTIVE SUMMARY

The goal of the decontamination effort in Cell G at the Metal Recovery Facility, Building 3505, located at the Oak Ridge National Laboratory, was two-fold: to determine the effectiveness of the dry decontamination technique employed and to provide data required to assess whether additional decontamination using this method would be beneficial in the eventual decommissioning of the facility. Allied Technology Group (ATG) was contracted to remove a portion of the concrete surface in Cell G by a technique known as scabbling. Some metallic cell components were also scabbled to remove paint and other surface debris. Generally, the scabbling operation was a success. Levels of contamination were greatly reduced. The depth of contaminant penetration into the concrete surfaces of certain areas was much greater than had been anticipated, necessitating the removal of additional concrete and extending ATG's period of performance. Scabbling and other related techniques will be extremely useful in the decontamination and decommissioning of other nuclear facilities with similar radiological profiles.

1. INTRODUCTION

The Metal Recovery Facility (MRF) at the Oak Ridge National Laboratory (ORNL) is a small-scale production reprocessing plant that was operated from 1951 to 1960. The facility consists of Building 3505 and an adjacent dissolver room, dissolver pit, and below-grade canal. Implementing a modified Purex process, operators of the MRF recovered uranium, plutonium, neptunium, and americium from a variety of feed materials. The reprocessing operations were conducted in a bank of seven concrete cells, designated Cells A through G. Cell G, the subject of this report, is located at the east end of Building 3505 (Appendix A, Fig. A.1).

In 1960, Building 3505 was judged inadequate to provide containment for processing large quantities of radioactive materials. Roof hatches opened directly to the environment and cell roof construction was deemed too light. Operational restrictions placed on the facility forced it into a shut-down mode, and the facility was abandoned in 1960. Before facility D&D could occur, upgrading and reconditioning of structures and services were necessary. Installing an add-on high-efficiency particulate air (HEPA) filtered cell ventilation system was the major construction task performed to ready the structure for decontamination. These modifications were performed in the early 1980s.

After building preparations sufficient to allow decontamination operations had been conducted, equipment removal efforts began. Equipment inside Cells A through G was dismantled and appropriately packaged for disposal. All remaining equipment supports and services were stripped to provide clean surfaces for decontamination activities.

Cell G is a structure made of concrete blocks grouted together. The cell is $8 \times 9 \times 17$ ft high and has a floor drain located in the center of a 6-in.-deep stainless steel floor pan. In the north wall of the cell is a 2-ft $\times$ 2-ft $\times$ 8-in.-thick steel access hatch, the bottom of which is approximately 3 ft, 6 in. from the floor. A metal hatch with structural support members constitutes the roof of the cell, and an 8 in. by 4 in. stainless steel panel is located in the southeast corner of the cell. A 2-in.-thick door on the south side of the cell is the remaining access to Cell G.

2. PURPOSE

Martin Marietta Energy Systems, Inc. (Energy Systems), contracted with ATG to decontaminate the MRF. The specific purpose of the Cell G decontamination project is to evaluate the effectiveness of commercially available dry decontamination techniques and to factor the results of this decontamination into the D&D design. Because of extensive radiological contamination, Cell G was chosen first for decontamination.

ATG provided the following plan for cell decontamination: to decontaminate Cell G, 1/4 in. of concrete will be removed from the surface of the concrete block structure. The method chosen for removal will generate little or no liquid radioactive waste. Dry decontamination techniques will also be used to decontaminate the stainless steel floor pan and the overhead structural members. At the end of the decontamination effort, the surface areas of the cell will be painted or sealed to prevent recontamination of clean surfaces.

3. BACKGROUND

Extremely high alpha contamination levels existed on, and were entrained in, the concrete surfaces of Cell G. Preliminary survey data (Appendix B, Report B.1) supplied by Energy Systems indicated that these levels were $>1.0 \times 10^6$ dpm per 100 cm². Beta-gamma levels in Cell G were <2 mrem/h. Thus, the primary concern for the decontamination task was alpha airborne contamination concentrations and not the penetrating beta-gamma radiation. Table 1 lists the alpha contamination levels in Cell G before decontamination.

Table 1. Cell G average alpha contamination

Area	0-6 ft (dpm/100 cm ²)	6-17 ft (dpm/100 cm ²)	Hot spot (dpm/100 cm ²)
North wall	461,000	45,000	>2,500,00 at 4 ft
East wall	110,000	40,000	800,00 SE at 7 ft
South wall	87,000	15,000	850,000 SW corner
West wall	69,000	16,000	500,000 SW corner

The primary radioisotope of concern in Cell G is ²³⁹Pu. Core bores taken from Cell G indicated that most of the contamination (up to 95% of the activity) resided in the first 1/4 in. of concrete (Ref. 1). The overall extent of contaminant migration into the block walls could not be assessed with certainty before decontamination efforts began. The main emphasis of the project was to remove the top 1/4 in. of concrete from the cell walls.

4. METHODOLOGY

To ensure proper planning and success of the decontamination project, ATG used detailed characterization data and the operational history of Cell G. Use of this information, provided by Energy Systems, led to a viable approach which would result in successful completion of the contracted task.

Characterization surveys indicated high levels of alpha contamination throughout the cell (Table 1). Thus, controlling internal exposure to workers and implementing contamination controls to protect other areas of the building and the environment were primary concerns in the decontamination effort. Penetrating radiation associated with beta-gamma was <2 mrem/h in the general area of the cell, reducing exposure concerns associated with the decontamination effort.

A HEPA-filtered cell ventilation system was installed in Building 3505, so that negative pressure could be maintained in all cells during decontamination efforts, assuring that airborne contamination would not flow to areas outside the cell. The HEPA system had an estimated flow of 10,000 ft³/min. To achieve maximum negative pressure, all cell penetrations were sealed with foam sealant. For backup ventilation, a portable 1000-ft³/min HEPA-filtered unit was available.

To control the spread of contamination from the cell to adjacent areas of the building, a double tent system was used and contamination reduction zones (CRZs) were established. The first CRZ was connected to the regulated area of the makeup room at the point of egress. The second CRZ was connected to the cell itself, where a high-contamination laydown area was set in place for exiting the cell. This CRZ also served as the staging area for equipment used for cell decontamination. A double-door system between the two CRZ areas provided another precautionary measure for controlling the spread of contamination. Step-off pads were strategically placed to assure that contamination would be confined to these areas (Appendix A, Fig. A.1). ATG committed to maintaining contamination levels of 5000 dpm per 100 cm² beta-gamma and 3000 dpm per 100 cm² alpha in CRZ 1 and 10,000 dpm per 100 cm² beta-gamma and 5000 dpm per 100 cm² alpha in CRZ 2.

A frisking station for personnel monitoring was set up at the point of final egress, and a PCM-1B whole body monitor was placed in the former control room to serve as a final contamination monitoring measure before personnel exited the regulated area (Appendix A, Fig. A.1).

A supplied air pressure demand system provided respiratory protection for decontamination technicians. This system gave technicians the highest protection factor, maximum comfort under the working conditions at hand, and excellent mobility. Energy Systems Radiation Protection (RP) established a protection factor of 1000.

To reduce the levels of airborne contamination and its spread to undesirable areas, a method used throughout the nuclear industry was added to the decontamination plan. A nontoxic strippable paint was applied to the walls of the cell to seal loose contamination. In many ways, this step alleviated concerns that had surrounded the cell decontamination effort: (1) airborne radioactive material was reduced, (2) hands-on decontamination effort was not required (this would have created liquid radioactive waste), (3) less radioactive waste was

generated because use of decontamination materials was minimized, and (4) physical labor was reduced because contamination was confined.

The equipment used to decontaminate Cell G was a system designed by Pentek, Inc. This Pentek system consists of a Vac-Pac unit comprising three parts: vacuum system, roughing filter system and HEPA filters, and hand-held scabble gun. The scabble gun, called the Corner Cutter, has 28 case-hardened needles surrounded by a tube that is connected to a 2-in.-diam vacuum hose. This adjustable tube is positioned within approximately 1/8 in. of the medium to be scabbled. The vacuum system pulls in the scabbled medium from the scabble gun through the vacuum hose of desired length. The filter system, which is mounted on a hydraulic lift, prevents the scabbled medium from escaping to the environment.

The Vac-Pac unit is equipped with a level indicator light which informs the operator when the drum is full. When the containment drum is full, the operator switches the Vac-Pac unit to the changeout mode. The filter system is hydraulically raised to enable the operator to insert a cardboard disk, sealing the roughing filter by vacuum and enabling the operator to place a lid on the full drum and prepare it for disposal. The full drum is removed, and an empty drum is set into place. The operator then lowers the Vac-Pac unit to the empty drum and switches the unit back to the run mode. The cardboard disk drops to the bottom of the fresh drum, making unnecessary any handling of contaminated media and equipment.

Site mobilization began January 14, 1993. Mobilization included setting up a compressor, sleeving airline hoses, staging Vac-Pac equipment for training, demonstrating the task to be done, and stocking personnel protective equipment (PPE) and supplies.

Training on Vac-Pac unit use was conducted on January 21 and 22, 1993. The system was demonstrated to members of the readiness review committee, Energy Systems managers, RP personnel, and the U.S. Department of Energy (DOE). As the actual decontamination project began, project personnel attended job briefings each morning to discuss the daily work plans and schedule and to discuss accomplishments of the previous work day, including any problems that had been encountered.

Scaffolding was staged January 27, 1993. The initial steps were to complete a comprehensive survey of the cell and to prepare the cell ceiling for scabbling. A highly contaminated ladder, light, and several tools had been left in the cell after previous equipment removal activities. If these items were not removed from the cell, contamination control would be difficult. The items were bagged inside the cell and then rebagged as they were removed. Then followed a hands-on decontamination of the ceiling, a pre-decontamination survey of the cell, and the application of strippable paint to the cell walls and floor. (See Appendix B, Reports B.2, B.3, and B.4 for pre- and post-painting radiological survey results.)

The scaffolding was then decontaminated to further enhance contamination control efforts. A foam sealant was injected into cell penetrations to ensure that negative pressure in the cell would be maximized and to prevent the potential contamination of adjacent areas.

Airborne concentrations in Cell G were elevated during ceiling decontamination and cell painting. The derived air concentration (DAC) for plutonium is $2.0 \times 10^{-12} \mu\text{Ci}/\text{cm}^3$ (Ref. 2). The concentration during ceiling decontamination and cell painting was $4.12 \times 10^{-10} \mu\text{Ci}/\text{cm}^3$. This concentration equates to a DAC fraction of 206. Using an exposure time of 2 h and a

protection factor of 1000, the total resultant DAC hours equaled 0.412 of DAC or 1.03 mrem total exposure to the workers. DAC formulas follow:

$$\text{DAC fraction} = \frac{\text{concentration}}{\text{DAC}}$$

$$\text{DAC hours} = \frac{\text{DAC fraction} \times \text{hours exposed}}{\text{protection factor}}$$

$$\text{dose (mrem)} = 2.5 \times \text{DAC hours}$$

The DAC assigned to the crew for the duration of the Cell G decontamination project was 11.24 DAC-hours. This amount equates to 28 mrem total exposure, an average of 4.66 mrem per crew member for the decontamination project.

Scabbling began on the ceiling area of Cell G on February 5, 1993. When crew members discovered that the ceiling area was structurally unstable, they aborted use of the scabble gun. Heavy rust areas in the hatch had caused thinning of the metal to the extent that holes were visible. On February 5, 1993, a decision was made to complete the ceiling decontamination by hands-on decontamination and to paint the ceiling. This decision was made because contamination levels in the ceiling were low and structural failure during scabbling was possible (Appendix B, Report B.5).

Cell wall scabbling began February 8, 1993. The control of airborne and loose contamination was the main concern involved in the decontamination process. To keep these contamination levels to a minimum during the decontamination efforts, crew members implemented the following strategy: they (1) removed the strippable paint from one block; (2) scabbled the exposed surface, which was composed of loose contamination; and then (3) removed 1/4 in. of concrete from this block before proceeding to the next. This method was extremely effective for the duration of the project. Contamination levels were kept to a minimum inside the cell as well as in the CRZs (Appendix B, Reports B.6 and B.7).

Scabbling was accomplished at an average rate of 65 ft²/week. Each day began with a 30-min briefing, followed by 45 min for PPE preparation. Three technicians worked 2 hr per entry, and there were generally two entries per day. The third technician, stationed outside Cell G, was accountable for Vac-Pac unit operation and was designated site contact for the two technicians scabbling, should an emergency situation develop.

The contamination levels increased as scabbling progressed from the top of the cell down (Appendix B, Report B.8). At the 7-ft elevation from the floor, contamination levels increased as shown in Table 1. These areas of the cell were where most of the equipment used in the recovery process had been located. To ensure that there was no increase in airborne radioactivity concentrations, the portable 1000-ft³ HEPA-filtered unit was put into operation. On March 22, 1993, the airborne concentrations increased during scabbling next to the floor pan. Migration of contamination down the walls from leaks or spills from process equipment and the 1-in.-wide lip on the floor pan might explain the increased contamination levels and the rise in airborne radioactivity during scabbling operations.

When the technicians finished scabbling the north and east walls, a direct frisk was initiated. At this point in the project, it was discovered that alpha contamination had

penetrated further than 1/4 in. into the concrete block in these areas (Appendix B, Report B.9). Smearable contamination levels also remained high. Four core bores—three on the north wall and one on the east wall—were obtained from the cell. The core samples were taken at the four highest levels of contamination, as determined by direct probe survey (Appendix B, Report B.10). Core bore results indicated that alpha contamination had penetrated as far as 3 1/2 in. into the concrete block. Areas on the north wall had the highest levels of alpha contamination. Table 2 lists the pre- and post-scabbling contamination levels of smearable alpha contamination for the north wall.

Table 2. North wall alpha contamination, pre- and post-scabbling results (smearable)

Block no.	Pre 1/4-in. removal alpha (dpm/100cm²)	Post 1/4-in. removal alpha (dpm/100cm²)
154	900,000	600
155	1,000,000	1,852
157	850,000	11,111
158	900,000	6,173
159	1,000,000	1,235
165	220,000	3,704
166	160,000	2,469
167	400,000	1,235
174	2,000,000	3,086
175	300,000	4,938
176	170,000	617
180	170,000	1,235
181*	>2,500,000	1,235
182*	1,600,000	1,852

* Indicates access hatch

Note: Smears were taken on blocks from the cell floor up four rows.

Because contamination levels on the north wall and its access hatch area were high, a sample strip of paint that had been removed from the access hatch was submitted for isotopic analysis. The results of the analysis follow:

2600 nCi gross alpha
2000 nCi gross beta
1800 nCi ^{241}Am
1600 nCi ^{239}Pu

Analysis of the strippable paint that had been removed from other, more representative, areas of the cell indicated much lower contamination levels. However, this paint was still more contaminated than all the other routinely generated waste such as chem wipes, masslin, and protective clothing. Thus, the decision to package the spent strip coat in a divergent container was made.

The cell door frame and access hatch had been decontaminated by April 7, 1993. The Pentek Corner-Cutter worked successfully, removing as much as four layers of paint from these surface areas. The smearable contamination levels on the cell door frame were reduced from 5.0×10^5 dpm per 100 cm^2 to 400 dpm per 100 cm^2 and, on the access hatch, were reduced from $>1.0 \times 10^6$ dpm per 100 cm^2 to 1.25×10^5 dpm per 100 cm^2 (Appendix B, Report B.11). Several areas of the cell door frame and access hatch have relatively high contamination levels that are embedded into the metal surfaces. Both the door frame and the hatch have been painted with the strippable paint and will have to be removed from the cell, properly packaged, and disposed of when Building 3505 is dismantled.

The crew encountered problems when decontaminating the stainless steel floor pan. These problems could be attributed to the acids that had been used in the metal recovery process: the acids had entrapped the contamination deep into the porous surface areas of the stainless steel. The crew aborted use of the Grit Blaster because of the additional volume of waste (approximately 80 ft^3) that would be generated during such a decontamination attempt. The Grit Blaster process would only scarify the surface area of the stainless steel. And, because the contamination was expected to be deeply imbedded, this decontamination technique was impractical.

Several hands-on decontamination efforts were performed on the stainless steel floor pan producing limited results. A decision was made to use Pentek 604 paint, a water-based, nonflammable, copolymer that has potential as a descaling and decontamination agent. When applied to nonporous surfaces, it bonds small molecules with larger molecules by water evaporation. The copolymer contracts upon drying, causing the coating to flake (self release) from the surface and to remove radioactive contamination in the process. However, use of the Pentek 604 paint caused no significant changes in the contamination levels on the stainless steel floor. The final survey (Appendix B, Report B.12) shows no significant variation from the precontamination survey.

On April 16, 1993, ATG had satisfied the contractual agreement to remove 1/4 in. of concrete from the surface area of Cell G. A decision was made to continue decontamination on an estimated 60 ft^2 of highly contaminated areas of the north, east, and west walls below the 8-ft elevation of the cell (Appendix A, Fig. A.2). The contracting officer representative determined that the highest contamination areas of the north, east, and west walls would be scabbled another 3/4 in. in an attempt to reduce the contamination levels.

This additional work was a scope change, and modifications to the original contract were required before work could proceed. The time delay associated with these modifications necessitated that several ATG personnel be laid off. On April 16, 1993, three decontamination technicians were laid off. And, on April 20, 1993, one Health Physics (HP) supervisor, one HP technician, and one decontamination supervisor were laid off.

After an extended process involving the DOE procurement department, ATG was allowed to continue with the project on July 26, 1993. The additional 3/4-in. removal was completed on August 23, 1993. The final survey was completed on August 27, 1993 (Appendix B, Report B.12), and ATG demobilization was also completed on this day.

A total of ten 21-gal drums of scabbled waste was generated by the decontamination project. A 5-g sample was taken from each drum and sent for radioisotopic analysis. A 50-g sample from each drum was taken from drums 1, 3, 5, and 7 for U.S. Environmental Protection Agency toxicity characteristic leaching procedure (TCLP) analysis. A radioactive analysis of the concrete medium derived that 2 to 40 nCi/g of alpha emitting radioisotopes were present, an amount well below the transuranic waste limit of 100 nCi/g. The TCLP results were negative: all Resource Conservation and Recovery Act constituents of the paint, which was part of the final waste form, were below regulatory limits. These results were established by the Analytical Chemistry Division at ORNL.

Each 21-gal drum contained 2.80 ft³ of waste, making the total volume of waste contained in the ten drums 28 ft³. The ten 21-gal drums of waste were placed into 55-gal drums—two 21-gal drums per 55-gal drum—for disposal. The volume of a 55-gal drum is 7.35 ft³. Ten 21-gal drums deposited into five 55-gal drums resulted in 5 x 7.35 ft³, or 36.75 ft³, of waste generated from Cell G for burial. The average weight of each 21-gal drum was approximately 200 lb. The packing system chosen provided enhanced safety by essentially providing an overpack.

A total of 300.5 ft³ of compactible waste was generated during the decontamination project. All waste generated—63 ft³ in February, 84 ft³ in March, 53.5 ft³ in April, and 100 ft³ in August—was disposed of as solid waste. All waste was <0.1 mrem/h per container.

5. RESULTS AND DISCUSSION

Decontamination of Cell G was highly successful. The levels of contamination have been reduced to as low as reasonably achievable (Appendix B, Reports B.8 and B.13). Removing contamination from the cell wall areas was an intricate operation. Decontamination became complicated around obstacles such as service mounts and electrical penetrations, which had given contamination a migration path. Grouting lacks the density of concrete; thus, contamination migrated in and around the porous grout to depths much greater than those anticipated. Grouted areas surrounding the cell door, access hatch, and stainless steel floor pan were prime areas for migration of contaminants. Some grouted areas had deteriorated to the point where there was no adherence to the blocks. Grouted areas 5-in.-long and 4-in.-deep collapsed from the blocks in several areas.

Each block of Cell G was individually surveyed, and the results recorded (Appendix B, Report B.12) were the highest measurable fixed contamination levels of alpha on each block. The grouting in some areas around the blocks were the most highly contaminated areas. The dollar amount budgeted for the project did not allow for performing detailed data surveys such as a radiological survey of the grout.

Contamination levels inside the cell were kept ALARA at all times. With the aid of the strippable paint, contamination levels inside the cell were maintained at <3000 dpm per 100 cm² during decontamination operations.

Because of their smearable and fixed contamination levels, the cell door frame, access hatch, and the stainless steel floor pan are, and will remain, the significant areas of concern (Appendix B, Report B.13, pp. 1 and 4). Workers applied strippable paint to the surface areas to avoid the spread of contamination to other areas of the cell and the adjoining areas of the facility.

The stainless steel floor pan is an obstacle that will not easily be overcome. The decontamination experience of ATG personnel leads them to suspect that, in all probability, the alpha contamination has penetrated behind the lip of the pan and under the floor pan area. The smallest fracture at a weld or penetration between the concrete block and the lip of the pan are transcendent regions for contamination to enter. Taking into consideration the years of operation and the amount of liquid radioactive material associated with the facility's recovery process, the contamination level underlying this area could be exceptionally high. Caution should be exercised when this floor pan is removed.

6. CONCLUSION

The MRF Cell G Decontamination Project has been a significant success. The project results have substantiated the success of the use of a commercially available dry decontamination technique that has not been used at ORNL before. Radioactive waste reduction is becoming an important issue at commercial and government burial sites, and the dry decontamination technique is an additional means of achieving waste reduction and eliminating liquid waste. Using this technique to eliminate high contamination levels reduces respiratory protection requirements, engineered controls, and, most importantly, environmental impact. The conclusion is that similar decontamination efforts can be implemented in other MRF process cells and at other facilities where D&D is anticipated.

7. REFERENCES

1. *Decontamination Project Plan for Cell G of the Metal Recovery Facility at Oak Ridge National Laboratory*, ORNL/ER/INT-17. Martin Marietta Energy Systems, Inc., Oak Ridge National Laboratory, Oak Ridge, Tennessee. April 1992.
2. *Radiation Protection for Occupational Workers*, DOE Order 5480.11. U.S. Department of Energy. Dec. 21, 1988.

Appendix A

VIEWS OF THE METAL RECOVERY FACILITY

Fig. A.1. Layout of the Metal Recovery Facility (Bldg. 3505).

Fig. A.2 View of high-contamination area.

Appendix B
REPORTS

NAME: B.D. Wilson
 DATE: 4-15-87
 PROJECT: 3505
 LOCATION: C-2nd Cell G
 DATE: 5-7-87
 OPERATOR: 606
 100
 Cell G West Wall (Grid Square Survey)
 Square Probed for Alpha

a	B	LOCATION (")	a	B	LOCATION (")	a	B	LOCATION (")
1	510,000	West Wall	34	12,000		67	12,000	
2	180,000		35	9,000		68	6,000	
3	350,000		36	14,000		69	3,000	
4	100,000		37	8,000		70	8,000	
5	170,000		38	13,000		71	12,000	
6	150,000		39	10,000		72	12,000	
7	400,000		40	13,000		73	6,000	
8	125,000		41	11,000		74	8,000	
9	240,000		42	30,000		75	4,000	
10	75,000		43	15,000		76	4,000	
11	7,000		44	7,000		77	12,000	
12	100,000		45	13,000		78	10,000	
13	50,000		46	80,000		79	120,000	
14	23,000		47	14,000		80	28,000	
15	150,000		48	40,000		81	7,000	
16	120,000		49	8,000		82	10,000	
17	50,000		50	10,000		83	11,000	
18	24,000		51	50,000		84	8,000	
19	30,000		52	8,000		85	6,000	
20	40,000		53	6,000		86	4,000	
21	60,000		54	8,000		87	14,000	
22	30,000		55	100,000		88	20,000	
23	18,000		56	10,000		89	10,000	
24	35,000		57	12,000		90	7,000	
25	25,000		58	9,000		91	8,000	
26	13,000		59	12,000		92	12,000	
27	130,000		60	12,000		93	15,000	
28	35,000		61	8,000		94	24,000	
29	30,000		62	12,000		95	11,000	
30	11,000		63	22,000		96	180,000	
31	25,000		64	10,000		97	11,000	
32	35,000		65	11,000		98	13,000	
33	30,000		66	7,000		99	40,000	
						100	40,000	

Fig. B.1. Pre-job radiological survey of Bldg. 3505, Cell G

B. D. Wilson
 101 200
 4-15-51 35005
 C-Zone Cell G
 5-7-57
 5-7-57
 600
 Cell G West and North Walls (Grid Same as
 Sixties Probed for Alpha
 1 sq. ft. each

a	B	LOCATION (*)	a	B	LOCATION (*)	a	B	LOCATION (*)
1	7,000	West Wall	34	18,000		67	400,000	
2	9,000		35	125,000		68	700,000	
3	9,000		36	9,000		69	400,000	
4	8,000		37	11,000		70	300,000	
5	5,000		38	8,000		71	1,300,000	
6	9,000		39	10,000		72	450,000	
7	3,000		40	8,000		73	1,500,000	
8	15,000		41	5,000		74	2,200,000	
9	3,000		42	8,000		75	300,000	
10	9,000		43	8,000		76	170,000	
11	8,000		44	8,000		77	90,000	
12	9,000		45	12,000		78	80,000	
13	7,000		46	2,000		79	90,000	
14	6,000		47	9,000		80	170,000	
15	4,500		48	5,000		81	2,500,000	
16	12,000		49	4,000		82	1,600,000	
17	11,000		50	30,000		83	220,000	
18	14,000		51	23,000		84	160,000	
19	12,000		52	10,000		85	140,000	
20	4,000		53	23,000		86	75,000	
21	7,000		54	900,000	North Wall	87	90,000	
22	7,000		55	1,000,000		88	100,000	
23	8,000		56	850,000		89	60,000	
24	6,000		57	850,000		90	250,000	
25	2,000		58	900,000		91	250,000	
26	7,000		59	1,000,000		92	100,000	
27	4,000		60	800,000		93	90,000	
28	3,000		61	500,000		94	50,000	
29	8,000		62	70,000		95	150,000	
30	7,000		63	180,000		96	100,000	
31	12,000		64	300,000		97	60,000	
32	18,000		65	220,000		98	40,000	
33	40,000		66	160,000		99	60,000	

Fig. B.1. (continued)

Fig. B.1. (continued)

North Wall		East Wall	
a	b	a	b
100,000	100,000	80,000	140,000
70,000	70,000	40,000	500,000
60,000	60,000	40,000	140,000
85,000	85,000	40,000	110,000
25,000	25,000	35,000	80,000
70,000	70,000	30,000	200,000
70,000	70,000	30,000	170,000
45,000	45,000	20,000	30,000
80,000	80,000	35,000	400,000
45,000	45,000	15,000	600,000
30,000	30,000	30,000	45,000
30,000	30,000	40,000	35,000
80,000	80,000	50,000	23,000
18,000	18,000	35,000	50,000
25,000	25,000	30,000	22,000
45,000	45,000	60,000	55,000
35,000	35,000	70,000	35,000
45,000	45,000	30,000	75,000
80,000	80,000	70,000	50,000
30,000	30,000	50,000	60,000
90,000	90,000	20,000	30,000
30,000	30,000	50,000	19,000
80,000	80,000	17,000	13,000
45,000	45,000	25,000	60,000
80,000	80,000	140,000	14,000
45,000	45,000	45,000	16,000
70,000	70,000	25,000	35,000
70,000	70,000	40,000	10,000
25,000	25,000	60,000	22,000
85,000	85,000	30,000	70,000
60,000	60,000	23,000	45,000
70,000	70,000	19,000	40,000
100,000	100,000	60,000	80,000

5.0. 6. 1/500
4-1551 300
Cell G North and East walls (Grid Survey 500)
5-7-87
5-7-87
500

D.D. Wilson 4-15-81 5000 Cell G 5-8-87
 301 to 400 Date 5-15-87
 Cell G 301-400
 5000 Picked for Alpha

a	B	LOCATION (*)	a	B	LOCATION (*)	a	B	LOCATION (*)
200,000		East Wall	34	32,000		67	50,000	
90,000			35	150,000		68	22,000	
90,000			36	650,000		69	23,000	
60,000			37	450,000		70	90,000	
50,000			38	40,000		71	55,000	
80,000			39	25,000		72	75,000	
120,000			40	40,000		73	30,000	
100,000			41	17,000		74	50,000	
24,000			42	32,000		75	19,000	
55,000			43	23,000		76	8,000	
45,000			44	15,000		77	35,000	
35,000			45	23,000		78	9,000	
10,000			46	14,000		79	12,000	
40,000			47	22,000		80	14,000	
90,000			48	13,000		81	6,000	
22,000			49	24,000		82	14,000	
115,000			50	18,000		83	32,000	
75,000			51	30,000		84	7,000	
30,000			52	450,000		85	3,000	
30,000			53	800,000		86	24,000	
17,000			54	25,000		87	45,000	
35,000			55	30,000		88	60,000	
20,000			56	16,000		89	18,000	
35,000			57	28,000		90	32,000	
50,000			58	14,000		91	14,000	
55,000			59	30,000		92	45,000	
35,000			60	55,000		93	15,000	
40,000			61	33,000		94	20,000	
45,000			62	35,000		95	28,000	
27,000			63	4,000		96	17,000	
25,000			64	16,000		97	10,000	
40,000			65	40,000		98	10,000	
12,000			66	24,000		99	14,000	

Fig. B.1. (continued)

B.D. Wilson

4-15-51

3505

Cell G

5-11-37

401

520

Date

5-14-37

B.D.W.

#401-500

Cell G

Smears prepared for Alpha

a	β	LOCATION (°)	a	β	LOCATION (°)	a	β	LOCATION (°)
28,000			34	32,000		67	16,000	
20,000			35	70,000		68	32,000	
14,000			36	25,000		69	20,000	
30,000			37	20,000		70	14,000	
160,000			38	14,000		71	10,000	
65,000			39	11,000		72	3,000	
13,000			40	6,000		73	10,000	
55,000			41	16,000		74	90,000	
60,000			42	22,000		75	60,000	
80,000			43	25,000	South Wall	76	120,000	
9,000			44	180,000		77	15,000	
16,000			45	30,000		78	8,000	
19,000			46	140,000		79	16,000	
17,000			47	160,000		80	30,000	
20,000			48	700,000		81	9,000	
28,000			49	180,000		82	9,000	
135,000			50	850,000		83	12,000	
15,000			51	40,000		84	11,000	
18,000			52	120,000		85	85,000	
18,000			53	35,000		86	9,000	
50,000			54	65,000		87	4,000	
18,000			55	75,000		88	3,000	
12,000			56	50,000		89	225,000	
6,000			57	100,000		90	90,000	
12,000			58	180,000		91	32,000	
11,000			59	80,000		92	13,000	
9,000			60	160,000		93	3,000	
8,000			61	11,000		94	12,000	
17,000			62	13,000		95	10,000	
28,000			63	13,000		96	13,000	
30,000			64	25,000		97	5,000	
35,000			65	45,000		98	8,000	
6,000			66	8,000		99	5,000	
						100	15,000	

Fig. P.1. (continued)

NAME: B. D. Wilson PHONE: 4-1551 RECORD NO.: 3503 LOCATION: Cell-G DATE: 5-18-87
 OPERATOR: 501 Date: 5-18-87 OPERATOR: BDW
 REMARKS: Cell-G Wall # 501-600
Smears Pretest for Alpha

a	B	LOCATION (*)	a	B	LOCATION (*)	a	B	LOCATION
1	12,000		34	25,000		67	6,000	
2	17,000		35	18,000		68	8,000	
3	7,000		36	20,000		69	15,000	
4	13,000		37	11,000		70	13,000	
5	24,000		38	14,000		71	16,000	
6	5,000		39	6,000		72	11,000	
7	20,000		40	17,000		73	15,000	
8	85,000		41	8,000		74	12,000	
9	25,000		42	13,000		75	18,000	
10	50,000		43	18,000		76	55,000	
11	14,000		44	10,000		77	25,000	
12	8,000		45	12,000		78	40,000	
13	9,000		46	6,000		79		
14	6,000		47	30,000		80		
15	10,000		48	4,000		81		
16	10,000		49	14,000		82		
17	8,000		50	16,000		83		
18	8,000		51	10,000		84		
19	10,000		52	10,000		85		
20	8,000		53	12,000		86		
21	6,000		54	9,000		87		
22	12,000		55	8,000		88		
23	40,000		56	10,000		89		
24	35,000		57	7,000		90		
25	15,000		58	7,000		91		
26	10,000		59	11,000		92		
27	12,000		60	12,000		93		
28	10,000		61	14,000		94		
29	25,000		62	9,000		95		
30	3,000		63	13,000		96		
31	6,000		64	4,000		97		
32	30,000		65	15,000		98		
33	8,000		66	18,000		99		

Fig. B.1. (continued)

North Wall

282	283	284	285	286	287	288	289
281	280	279	278	277	276	275	274
266	267	268	269	270	271	272	273
265	264	263	262	261	260	259	258
250	251	252	253	254	255	256	257
249	248	247	246	245	244	243	242
234	235	236	237	238	239	240	241
233	232	231	230	229	228	227	226
218	219	220	221	222	223	224	225
217	216	215	214	213	212	211	210
202	203	204	205	206	207	208	209
201	200	199	198	197	196	195	194
186	187	188	189	190	191	192	193
185	184	183	182	181	180	179	178
170	171	172	173	174	175	176	177
169	168	167	166	165	164	163	162
154	155	156	157	158	159	160	161

Northwest Corner

Fig. B.1. (continued)

East Wall

435	436	437	438	439	440	441	442	292
434	433	432	431	430	429	428	427	426
417	418	419	420	421	422	423	424	425
416	415	414	413	412	411	410	409	408
399	400	401	402	403	404	405	406	407
398	397	396	395	394	393	392	391	390
381	382	383	384	385	386	387	388	389
380	379	378	379	376	375	374	373	372
363	364	365	366	367	368	369	370	371
362	361	360	359	358	357	356	355	354
345	346	347	348	349	350	351	352	353
344	343	342	341	340	339	338	337	336
327	328	329	330	331	332	333	334	335
326	325	324	323	322	321	320	319	318
309	310	311	312	313	314	315	316	317
308	307	306	305	304	303	302	301	300
290	291	293	294	295	296	297	298	299

Northeast corner 45

* 292 got skipped, added to test block on wall.

Fig. B.1. (continued)

West Wall

143	146	147	148	149	150	151	152	153
144	145	142	141	140	139	138	137	136
127	128	129	130	131	132	133	134	135
126	125	124	123	122	121	120	119	118
109	110	111	112	113	114	115	116	117
108	107	106	105	104	103	102	101	100
91	92	93	94	95	96	97	98	99
90	89	88	87	86	85	84	83	82
73	74	75	76	77	78	79	80	81
72	71	70	69	68	67	66	65	64
55	56	57	58	59	60	61	62	63
54	53	52	51	50	49	48	47	46
37	38	39	40	41	42	43	44	45
36	35	34	33	32	31	30	29	28
19	20	21	22	23	24	25	26	27
18	17	16	15	14	13	12	11	10
1	2	3	4	5	6	7	8	9

↗
Southwest
Corner

Fig. B.1. (continued)

South Wall

1	2	3	4	5	6	7	8
573	574	575	576	577	578	502*	505*
572	571	570	569	568	567	566	565
557	558	559	560	561	562	563	564
556	555	554	553	552	551	550	549
541	542	543	544	545	546	547	548
540	539	538	537	536	535	534	533
525	526	527	528	529	530	531	532
524	523	522	521	520	519	518	517
509	510	511	512	513	514	515	516
508	507	506	504*	503*	501	500	499
491	492	493	494	495	496	497	498
490	489	488	487	486	485	484	483
475	476	477	478	479	480	481	482
474	473	472	471	470	469	468	467
459	460	461	462	463	464	465	466
458	457	456	455	454	453	452	451
443	444	445	446	447	448	449	450

Southeast Corner

* Numbers 502 & 505 were accidentally skipped, added to last two blocks at top of wall.

Fig. B.1. (continued)

RADIOLOGICAL SURVEY REPORT

DATE 1-27-93		INSTRUMENTATION USED			
TIME 1400	MODEL 3	SN 97992	% EFF. 10	CAL. DUE DATE 12/30/93	
SURVEYOR RUD GRISHAM	5	97134	20	12/30/93	
LOCATION CELL-G	N/A	N/A	N/A	N/A	
REVIEWED BY CVH					
Smear locations circled: Dose Rates = mR/hr					

PRE DECEN SURVEY		1987	
SMEAR NUMBERS CORRELATE TO MMES		1985	
CELL-G SURVEY LOCATIONS.		2-1-93	

SMEAR RESULTS		
DPM/100CM ²		
BETA-GAMMA	ALPHA	
2	15K	10K
96	3K	2.5K
135	12K	12.5K
80	5K	10K
109	2.1K	1.5K
162	50K	45K
176	35K	40K
196	35K	40K
242	1K	2.5K
282	2.1K	2.5K
294	6K	6K
307	70K	75K
331	6K	6K
365	1.5K	5K
417	1K	10K
444	42K	45K
476	8K	12.5K
490	60K	60K
523	2K	4K
556	10K	1.5K
1	10K	11K
2	10K	11K
3	10K	18.5K
4	2.1K	1K
5	2.1K -	500
6	2.1K	1K
1	2.1K	100
2	2.1K	100
3	2.1K	100

WEST WALL

DOOR/WALL

EAST WALL

SOUTH WALL

FLOOR

CEILING

CEILING POST DECEN

FORM 124

Fig. B.2. Radiological survey report, Jan. 27, 1993.

FORM 124

Fig. B.3. Radiological survey report, Feb. 3, 1993.

RADIOLOGICAL SURVEY REPORT

DATE 2-3-93		INSTRUMENTATION USED			
TIME 1430 ^{PM} 1445	MODEL	S/N	% EFF.	CAL DUE DATE	
SURVEYOR N. REYNOLDS	3	97992	10	12/30/93	
LOCATION C.R.Z. #1, C.R.Z. #2, REG AREA	3	97427	20	12/30/93	
REVIEWED BY	19	98059	N/A	12/30/93	
Smear locations circled; Data Rates = $\mu R/h$ AND UNDERLINED.					

⊗ = Air Sample

SMAR RESULTS			
DPM/100CM ²			
BETA-GAMMA	ALPHA		
1	<1,000	<200	FLOOR
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
18			
19			
20			
21			
22			
23			
24			
25			
26			
27			
28	<1,000	<200	FLOOR

FORM 124

Fig. B.4. Radiological survey report, Feb. 3, 1993.

RADIOLOGICAL SURVEY REPORT

DATE		INSTRUMENTATION USED			
TIME	1415	MODEL	S/N	% EFF.	CAL. DUE DATE
SURVEYOR	G.K. HARRIS / N. ROYALDS	3	97992	10	12/30/93
LOCATION	CELL G	3	97134	20	12/30/93
REVIEWED BY	<i>[Signature]</i>	N/A	N/A	N/A	N/A

Smear locations circled; Beta-Rates = In Rm.

CEILING

ELEC. CORD
 (α) 1,000 CPM/PROBE
 (β-γ) 100 CPM/PROBE

I-BEAM
 (α) 3,500 CPM/PROBE
 (β-γ) <8KG CPM/PROBE

SMEAR RESULTS

	BETA-GAMMA	ALPHA
1	<1,000	<300
2	↑	↑
3		
4		
5		
6		
7		
8		
9	↓	↓
10	<1,000	<300
N A		

FORM 124

Fig. B.5. Radiological survey report, April 13, 1993.

RADIOLOGICAL SURVEY REPORT

DATE 3-19-93		INSTRUMENTATION USED			
TIME 1425	MODEL 3	S/N 47442	% EFF. 10	CAL DUE DATE 12/30/93	
SURVEYOR B. GANN / C. HARRIS		3	47134	20	12/30/93
LOCATION CELL G		19	48059	N/A	12/30/93
REVIEWED BY <i>[Signature]</i>					

Smear locations circled. Dose rates = mR/hr AND UNDERLINED

⊗ = AIR SAMPLE (10' FROM CEILING)

SMEAR RESULTS			
DPM/100CM ²			
BETA-GAMMA	ALPHA		
1	<1,000	<300	NORTH WALL
2	↑	↑	
3			
4			
5			NORTH WALL
6			WEST WALL
7			
8			
9			
10			WEST WALL
11			SOUTH WALL
12			
13			
14			
15			SOUTH WALL
16			EAST WALL
17			
18			
19			
20			EAST WALL
21			CEILING
22			
23			
24			
25	-	<300	CEILING
26		500	FLOOR
27		<300	
28		500	
29	↓	<300	
30	<1,000	<300	FLOOR

FORM 124

Fig. B.6. Radiological survey report, Mar. 19, 1993.

RADIOLOGICAL SURVEY REPORT

DATE	INSTRUMENTATION USED			
3-19-93				
TIME 1435	MODEL	S/N	% EFF.	CAL DUE DATE
SURVEYOR B. Gann/C. Harris	3	97992	10	12/30/93
LOCATION C.R.Z. #1, C.R.Z. #2, REG. AREA	3	97134	20	12/30/93
REVIEWED BY RWJ	19	98059	N/A	12/30/93
Smear locations circled; Data Rates = mRAE ~~NR/HR~~ AND UNDERLINED				

⊗ = Air Sample

①
120

C.R.Z. #1

③
100

④
80

②
100

⑤
81

⑥
100

C.R.Z. #2

⑧

⑦
100

⑨
200

130
⑩
10

⑪
10

SMEAR RESULTS	
DIR/100CM ²	
BETA-GAMMA	ALPHA
1	<1,000
2	↑
3	↑
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
16	
17	
18	↓
19	↓

REGULATED AREA

⑫   ⑬

⑭

⑮   ⑯

⑰

⑱   ⑲

Fig. B.7. Radiological survey report, Mar. 19, 1993.

RADIOLOGICAL SURVEY REPORT

DATE <u>4-6-93</u>		INSTRUMENTATION USED			
TIME	<u>N/A</u>	MODEL	S/N	% ERR.	CAL. DUE DATE
SURVEYOR	<u>C. V. Harris / B. A. Wells / M. A. Reynolds</u>	<u>#3 B1</u>	<u>3517-07A</u>	<u>10</u>	<u>12-30-93</u>
LOCATION	<u>Cell 9 Bldg 3505</u>	<u>#3 A</u>	<u>3550-149</u>	<u>20</u>	<u>12-30-93</u>
REVIEWED BY	<u>RW. H. H. H.</u>				
Smear locations circled; Dose Rate = mR/hr					

ROWS AND BLOCKS ARE NUMBERED AS FOLLOWS:

Row: #1, starts w/ bottom row and ends w/ top row #25

Blocks: #1, starts at left side of every row on each wall

(amount of blocks vary on each row)

(1/4, 1/2, or whole blocks are each assigned a whole number)

Fig. B.8. Radiological survey report, April 6, 1993.

* ON METAL
(PIPE OR BOLTS)WALL NORTH

row#	blk#	Alpha probe cpm	Alpha DPM	Alpha smear/dpm	Beta- Gamma probe	Beta- Gamma DPM	Beta- Gamma smear/dpm
1	1	5,000	25,000	617	3,500	35,000	<1,000
	2	14,000	70,000	1,852	10,000	100,000	<1,000
	3	70,000	350,000	1,852	30,000	300,000	1,000
	4	130,000	650,000	11,111	65,000	650,000	2,000
	5	120,000	600,000	6,73	20,000	200,000	1,000
	6	30,000	150,000	1,235	10,000	100,000	<1,000
	7	5,000	25,000	617	2,600	26,000	↑
2	1	40,000	200,000	1,235	10,000	100,000	↑
	2	20,000	100,000	617	10,000	100,000	↓
	3	50,000	250,000	1,235	16,000	160,000	↓
	4	100,000	500,000	2,469	20,000	200,000	<1,000
	5	150,000	750,000	3,704	32,000	320,000	10,000
	6	50,000	250,000	3,086	15,000	150,000	<1,000
3	1	6,000	30,000	247	2,500	25,000	<1,000
	2	100,000	500,000	988	22,000	220,000	500
	3	10,000	50,000	741	7,000	70,000	<1,000
	4	16,000	80,000	1,111	2,200	22,000	↑
	5	100,000	500,000	3,086	22,000	220,000	↑
	6	40,000	200,000	4,938	14,000	140,000	↑
	7	28,000	140,000	617	7,000	70,000	↑
4	1	2,000	10,000	617	600	6,000	↑
	2	9,000	45,000	617	2,200	22,000	↑
	3	3,000	15,000	741	2,200	22,000	↑
	4	100,000	500,000	1,852	43,000	430,000	↑
	5	32,000	160,000	1,235	8,000	80,000	↑
	6	30,000	150,000	1,235	7,000	70,000	↑
5	1	600	3,000	494	50	500	↑
	2	5,000	25,000	247	1,800	18,000	↓
	3	4,000	20,000	370	11,000	11,000	<1,000
	4	150,000	750,000	4,321	50,000	500,000	2,500
	5	100,000	500,000	1,852	28,000	280,000	<1,000
	6	10,000	50,000	617	2,800	28,000	<1,000

Fig. B.8. (continued)

Fig. B.8. (continued)

WALL NORTH

* METAL (BOLT or PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
9	1	800	4,000	250	≤ BK6	≤ BK6	≤ BK6
	2	500	2,500	0	≤ BK6	≤ BK6	↑
	3	400	2,000	0	50	500	↑
	4	2200	11,000	100	700	7000	↑
	5	6000	30,000	100	2400	24,000	↑
	6	17,000	85,000	0	5,000	50,000	↓
	7	9,000	45,000	0	1600	16,000	200
10	1	500	2500	0	150	1500	≤ BK6
	2	500	2500	0	200	2,000	↑
	3	700	3500	0	200	2,000	↑
	4	500	2500	250	700	7,000	↑
	5	25,000	125,000	500	3600	36,000	↑
	6	1,000	5,000	0	120	1200	↑
11	1	300	1500	0	100	1000	↑
	2	190	950	0	≤ BK6	≤ BK6	↑
	3	210	1050	0	≤ BK6	≤ BK6	↑
	4	140	700	0	60	600	↑
	5	5,000	25,000	250	800	8,000	↑
	6	1200	6,000	0	400	4,000	↓
	7	150	750	0	≤ BK6	≤ BK6	200
12	1	180	900	0	≤ BK6	≤ BK6	≤ BK6
	2	600	3000	0	100	1000	↑
	3	50	250	50	≤ BK6	≤ BK6	↓
	4	1300	6500	0	≤ BK6	≤ BK6	200
	5	2700	13,500	0	1000	10,000	≤ BK6
	6	2,800	14,000	0	700	7,000	↑
13	1	250	1250	0	≤ BK6	≤ BK6	↑
	2	1500	7,500	0	400	4,000	↑
	3	300	1,500	50	250	2,500	↑
	4	50	250	0	150	1,500	↓
	5	40	200	0	≤ BK6	≤ BK6	50
	6	30	150	0	≤ BK6	≤ BK6	≤ BK6
	7	300	1,500	0	100	1000	≤ BK6

Fig. B.8. (continued)

WALL NORTH

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
14	1	600	3000	0	120	1,200	≤ BK6
	2	1000	5000	0	420	4,200	150
	3	40	200	0	≤ BK4	≤ BK4	≤ BK4
	4	100	500	50	↑	↑	↑
	5	50	250	0	↓	↓	
	6	120	600	0	↓	↓	
15	1	80	400	0	↓	↓	
	2	1500	7500	0	100	1000	
	3	700	3500	0	140	1400	
	4	50	250	0	≤ BK4	≤ BK4	
	5	60	300	0	↑	↑	
	6	60	300	250	↓	↓	
16	7	130	650	250	20	200	
	1	300	1500	0	100	1000	
	2	1000	5,000	0	100	1000	
	3	80	400	0	≤ BK4	≤ BK4	
	4	70	350	0	↑	↑	
	5	50	250	0	↓	↓	
17	6	130	650	0	↓	↓	
	1	20	100	0	↓	↓	
	2	2500	12,500	0	600	6000	
	3	20	100	0	40	400	
	4	100	500	0	50	500	
	5	40	200	0	30	300	
18	6	50	250	0	≤ BK4	≤ BK4	
	7	20	100	0	↑	↑	
	1	200	1000	0	↓	↓	
	2	4,000	20,000	150	750	7500	
	3	40	200	0	≤ BK4	≤ BK4	
	4	40	200	0	50	500	
	5	20	100	0	≤ BK4	≤ BK4	≤ BK4
	6	20	100	0	50	500	100

Fig. B.8. (continued)

WALL NORTH

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
19	1	500	2500	0	300	3000	≤ BKG
	2	500	2500	0	250	2500	↑
	3	500	2500	0	140	1400	↓
	4	500	2500	0	60	600	↓
	5	50	250	60	≤ BKG	≤ BKG	200
	6	50	250	0	↑	↑	≤ BKG
	7	50	250	0	↓	↓	↑
20	1	250	1250	0	↓	↓	↑
	2	400	2000	0	140	1400	↑
	3	40	200	0	≤ BKG	≤ BKG	↑
	4	20	100	50	40	400	↑
	5	50	250	0	20	200	↑
	6	260	1300	150	≤ BKG	≤ BKG	↑
21	1	200	1000	0	80	800	↑
	2	1000	5000	0	300	3000	↑
	3	700	3500	0	400	4000	↑
	4	1200	6000	0	800	8000	↑
	5	100	500	0	200	2000	↑
	6	300	1500	30	40	400	↑
	7	30	150	0	20	200	↑
22	1	600	3000	0	≤ BKG	≤ BKG	↑
	2	300	1500	0	↑	↑	↑
	3	30	150	0	↓	↓	↓
	4	20	100	0	50	500	300
	5	30	150	0	≤ BKG	≤ BKG	≤ BKG
	6	20	100	0	↑	↑	↑
23	1	60	300	0	↑	↑	↑
	2	30	150	0	↑	↑	↑
	3	20	100	0	↑	↑	↑
	4	60	300	0	↑	↑	↑
	5	30	150	0	↓	↓	↓
	6	40	200	0	50	500	↓
	7	30	150	0	≤ BKG	≤ BKG	200

Fig. B.8. (continued)

WALL

NORTH

*

METAL

(BOLT

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[illegible]

Fig. B.8. (continued)

* ON METAL
(PIPE OR BOLTS)

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WALL East

row#	blk#	Alpha probe cpm	Alpha DPM	Alpha smear/dpm	Beta- Gamma probe	Beta- Gamma DPM	Beta- Gamma smear/dpm
1	1	45,000	225,000	864	20,000	200,000	<1,000
	2	35,000	175,000	370	22,000	220,000	↑
	3	5,000	25,000	247	350	3,500	
	4	1,000	5,000	247	400	4,000	
	5	200	1,000	370	40	400	
2	1	2,500	12,500	494	1800	18,000	
	2	70,000	350,000	988	33,000	330,000	
	3	70,000	350,000	741	30,000	300,000	
	4	700	3,500	247	60	600	
	5	2500	12,500	247	1200	12,000	
	6	600	3,000	247	40	400	
3	1	30,000	150,000	370	18,000	180,000	
	2	170,000	850,000	494	23,000	230,000	
	3	60,000	300,000	370	20,000	200,000	
	4	3500	17,500	247	600	6,000	
	5	2000	10,000	247	14,000	140,000	
4	1	20,000	100,000	493	5,000	50,000	
	2	45,000	225,000	247	12,000	120,000	
	3	12,000	60,000	247	100	1,000	
	4	2,000	10,000	247	600	6,000	
	5	300	1,500	494	100	1,000	
	6	100	500	247	20	200	
5	1	30,000	150,000	988	10,000	100,000	
	2	50,000	250,000	2469	22,000	220,000	
	3	2,000	10,000	741	* 250	2,500	
	4	100	500	123	≤ BK6	≤ BK6	
	5	600	3000	247	≤ BK6	≤ BK6	
6	1	7,000	35,000	494	600	6,000	
	2	12,000	60,000	247	5,000	50,000	
	3	10,000	50,000	370	4200	42,000	
	4	300	1,500	247	100	1,000	
	5	50	250	247	40	400	
	6	150	750	123	40	400	<1,000

Fig. B.8. (continued)

* ON METAL
(PIPE OR BOLT)

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WALL East

[illegible]

Fig. B.8. (continued)

WALL EAST * METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
9	1	400	2000	50	≤ BKG	≤ BKG	≤ BKG
	2	2000	10,000	300	450	4500	↑
	3	2700	13,500	0	200	2000	
	4	100	500	0	≤ BKG	≤ BKG	
	5	100	500	0	↑	↑	
10	1	100	500	0	50	500	
	2	1000	5,000	300	200	2,000	
	3	800	4,000	0	≤ BKG	≤ BKG	
	4	50	250	0	↑	↑	
	5	60	300	0	↓	↓	
	6	130	650	0	↓	↓	
11	1	5,000	25,000	0	800	8,000	
	2	700	3,500	0	200	2,000	
	3	40	200	0	≤ BKG	≤ BKG	
	4	20	100	0	↑	↑	
	5	40	200	0	↓	↓	
12	1	400	2,000	0	↓	↓	
	2	700	3,500	0	150	1,500	
	3	150	750	0	≤ BKG	≤ BKG	
	4	20	100	0	↑	↑	
	5	10	50	0	↓	↓	
	6	10	50	0	↓	↓	
13	1	400	2,000	0	100	1,000	
	2	1,000	5,000	0	≤ BKG	≤ BKG	
	3	10	50	0	* 100	1,000	
	4	200	1,000	0	≤ BKG	≤ BKG	
	5	40	200	0	70	700	
14	1	10	50	0	≤ BKG	≤ BKG	
	2	600	3,000	0	250	2,500	↓
	3	40	200	0	50	500	≤ BKG
	4	20	100	0	≤ BKG	≤ BKG	↑
	5	40	20	0	↑	↑	↓
	6	10	50	0	≤ BKG	≤ BKG	≤ BKG

Fig. B.8. (continued)

WALL EAST

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
15	1	500	2500	0	≤ BK4	≤ BK4	≤ BK4
	2	2800	14,000	0	600	6000	↑
	3	30	150	0	≤ BK4	≤ BK4	
	4	20	100	0	↑	↑	
	5	30	150	0			
	6	20	100	0			
	7	100	500	0			
16	1	50	250	0			
	2	200	1000	0			
	3	40	200	0			
	4	60	300	0			
	5	20	100	0			
	6	20	100	0			
	7	20	100	0			
	8	180	900	0			
17	1	20	100	0			
	2	20	100	0			
	3	20	100	0			
	4	20	100	0			
	5	20	100	0			
	6	0	0	0			
	7	20	100	0			
18	1	50	250	0			
	2	500	2500	100			
	3	20	100	0			
	4	50	250	0			
	5	0	0	0			
	6	50	250	0			
	7	0	0	0	↓	↓	↓
	8	0	0	0	≤ BK4	≤ BK4	≤ BK4

Fig. B.8. (continued)

WALL EAST

*METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
19	1	200	1000	0	10	100	≤ BK4
	2	150	750	0	≤ BK4	≤ BK4	↑
	3	20	100	0	≤ BK4	≤ BK4	
	4	20	100	0	20	200	
	5	0	0	0	≤ BK4	≤ BK4	
	6	40	200	0	↑	↑	
	7	0	0	0			
20	1	30	150	0			
	2	100	500	0			
	3	20	100	0	↓	↓	
	4	10	50	0	30	300	
	5	70	350	0	20	200	
	6	10	50	0	≤ BK4	≤ BK4	
	7	20	100	0			
	8	0	0	0			
21	1	10	50	0			
	2	40	200	0			
	3	30	150	0			
	4	30	150	0			
	5	10	50	0			
	6	10	50	0			
	7	20	100	0			
22	1	0	0	0			
	2	10	50	0			
	3	20	100	0			
	4	* 20	100	0			
	5	30	150	0			
	6	20	100	0			
	7	* 20	100	0			
	8	20	100	0	≤ BK4	≤ BK4	≤ BK4

Fig. B.8. (continued)

* METAL (BOLT OR PIPE)

Fig. B.8. (continued)

WALL SOUTH[illegible]

Fig. B.8. (continued)

WALL SOUTH

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
9	1	10	50	0	≤ BKG	≤ BKG	≤ BKG
	2	30	150	0	↑	↑	↑
	3	10	50	0			
10	1	10	50	0			
	2	120	600	0			
11	1	20	100	0			
	2	20	100	0			
	3	30	150	0			
	4	30	150	0			
	5	50	250	0			
12	1	20	100	0			
	2	20	100	0			
	3	40	200	0			
	4	50	250	0			
	5	10	50	0			
13	1	50	250	0			
	2	50	250	0			
	3	150	750	0			
	4	50	250	0			
	5	20	100	0			
14	1	10	50	0			
	2	20	100	0			
	3	40	200	0			
	4	40	200	0			
	5	20	100	0			
15	1	40	200	0			
	2	20	100	0			
	3	20	100	0			
	4	40	200	0			
	5	20	100	0			
	6	20	100	0	↓	↓	↓
	7	20	100	0	≤ BKG	≤ BKG	≤ BKG

Fig. B.8. (continued)

WALL SOUTH

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
16	1	20	100	0	≤ BKG	≤ BKG	≤ BKG
	2	20	100	0	↑	↑	↑
	3	20	100	0			
	4	20	100	0			
	5	20	100	0			
	6	20	100	0			
17	1	20	100	0			
	2	40	200	0	↓		
	3	20	100	0	≤ BKG	≤ BKG	≤ BKG
	4	20	100	0	50	500	↑
	5	20	100	0	≤ BKG	≤ BKG	
	6	20	100	0	↑	↑	
	7	20	100	0			
18	1	20	100	0			
	2	20	100	0			
	3	20	100	0			
	4	40	200	0			
	5	20	100	0			
	6	20	100	0			
19	1	20	100	0			
	2	20	100	0			
	3	20	100	0			
	4	20	100	0			
	5	20	100	0			
	6	20	100	0			
	7	20	100	0			
20	1	20	100	0			
	2	20	100	0			
	3	20	100	0			
	4	20	100	0			
	5	20	100	0	↓	↓	↓
	6	20	100	0	≤ BKG	≤ BKG	≤ BKG

Fig. B.8. (continued)

WALL SOUTH

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
21	1	20	100	0	≤ BKG	≤ BKG	≤ BKG
	2	20	100	0	≤ BKG	≤ BKG	≤ BKG
	3	20	100	0	100	1,000	↑
	4	40	200	0	≤ BKG	≤ BKG	
	5	20	100	0	↑	↑	
	6	20	100	0			
	7	20	100	50			
22	1	20	100	0	↓	↓	
	2	20	100	0	≤ BKG	≤ BKG	
	3	40	200	0	50	500	
	4	20	100	0	50	500	
	5	20	100	0	≤ BKG	≤ BKG	
	6	* 400	2,000	0	* 400	4,000	
23	1	0	0	0	≤ BKG	≤ BKG	
	2	0	0	0	↑	↑	
	3	20	100	0			
	4	0	0	0	↓	↓	
	5	20	100	250	≤ BKG	≤ BKG	
	6	10	50	0	50	500	
	7	10	50	0	50	500	
24	1	0	0	0	≤ BKG	≤ BKG	
	2	0	0	0	50	500	
	3	0	0	0	≤ BKG	≤ BKG	
	4	20	100	0	≤ BKG	≤ BKG	
	5	20	100	100	50	500	
	6	30	150	0	≤ BKG	≤ BKG	
25	1	20	100	0	250	2,500	
	2	50	250	0	200	2,000	
	3	20	100	0	100	1,000	
	4	100	500	0	50	500	
	5	50	250	0	50	500	
	6	20	100	0	≤ BKG	≤ BKG	↓
	7	40	200	0	50	500	≤ BKG

Fig. B.8. (continued)

WALL WEST* ON METAL
(PIPE OR BOLT)

row#	blk#	Alpha probe CPM	Alpha DPM	Alpha smear/dpm	Beta- Gamma probe	Beta- Gamma DPM	Beta- Gamma smear/dpm
1	1	2,000	10,000	0	* 1,000	10,000	< 1,000
	2	1,000	5,000	0	1,800	18,000	↑
	3	500	2,500	50	1,000	10,000	
	4	20,000	100,000	100	5,000	50,000	
	5	4,000	20,000	100	1,500	15,000	
	6	3,000	15,000	50	1,800	18,000	
	7	25,000	125,000	1,500	* 22,000	220,000	
2	1	200	1,000	50	40	400	
	2	200	1,000	0	40	400	
	3	500	2,500	0	300	3,000	
	4	2,500	12,500	50	2,000	20,000	
	5	10,000	50,000	250	5,000	50,000	
	6	2,000	10,000	100	1,500	15,000	
	7	5,000	25,000	100	2,200	22,000	
	8	3,500	17,500	500	10,000	100,000	
3	1	200	1,000	50	50	500	
	2	450	2,250	0	250	2,500	
	3	450	2,250	0	50	500	
	4	200	1,000	0	50	500	
	5	3,000	15,000	50	900	9,000	
	6	6,000	30,000	50	1,200	12,000	
	7	14,000	70,000	250	3,000	30,000	
4	1	100	500	50	50	500	
	2	80	400	50	20	200	
	3	600	3,000	0	50	500	
	4	600	3,000	50	150	1,500	
	5	1,200	6,000	50	600	6,000	
	6	600	3,000	50	200	2,000	
	7	2,200	11,000	0	400	4,000	↓
	8	2,500	12,500	150	2,000	20,000	< 1,000

Fig. B.8. (continued)

WALL WEST* ON METAL
(PIPE or BOLT)

row#	blk#	Alpha probe CPM	Alpha DPM	Alpha smear/dpm	Beta- Gamma probe	Beta- Gamma DPM	Beta- Gamma smear/dpm
5	1	80	400	50	20	200	↑ ≤ 1,000
	2	600	3,000	0	60	600	
	3	100	500	0	60	600	
	4	100	500	50	50	500	
	5	800	4,000	0	100	1,000	
	6	2,000	10,000	100	600	6,000	
	7	700	3,500	50	80	800	
6	1	0	0	0	≤ BKG	≤ BKG	
	2	50	250	50	≤ BKG	≤ BKG	
	3	1,500	7,000	50	50	500	
	4	0	0	50	≤ BKG	≤ BKG	
	5	50	250	100	≤ BKG	≤ BKG	
	6	1,000	5,000	150	500	5,000	
	7	600	3,000	100	200	2,000	
	8	650	3,250	200	100	1,000	
7	1	50	250	50	40	400	
	2	1,000	5,000	0	650	6,500	
	3	0	0	0	40	400	
	4	50	250	0	40	400	
	5	200	1,000	50	40	400	
	6	400	2,000	50	400	4,000	
	7	800	4,000	100	800	8,000	
8	1	20	100	50	40	400	
	2	50	250	0	40	400	
	3	360	1,800	0	200	2,000	
	4	0	0	50	40	400	
	5	50	250	0	50	500	
	6	300	1,500	0	40	400	
	7	800	4,000	50	300	3,000	
	8	4,200	21,000	150	1,500	15,000	↓ ≤ 1,000

Fig. B.8. (continued)

WALL West

* METAL (Bolt or Pipe)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
9	1	60	300	100	≤ BKG	≤ BKG	≤ BKG
	2	1,000	5,000	0	↑	↑	↑
	3	40	200	0	↓	↓	↓
	4	40	200	0	↓	↓	↓
	5	100	500	0	↓	↓	↓
	6	100	500	0	≤ BKG	≤ BKG	≤ BKG
	7	1,600	8,000	100	500	5,000	
10	1	40	200	0	≤ BKG	≤ BKG	
	2	60	300	0	↑	↑	
	3	20	100	0	↓	↓	
	4	20	100	0	↓	↓	
	5	50	250	0	↓	↓	
	6	120	600	0	↓	↓	
	7	200	1,000	50	≤ BKG	≤ BKG	
11	8	5,000	25,000	100	500	5,000	
	1	20	100	0	≤ BKG	≤ BKG	
	2	100	500	0	↑	↑	
	3	40	200	0	↓	↓	
	4	40	200	0	↓	↓	
	5	50	250	0	↓	↓	
	6	20	100	0	≤ BKG	≤ BKG	
12	7	1,000	5,000	0	100	1,000	
	1	20	100	0	≤ BKG	≤ BKG	
	2	40	200	0	↑	↑	
	3	300	1,500	0	↓	↓	
	4	60	300	0	↓	↓	
	5	40	200	0	↓	↓	
	6	40	200	0	↓	↓	
	7	20	100	0	↓	↓	
	8	200	1,000	0	≤ BKG	≤ BKG	≤ BKG

Fig. B.8. (continued)

WALL West

* METAL (BOLT OR PIPE)

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
13	1	40	200	0	≤ BKG	≤ BKG	≤ BKG
	2	40	200	0	↑	↑	↑
	3	40	200	0	↑	↑	↑
	4	20	100	0	↓	↓	↓
	5	20	100	0	↓	↓	↓
	6	20	100	0	≤ BKG	≤ BKG	↓
	7	*2000	10,000	100	*400	4,000	≤ BKG
14	1	20	100	0	≤ BKG	≤ BKG	↑
	2	0	0	50	↑	↑	↑
	3	100	500	0	≤ BKG	≤ BKG	↑
	4	0	0	50	50	500	↑
	5	20	100	0	≤ BKG	≤ BKG	↑
	6	20	100	0	↑	↑	↑
	7	50	250	0	≤ BKG	≤ BKG	↑
	8	3,000	15,000	200	550	5,500	↑
15	1	0	0	0	≤ BKG	≤ BKG	↑
	2	20	100	0	↑	↑	↑
	3	20	100	50	↑	↑	↑
	4	50	250	0	↓	↓	↓
	5	50	250	0	↓	↓	↓
	6	20	100	50	≤ BKG	≤ BKG	↓
	7	2,000	10,000	50	500	5,000	↓
16	1	0	0	0	≤ BKG	≤ BKG	↓
	2	0	0	0	↑	↑	↓
	3	0	0	0	↑	↑	↓
	4	50	250	0	↓	↓	↓
	5	0	0	0	↓	↓	↓
	6	300	1,500	0	↓	↓	↓
	7	250	1,250	0	≤ BKG	≤ BKG	↓
	8	1,000	5,000	50	200	2,000	≤ BKG

Fig. B.8. (continued)

* METAL (BOLT OR PIPE)

Fig. B.8. (continued)

* METAL (BOLT OR PIPE)

Fig. B.8. (continued)

* METAL (BOLT OR PIPE)

Fig. B.8. (continued)

Fig. B.8. (continued)

RADIOLOGICAL SURVEY REPORT

DATE 3-24-93		INSTRUMENTATION USED			
TIME 1130		MODEL	S/N	% EFF.	CAL DUE DATE
SURVEYOR R.W. GRISHAM / R.W. WELLS		MODEL 3	99427	20	12-30-93
LOCATION BLD 3505 CELL - G			N		
REVIEWED BY R.W. [Signature]			1A		
Smear locations circled: Dose Rates = mR/hr					

Probe

DIRECT READINGS IN COUNTS PER MINUTE

1. 450,000	11. 35,000
2. 500,000	12. 20,000
3. 4000	
4. 2100	
5. 2000	
6. 4,000	
7. 50,000	
8. 30,000	
9. 30,000	
10. 40,000	

STRIPPABLE PAINT ON FLOOR

SMEAR RESULTS		
DPM/100CM ²		
BETA-GAMMA	ALPHA	
1	N/A	52K
2	↑	50K
3		750
4		1300
5		2500
6		350
7	Y	10K
8	N/A	10K

Fig. B.9. Radiological survey report, Mar. 24, 1993.

**CORE SAMPLE
LOCATIONS AND RESULTS**

Fig. B.10. Core sample locations and results.

RADIOLOGICAL SURVEY REPORT

DATE 4-7-93

TIME 0915

SURVEYOR N. REYNOLD / C. F. HARRIS

LOCATION CELL G - DRG FRAME & HATCH

REVIEWED BY *[Signature]*

Smear locations circled; Door Rate = mBq/hr

INSTRUMENTATION USED

MODEL	SN	% EFF.	CAL. DATE
Model 3	19790	10	12/30/93
Model 3	197134	20	12/30/93

Door Frame

- Location 1: 20K α cpm, 2K β cpm
- Location 2: 5K α cpm
- Location 3: 50K cpm
- Location 4: 100 cpm α
- Location 5: 5K α cpm, 1.5K β cpm

SMEAR RESULTS
DPM/100CM²

BETA-GAMMA	ALPHA
1 1K	500
2 1K	500
3 ± BKg	250
4 ± BKg	100
5 ± BKg	400
Access	Hatch
1 10K	5K
2 2K	1K
3 12K	10K
4 160K	125K
5 3K	1.25K
6 4K	2K

Access Hatch

- Location 1: 10K α cpm
- Location 2: 2K α cpm
- Location 3: 8K α cpm
- Location 4: 25K α cpm
- Location 5: 500 α cpm, 12K α cpm
- Location 6: 10K β cpm

Other counts: 300K β cpm, 150K α cpm, 50K β cpm, 120K α cpm, 100K α cpm, 450K α cpm, 7500K α cpm, 80K β cpm.

Fig. B.11. Radiological survey report, April 7, 1993.

NORTH WALL CONTAMINATION LEVELSAlpha contamination dpm/direct probe fixed

	<u>POST 1/4" REMOVE</u>	<u>POST 3/4" REMOVE</u>	<u>ALPHA SMEARABLE</u>
row#	block#	alpha dpm	alpha dpm
			dpm/100cm ²
(1)	1	25,000	5,000
	2	70,000	50,000
	3	350,000	25,000
	4	650,000	25,000
	5	600,000	100,000
	6	150,000	25,000
	7	25,000	50,000
(2)	1	200,000	15,000
	2	100,000	15,000
	3	250,000	5,000
	4	500,000	150,000
	5	750,000	100,000
	6	250,000	50,000
(3)	1	30,000	5,000
	2	500,000	25,000
	3	50,000	1,000
	4	80,000	3,000
	5	500,000	100,000
	6	200,000	20,000
	7	140,000	50,000
(4)	1	10,000	3,000
	2	45,000	5,000
	3	15,000	2,000
	4	500,000	100,000
	5	160,000	1,000
	6	150,000	5,000
(5)	1	3,000	1,000
	2	25,000	5,000
	3	20,000	1,000
	4	750,000	50,000
	5	500,000	20,000
	6	50,000	5,000
(6)	1	2,500	5,000
	2	6,000	1,000
	3	4,000	5,000
	4	37,500	5,000
	5	550,000	25,000
	6	17,500	1,000
(7)	1	4,000	500
	2	75,000	500
	3	1,500	500
	4	12,500	500
	5	400,000	10,000
	6	90,000	3,000
	7	15,000	500

< 300

< 300

Fig. B.12. North wall contamination levels.

NORTH WALL CONTAMINATION LEVELSAlpha contamination dpm/direct probe fixed

	<u>POST 1/4" REMOVEL</u>	<u>POST 3/4" REMOVEL</u>	<u>ALPHA SMEARABLE</u>	
row#	block#	alpha dpm	alpha dpm	dpm/100cm²
(8)	1	3,000	500	< 300
	2	6,000	500	:
	3	6,500	1,000	:
	4	175,000	5,000	:
	5	500,000	5,000	:
	6	80,000	3,000	:
(9)	5	30,000	4,000	:
	6	85,000	3,000	:
	7	45,000	5,000	:
(10)	5	125,000	1,000	< 300

Fig. B.12. (continued)

EAST WALL CONTAMINATION LEVELSAlpha contamination dpm/direct probe fixed

		<u>POST 1/4" REMOVE</u>	<u>POST 3/4" REMOVE</u>	<u>ALPHA SMEARABLE</u>
row#	block#	alpha dpm	alpha dpm	dpm/100cm ²
(1)	1	225,000	30,000	< 300
	2	175,000	10,000	
	3	25,000	500	
(2)	1	12,500	1,000	:
	2	350,000	50,000	
	3	350,000	25,000	
	4	3,500	4,000	
	5	12,500	20,000	
(3)	1	150,000	25,000	:
	2	850,000	150,000	
	3	300,000	1,000	
	4	17,500	2,000	
	5	10,000	4,000	
(4)	1	100,000	20,000	:
	2	200,000	15,000	
	3	60,000	< 300	
	4	10,000	1,000	
(5)	1	150,000	10,000	:
	2	250,000	5,000	
	3	10,000	1,000	
(6)	1	35,000	15,000	:
	2	60,000	15,000	
	3	50,000	4,000	
(7)	1	16,500	5,000	:
	2	75,000	5,000	
	3	90,000	5,000	
(8)	1	7,000	2,000	:
	2	45,000	< 300	
(9)	1	2,000	2,000	< 300
	2	10,000	2,000	

Fig. B.13. East wall contamination levels.

WEST WALL CONTAMINATION LEVELSAlpha contamination dpm/direct probe fixed

		<u>POST 1/4" REMOVE</u>	<u>POST 3/4" REMOVE</u>	<u>ALPHA SMEARABLE</u>
row#	block#	alpha dpm	alpha dpm	dpm/100cm ²
(1)	3	2,500	5,000	< 300
	4	100,000	2,000	< 300
	5	20,000	1,500	< 300
	6	15,000	5,000	< 300
Pipe --	7	125,000	25,000	15,000
(2)	4	12,500	5,000	< 300
	5	50,000	2,000	< 300
	6	10,000	2,000	< 300
	7	25,000	5,000	< 300
(3)	8	17,500	10,000	< 300
	5	15,000	2,000	< 300
	6	30,000	5,000	< 300
	7	25,000	5,000	< 300
(4)	5	6,000	5,000	< 300
	6	3,000	2,000	< 300
	7	11,000	500	< 300
	8	12,500	5,000	< 300
(5)	5	4,000	5,000	< 300
	6	10,000	300	< 300
	7	3,500	1,500	< 300
(6)	6	5,000	1,000	< 300
	7	3,000	2,000	< 300
	8	3,250	1,000	< 300
(7)	7	4,000	5,000	< 300

Fig. B.14. West wall contamination levels.

PAGE # 1 of 5 RADIOLOGICAL SURVEY REPORT

DATE	8-27-93		INSTRUMENTATION USED		
TIME	1000	MODEL	S/N	% EFF.	CAL DUE DATE
SURVEYOR	N. REYNOLDS	3	97134	10	12-30-93
LOCATION	CELL G. (90380)	3	97992	20	12-30-93
REVIEWED BY	J. M. [Signature]				
Smear locations circled; Dogs Bated = mR/hr					

Fig. B.15. Radiological survey report, Aug. 27, 1993.

WALL NORTH PAGE # 2 of 5
WALL

2 MODEL 3 #97134
R-8 MODEL 3 #97992

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
1	1	1,000	5,000	< 300	280	2800	< 1,000
1	2	10,000	50,000		5100	51,000	
1	3	5,000	25,000		800	8,000	
1	4	5,000	25,000		5,000	50,000	
1	5	20,000	100,000		350	3500	
1	6	5,000	25,000		800	8000	
1	7	10,000	50,000		3,000	30,000	
2	1	3,000	15,000		800	8,000	
2	2	3,000	15,000		1400	14,000	
2	3	1,000	5,000		450	4500	
2	4	30,000	150,000		15,000	150,000	
2	5	20,000	100,000		4100	41,000	
2	6	10,000	50,000		1,000	10,000	
3	1	1,000	5,000		350	3500	
3	2	5,000	25,000		2000	20,000	
3	3	200	1,000		800	8,000	
3	4	600	3,000		2,500	25,000	
3	5	20,000	100,000		3,000	30,000	
3	6	4,000	20,000		< 100	< 1,000	
3	7	10,000	50,000	300	2,000	20,000	
4	1	600	3,000	< 300	< 100	< 1,000	
4	2	1,000	5,000		220	2200	
4	3	400	2,000		120	1200	
4	4	20,000	100,000		6200	62,000	
4	5	200	1,000		< 100	< 1,000	
4	6	1,000	5,000		< 100	< 1,000	
5	1	200	1,000		< 100	< 1,000	
5	2	1,000	5,000		< 100	< 1,000	
5	3	200	1,000		< 100	< 1,000	
5	4	10,000	50,000		1800	18,000	
5	5	4,000	20,000		< 100	< 1,000	
5	6	1,000	5,000	< 300	< 100	< 1,000	< 1,000

Fig. B.15. (continued)

2 MODEL 3 #9713
B-8 MODEL 3 #9799.

WALL NORTH WALL
PAGE #3 of 5

row#	blk#	Alpha probe	Alpha DPM	Alpha smear/dpm	Beta-Gamma probe	Beta-Gamma DPM	Beta-Gamma smear/dpm
6	1	1,000	5,000	< 300	< 100	< 1,000	< 1,000
6	2	200	1,000		< 100	< 1,000	
6	3	1,000	5,000		< 100	< 1,000	
6	4	1,000	5,000		1,000	10,000	
6	5	5,000	25,000		< 100	< 1,000	
6	6	200	1,000				
7	1	100	500				
7	2	100	500				
7	3	100	500				
7	4	100	500		< 100	< 1,000	
7	5	2,000	10,000		6,000	60,000	
7	6	600	3,000		< 100	< 1,000	
7	7	100	500		200	2,000	
8	1	100	500		< 100	< 1,000	
8	2	100	500		< 100	< 1,000	
8	3	200	1,000		200	2,000	
8	4	1,000	5,000		1,000	10,000	
8	5	1,000	5,000		2,000	20,000	
8	6	600	3,000		1,000	10,000	
9	5	800	4,000		1,000	10,000	
9	6	600	3,000		2,000	20,000	
9	7	1,000	5,000		2,000	20,000	
10	5	200	1,000	< 300	1,000	10,000	< 1,000

Fig. B.15. (continued)

Page 4 of 5

Fig. B.15. (continued)

PAGE 5 of 5

Fig. B.15. (continued)

Appendix C
LESSONS LEARNED

The conduct of the MRF Cell G decontamination project provided insight into areas where improvements can be made for future endeavors of a similar nature. Following is a synopsis of lessons learned from this project:

1. One of the original goals of this project was to find a quick mechanism to contract with an established company (by task order arrangement) to perform actual decontamination work. The selection of ATG necessitated the use of DOE Procurement to place the contract. Because of many delays for various reasons, the procurement process took 3.5 years to complete. Obviously, this timeframe was not compatible with established schedules and resulted in milestones continually not being met. Future contracts should be placed with MMES Procurement, where programmatic interests have a greater influence on procurement priorities.
2. Use of a fixed price subcontract posed numerous problems for the type of work performed. The level of decontamination work necessary to achieve desired end-points cannot be accurately assessed beforehand, because the depth of contaminant penetration varied considerably in the cell. Decontamination work tends to encompass a vast amount of unknowns which prevent accurate fixed price estimates. Time delays associated with change notices and modifications to the contract caused schedule delays and milestones to slip. More flexible procurement strategies should be considered for future projects of this nature.
3. The subcontractor needs to provide more time in the period of performance to accommodate the various types of training for its personnel. Considering the scrutiny that this type of work receives, it would also be prudent to factor in additional time for environmental, safety, and health audits and reviews. Both of these items need to be reflected in the subcontractor's bid and schedule.
4. Contaminant penetration into the concrete walls was much greater than expected based on prior characterization efforts. The type of processes used during the operational years, location of process equipment, radioisotopic composition of the contamination, structural composition of the area to be decontaminated, and potential pathways of contaminant migration (grout between concrete blocks) are all factors that should be analyzed to more accurately determine the extent of decontamination effort required. Unless prior characterization took all of the preceding into account, these data should not be heavily relied on as an accurate assessment, but should only be used to provide a general contamination profile of the area. Verification of existing data should be considered during the project planning phase.
5. A major problem during the course of this project was the selection of respiratory protective equipment. Based on the existing contamination levels in Cell G, Radiation Protection stipulated the protection factor for respiratory equipment while performing decontamination operations. Several types of respirators were considered for use but, during the time that contract implementation was attempted, the protection factors accepted by Industrial Hygiene were lowered dramatically. This caused several reevaluations of what the desired respiratory device should be, and the establishment of an acceptable breathing air system ultimately became a time-critical component. Close interaction with Industrial Hygiene and Radiation Protection was necessary to ensure that all administrative and technical requirements were met.

Appendix D
COST AND SCHEDULE SUMMARY

The total cost of the Cell G decontamination project is provided below. It is a combination of expenses incurred by ATG and MMES.

Cell Decontamination (ATG)

Operating personnel wages, benefits, etc.	\$324,461
Supplies	\$22,864
Equipment rental	\$15,137
Subtotal	<u>\$362,463</u>

Cell Decontamination Support (MMES)

Support personnel wages	\$151,477
Supplies (includes respirators)	\$41,507
Sample analyses	\$12,776
Health Physics oversight	\$28,411
Project management	\$71,933
Subtotal	<u>\$306,104</u>
Grand Total	<u>\$668,567</u>

Project: ORNL MRF HOT Cell

Critical Progress Summary

NonCritical

Milestone ◆

Fig. D.1. MRF Cell C

March	April	May	June	July	August	September	October

Critical
 Progress
 Summary
 NonCritical
 Milestone

project schedule.

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