Attachment C

Advanced Medical Systems, Inc.

Decommissioning Cost Estimate for the London Road Site in Cleveland, Ohio

January, 1995

Revision 0

SCIENTIFIC ECOLOGY GROUP, INC.

Radiological Engineering & Decommissioning Services

Advanced Medical Systems, Inc.

Decommissioning Cost Estimate for the London Road Site in Cleveland, Ohio

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PROPRIETARY STATEMENT

EXECUTIVE SUMMARY

The Radiological Engineering and Decommissioning Services division of Scientific Ecology Group, Inc., has provided a decommissioning cost estimate for the Advanced Medical Systems, Inc. London Road Site located at Cleveland Ohio under the NRC License No. 34-19089-01. This cost estimate was developed using a systematic approach. Applicable release levels were identified and historical data was reviewed. Specific information regarding structures and equipment was used to estimate waste volumes and remediation costs.

Itemized costs were determined, including costs for manpower and equipment resources, packaging, shipping and burial activities, and the performance of final status surveys for buildings and structures. The estimated decommissioning cost is $1,795,612 in terms of 1995 dollars. This estimate is for budgetary purposes only and is not a proposal or cost estimate for Scientific Ecology Group, Inc., to perform decommissioning work.

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1.0 INTRODUCTION

1.1 Purpose

The Radiological Engineering and Decommissioning Services (RE&DS) division of Scientific Ecology Group, Inc. (SEG) has prepared this document for the purpose of providing a decommissioning cost estimate for the Advanced Medical Systems London Road Site. The cost estimate includes only those activities and cost factors required to remove residual radioactivity to levels which will permit release of the site for unrestricted use in accordance with the NRC guidelines in, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material.*

Costs associated with the demolition and removal of non-contaminated equipment or structures are not included in this cost estimate. An actual date to perform decommissioning has not been projected as portions of the facility will continue to be used. The cost estimate provided by this report is in terms of 1995 dollars. This estimate is intended to be used for funding and budgetary purposes and does not constitute proposal or cost estimate for SEG to perform work.

1.2 Scope

The scope of this report is to present the estimated costs derived for decommissioning the Advanced Medical Systems London road Site. The specific areas and systems covered by this estimate include:

- Hot Cell, First Floor
- Decontamination Room, First Floor
- Isotope Shop Area, First Floor
- High Level Waste Storage Room, First Floor
- Airlock, First Floor
- Clean Equipment Room, Second Floor
- HEPA Systems Room, Second Floor

- Waste Storage Room, basement
- Clean Area, basement
- Waste Water Hold-Up Tank Room (WHUT), basement

This estimate has been prepared to support the requirements of 10 CFR 70, *Domestic Licensing of Special Nuclear Material*, and Regulatory Guide 1.159, *Assuring the Availability of Funds For Decommissioning Nuclear Reactors*. This estimate addresses activities related to the removal of hardware, structural materials, and miscellaneous materials as necessary to reduce levels of residual radioactivity to below the guideline values specified in the NRC *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of License for Byproduct, Source, or Special Nuclear Material.*

Decommissioning costs are directly related to the degree of remediation required and the amount of radioactive waste generated. The extent of remediation is based on radiological data, proven decontamination processes and experience with similar projects. The volume of radioactive wastes generated were determined from facility drawings, equipment sizes, radiological data, and proven volume reduction processes. Costs associated with the performance of final status surveys were estimated based on the size of the various areas being decommissioned and their prior radiological history.

The cost estimate for London Road Site utilizes a combination of unit price estimates and task-based estimates to arrive at a total cost for decommissioning all areas. The unit cost methodology is modeled after the method used in the *Means Building Construction Cost Data*. The decommissioning work is first divided into units of work, such as removing 2-inch pipe and then the unit of cost per foot of pipe is multiplied by the feet of pipe to arrive at the cost. A similar method is used for decontamination work, such as decontaminating concrete floor to a depth of 1/4 inch. The unit of cost per square foot of concrete floor area is multiplied by the square feet of floor area to arrive at the cost. The estimate includes the craft labor, supervision, health physics support, waste disposal, materials and equipment necessary to actually perform this task. Other work is priced using the task based methodology which is modeled after the method used by PNL (Pacific Northwest Laboratory) to prepare the estimates presented in NUREG/CR-1756, *Technology Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors*, March 1982. The work is divided into tasks such as decontaminating a hot cell using robot operated decontamination equipment, and then an estimate or vendor price quote is obtained for each task. The various costs derived from the two methods are combined and a project schedule is developed which defines the duration and man loading for the project. The schedule and man-loading information is used in the development of on site project management costs, travel and living costs, equipment rental costs, home office support costs, and owner oversight costs.

1.3 Discussion

The following assumptions and bases were utilized in developing the cost estimate.

- The building will remain in place after decommissioning.
- The Co^{60} source inventory in the facility will be shipped to other sites as part of the decommissioning.
- All contaminated equipment will be removed for disposal.
- The soil under the building has been sampled and is un-contaminated.
- All equipment, electrical boxes, conduit, pipes and ducts in contaminated rooms are assumed to be contaminated.
- The interior partition wall framing studs and wall board in contaminated rooms are assumed to be contaminated.
- The decommissioning of the WHUT room will not take place until the year 2018 to allow decay of the Co^{60} activity to a manageable level.
- Contaminated equipment not decontamination onsite will be shipped to a volume reduction facility for processing prior to disposal.
- Radioactive waste will be disposed of at the Midwest Compact disposal site in Ohio. The compact disposal site has not been selected as yet.

2.0 GENERAL SITE DESCRIPTION

The Advanced Medical Systems Site at London Road in Cleveland, Ohio, was used to produce Co^{60} and Cs^{137} sources for medical applications.

The Advanced Medical Systems Site is located northeast of Cleveland, Ohio at 1020 London Road. This is a small site as shown in Figure 2-1, and only part of the site was involved with radioactive material handling and storage. The remainder of the site is used for normal warehouse operations.

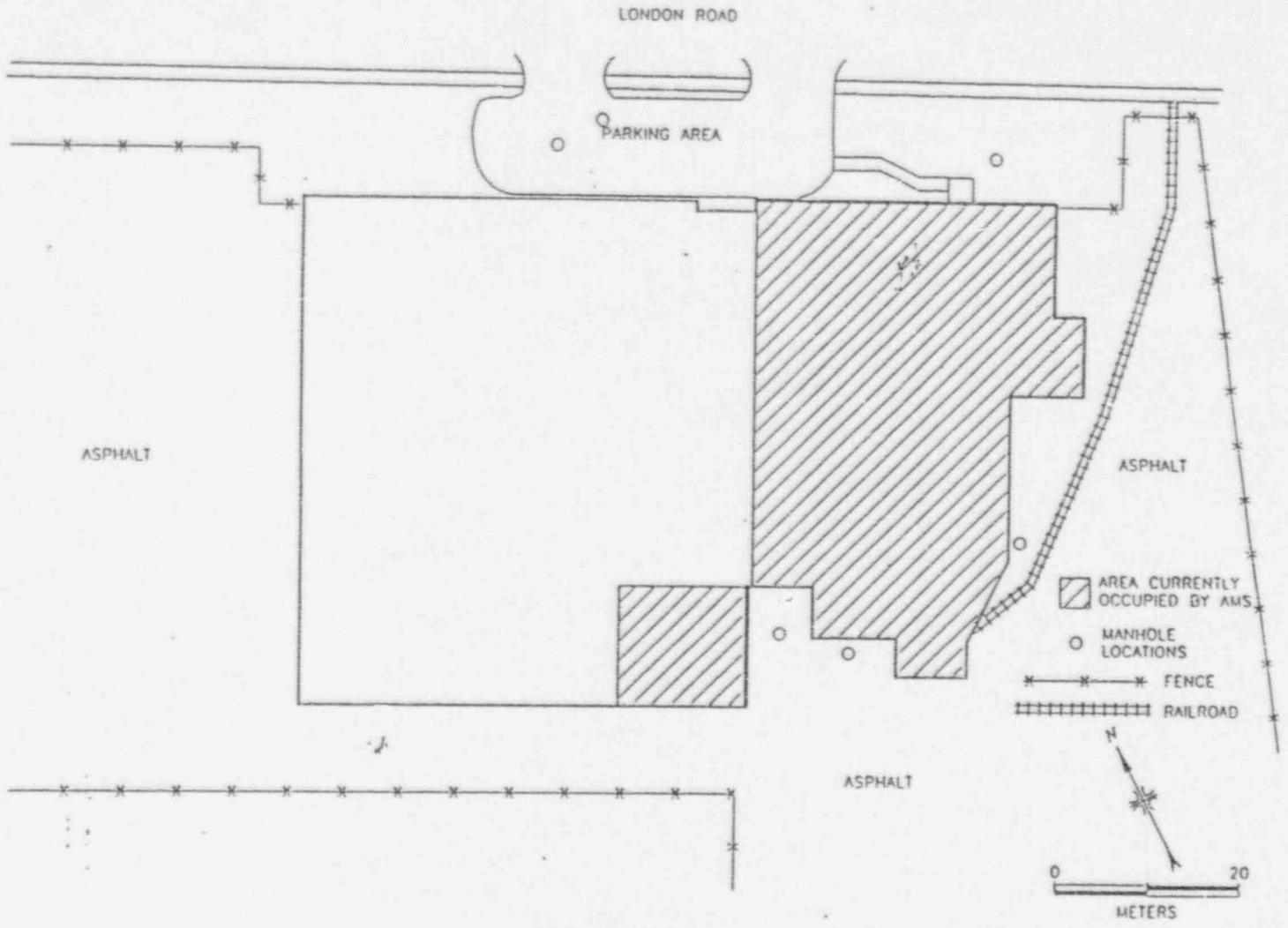

Figure 2-1
Advanced Medical Systems London Road Site

3.0 RADIOLOGICAL CONDITIONS

The Advanced Medical Systems Site in Cleveland, Ohio, was visited in September of 1994 to gather physical facility and nuclear data for this site. Site drawings, photographs and drawings of facility buildings, and radiological data for affected areas were obtained. On site staff members were interviewed to determine radiological history of affected areas and the site in general.

The remediation decisions, survey decisions and waste volume estimates in this report were based on available information. Conservative assumptions were made based upon historical use information, the condition of the area and the experience of the contractor with similar decommissioning projects.

The radiological conditions, related historical information, and the bases for remediation decisions are provided for the various affected areas below.

3.1 Radionuclides of Concern at the London Road Facility

The radioactive materials of concern at this site are Co^{60}, Cs^{137}, and Depleted Uranium (DU). The current inventory of Co^{60} is approximately 70,000 Curies at this facility, this inventory will be removed as part of the decommissioning. The Co^{60} was fabricated into sealed sources which were used in cancer therapy equipment. The current inventory of Cs^{137} is zero. The Cs^{137} was fabricated into sealed sources for industrial and research use. The current inventory of DU is approximately 2,500 kilograms, this inventory will be removed as part of the decommissioning. The DU is used in source heads for shielding and their is no reason to suspect DU contamination in the area because the DU was not processed or machined at this site. The acceptable surface contamination levels are as given in *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material, August 1987.* These acceptable levels for Co^{60} and Cs^{137} are less than 5,000 dpm/100 cm^2 average for fixed activity, less than 15,000 dpm/100 cm^2 maximum for fixed activity, and less than 1,000 dpm/100 cm^2 for removable activity. The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively. The acceptable soil concentration limits are as given in *Federal Register Vol. 57, No. 34, February 20, 1992 / Notices, "Order Establishing Criteria and Schedule for Decommissioning the Bloomsburg Site", Attachment 3.* These acceptable levels are 8 pCi/gram for Co^{60} and 15 pCi/gram for Cs^{137}.

The radiological condition of the facility was ascertained from Advanced Medical Systems records. Current survey records were obtained for the restricted areas and prior survey records for all other areas at the site. A summary of the survey data is provided in Appendix A.

3.2 Hot Cell

The hot cell was designed and equipped to encapsulate large sources of medical therapy and industrial radiography. The cell is six feet square and has 5-1/2 foot thick concrete walls and a four foot thick floor and ceiling. There is a stainless steel floor pan in the cell and 1/4 inch thick steel wall plates 11 foot tall. The cell has a six foot wide 42 ton hinged door at the rear. Numerous small access ports are located on the front and side faces of the cell, and a 20 inch square port opens from each side. There is a 60 inch thick glass and zinc bromide window at the cell front. Remote handling is accomplished with a pair of manipulators and a 2 ton overhead crane. Every item of equipment in the cell and every item in the cell structure is removable. A sketch of the first floor of the building including the hot cell is shown in Figure 3-1.

The hot cell contained approximately 12,400 curies of Co^{60} when the site was visited in September of 1994 including approximately 5,500 curies in a stuck storage plug in the cell floor. There was a shipping cask in the cell which was being prepared to ship some of the cobalt inventory off site. The dose rates within the cell are approximately 12 R/hr with certain hot spots exceeding 12 R/hr. The Co^{60} sources will be decontaminated and shipped offsite as part of the decommissioning.

3.3 Isotope Shop

The isotope shop is located on the first floor next to the hot cell and is shown in a sketch of the first floor area in Figure 3-1. The isotope shop area has a concrete floor, ceiling, and interior walls, the exterior walls are painted brick. Co^{60} sources were transported around this area in shielded containers such as the "transfer monster" which was used to move sources from the "storage garden" to the hot cell. The "transfer monster" is expected to still be on site at the time of decommissioning but all other transfer and shipping shields are expected to have been removed. The shop also contains a hood setting on a table, a second table, a sink, an old trash compactor, a 3 ton overhead hoist with trolley, a wall cabinet and a Tow Motor. The Tow Motor is an electric fork lift where the operator stands behind it to operate it. The isotope shop also contains the "storage garden" and irradiation facility. The dose rates in the isotope shop average about 1 mR/hr with a maximum of 10 mR/hr. The contamination levels average about 100,000 dpm/100 cm^2 with a maximum of 188,000 dpm/100 cm^2.

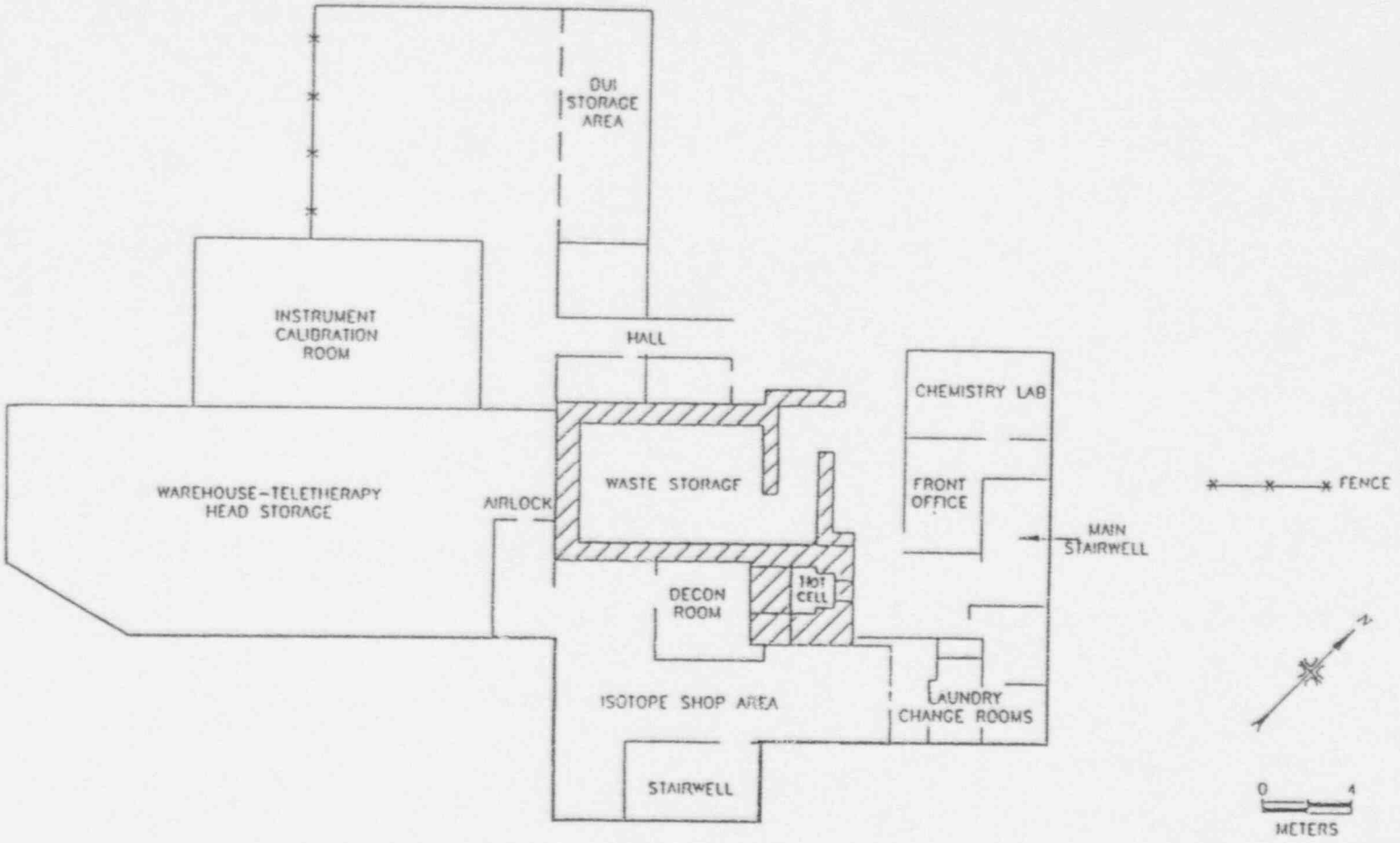

Figure 3-1
AMS Facility First Floor

The "storage garden" and irradiation facility is located in the southwest corner of the building and contains vertical tubes in a six foot square well extending from the first floor level to the basement level. An L-shaped shield around the well in the basement level is provided by two sand filled shield rooms which are accessible through man-holes in the first floor. The high density concrete walls containing the sand shield are two feet thick. There are 54 storage tubes in the "storage garden" rectangular array. The tubes are in a 7 x 9 array with the center nine spaces left open. The center space is fitted wit an irradiation plug which can handle objects up to 8-1/2 inches square by 12 inches high. The storage tubes terminate in a metal container through which cooling air is drawn from the room through the "storage garden" to the HEPA exhaust system. The "storage garden" contains about 2,900 curies of Co^{60}.

There is stairwell from the back of the isotope room to the basement area. This stairwell is contaminated with dose rates of less than 1 mR/hr and contamination levels averaging about 10^6 dpm/100 cm^2.

3.4 Decontamination Room

The decontamination room is located in the behind the hot cell and at the side of the Isotope Shop as shown in a sketch of the first floor area in Figure 3-1. The decontamination shop area has a concrete floor and walls. The room provides space enough for opening the hot cell door into the ventilation controlled space of the decontamination room. The room is equipped with water outlets and a "hot" floor drain used during decontamination operations. In addition there is vault in one corner of the room that contains some items from the hot cell and lead blankets. There are also some large lead shield beams in one corner of the room. This area is contaminated and has dose rates averaging greater than 10 mR/hr and smearable contamination levels averaging about 3 x 10^6 dpm/100 cm^2.

3.5 High Level Waste Storage Room

The High Level Waste Storage Room Area is located next to the hot cell on the first floor as shown in a sketch of the first floor area in Figure 3-1. This room has concrete floors, walls and ceiling. There are 24 drums of waste stored in the room along with 21 used HEPA filters, a small cart, portable cabinet and wall cabinets. This area has dose rates averaging about 400 mR/hr and contamination levels averaging about 75 dpm/100 cm^2 with a maximum contamination level of 100 dpm/100 cm^2. The area in front of the shield wall in this room is a storage area for various items containing Depleted Uranium.

3.6 Clean Equipment Room

The clean equipment room is located on the second floor as shown in a sketch of the second floor area in Figure 3-2. This room has concrete floors, walls and ceiling and contains all the facility service equipment except for the HEPA ventilation equipment. There are two items of contaminated equipment in the room, an air supply blower and the exhaust stack sampling system. This area has dose rates averaging less than 1 mR/hr and a maximum dose rate of 30 mR/hr on a wall adjoining the HEPA equipment room. Contamination levels averaged about 170 dpm/100 cm^2 with a maximum contamination level of 190 dpm/100 cm^2.

3.7 HEPA Equipment Room

The HEPA equipment room is located on the second floor as shown in a sketch of the second floor area in Figure 3-2. This room has concrete floors, walls and ceiling and contains the facility HEPA ventilation equipment. There is a large HEPA exhaust blower with four 2 x 2 HEPA filters in a housing that services all isotope areas except the hot cell. In addition there is a small HEPA exhaust blower with one 2 x 2 HEPA filter in a housing that services the hot cell. This room also contains an abandoned emergency power generator, the hoist motor for the hot cell hoist, and a wood "A" frame with a small manually operated hoist attached. This area has dose rates averaging about 60 mR/hr with a maximum dose rate of 2,000 mR/hr on the exhaust duct from the hot cell. Contamination levels averaged about 11,000 dpm/100 cm^2 with a maximum contamination level of 17,000 dpm/100 cm^2.

3.8 Dry Waste Storage Room

The dry waste storage room is located in the basement as shown in a sketch of the basement area in Figure 3-3. This room has concrete floors, walls and has a drum storage area along one wall with a temporary shielding wall erected between storage area and the main part of the room. The room contains 17 waste drums, a large shop table with vise, and a 55 gallon waste holding tank. The bottom of the stairwell from the isotope room contains 2 floor buffers and 2 mops with buckets. The mop buckets are stored against a wall with a lead sheet in front of them. There also over 500 high density concrete blocks in the room that were placed against the walls to the WHUT room to reduce dose rates. This area has dose rates averaging about 7 mR/hr with a maximum general dose rate of 50 mR/hr. One drum behind the storage shield has a drum with a contact dose reading of about 1,000 R/hr. Contamination levels averaged about 900,000 dpm/100 cm^2 with a maximum contamination level of 2,100,000 dpm/100 cm^2.

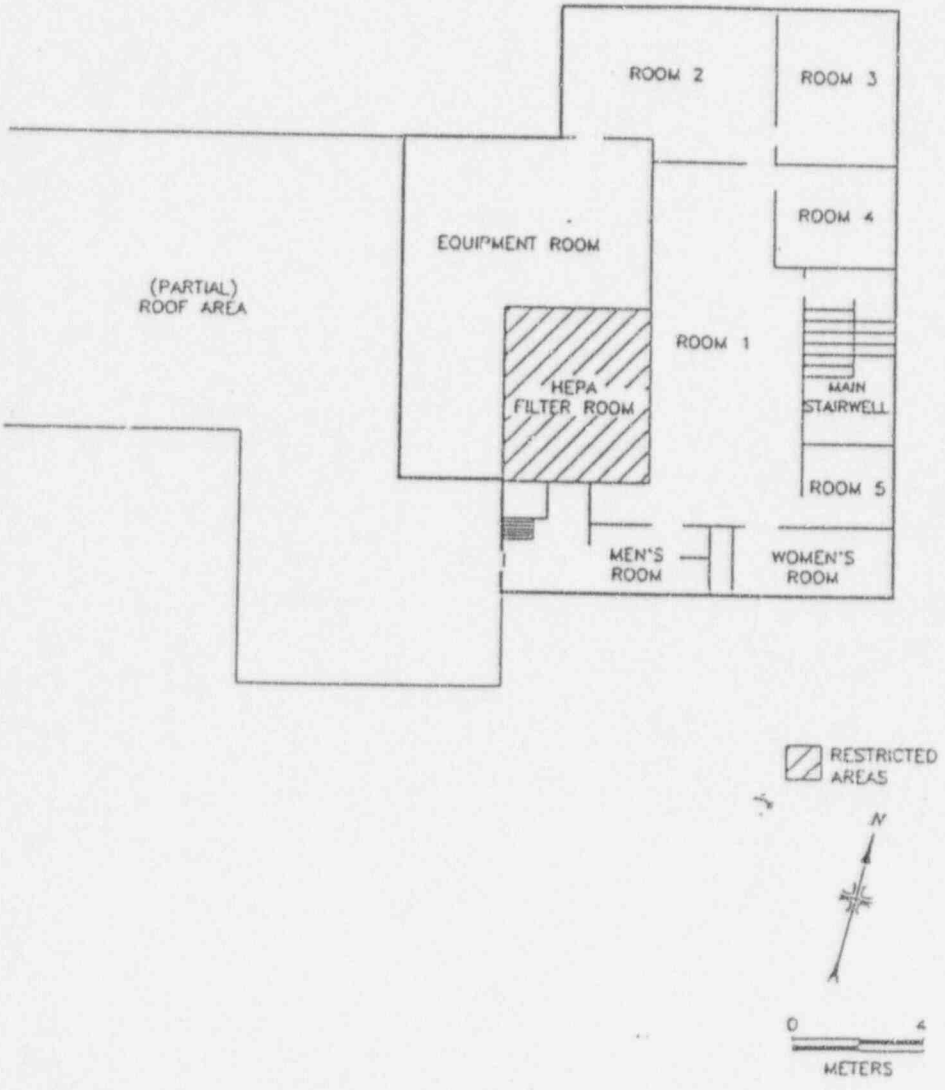

Figure 3-2
AMS Facility Second Floor

Figure 3-3
AMS Facility Basement

3.9 WHUT Room

The Waste Hold-Up (WHUT) room is located in the basement directly under the hot cell as shown in a sketch of the basement area in Figure 3-3. This room has concrete floors, walls and ceiling. The room walls are three foot thick to provide shielding for the room contents. There is an entry room that contains an abandoned drum compactor. The WHUT room contains 100 and 500 gallon waste receiving tanks, two small ion exchange columns, a table for the ion exchange columns and about 1 inch of sediment uniformly distributed on the floor. This information was taken form the report *Remedial Actions for the Waste Hold Up Tank Room*, NSS, 8 February, 1988. This document also reported that the dose rate from one of the tanks was approximately 2000 R/hr and that smears taken of the floor sediment each produced a dose rate of 1.5 R/hr at 1 centimeter. This area has dose rates estimated to average about 250 R/hr with a maximum dose rate of 2,000 R/hr.

3.10 Basement Clean Side

The basement clean side is located on the east side of the basement next to the WHUT room. It consists of three rooms, the Air Sampling Room, the ISODOSE Curve Room, and the Unoccupied Room. The rooms have concrete floors, ceiling, and exterior walls. The interior walls are standard 2 x 4 wood framed walls with a painted drywall surface. These rooms contain a large plastic tank, an air sampler pump, large metal shelves holding ISODOSE Curves, wooden shelf supports, a sink with metal cabinet, two chairs, and two steel doors. There are 45 high density concrete blocks in the unoccupied room to provide additional shielding from the WHUT room. This area has dose rates averaging about 1 mR/hr with a maximum dose rate of 20 mR/hr in the Unoccupied room. Contamination levels averaged about 1,250 dpm/100 cm^2 with a maximum contamination level of 3,410 dpm/100 cm^2.

3.11 Miscellaneous Areas

The miscellaneous areas at the London road site do not individually contribute significantly to the cost of decommissioning. These areas are summarized in table 3-1.

Table 3-1
AMS London Road Site Miscellaneous Areas

Area	Area Construction Materials	Contaminated Equipment Description	Average Dose Rate mR/hr	Average Activity Level dpm/100 cm²
Air Lock	Concrete floor and interior walls, metal ceiling and exterior walls.	Power cord for Isotope room Tow Motor, 30 concrete shield blocks, and a utility cart.	<1	7,600
Isotope Warehouse	Concrete floor, concrete block and clay brick walls, and metal ceiling.	Old hot cell shield window.	1	128
Former Chemistry Lab	Concrete floor, clay brick walls, and metal ceiling.	None	<0.1	<1,170
Hot Cell Control Room	Concrete floor walls and ceiling.	None	<0.1	<1,170
First Floor Office Areas	Concrete floor and ceiling, and standard drywall.	None	0.1	<1,170
Isotope Shop Locker Room	Concrete floor and ceiling, clay brick and standard drywall.	None	<0.1	1000
Instrument Calibration Room	Concrete floor, clay brick and standard drywall, and metal ceiling.	None	<0.1	<710
Caged Storage Area	Concrete floor, concrete block and clay brick walls, and metal ceiling.	None	1	128
Second Floor Office Areas	Concrete floor and ceiling, clay brick and standard drywall.	None	0.1	1,200
Sewers	Iron pipe in buildings	None	0.84	____
Outdoor Areas	Mostly paved with some natural soil areas.	None	0.028	0.8 pCi/g

4.0 ESTIMATION METHODS

The estimated cost to decommission the licensed areas at the Advanced Medical Systems, Inc., London Road Site is $1,795,612. This section of the cost estimate report provides an overview of the considerations and factors that influenced the decommissioning cost estimate. Table 4-1 provides a summary of the cost associated with each area of the London Road Site.

Table 4-1
Decommissioning Cost Summary - Advanced Medical Systems, London Road

Operation	Man-hours	Labor Plus Travel & Living	Waste Processing & Shipping	Equipment Contracts & ***Supplies	Asbestos Waste Shipping & Disposal	Radwaste Shipping & Disposal	Total Cost
Hot Cell	529	$31,782	$6,111	$30,036		$3,402	$71,331
Isotope Shop	2,448	$147,043	$32,787	$9,162	$920	$10,932	$200,844
Decontamination Room	562	$33,750	$66,850	$2,324		$6,203	$109,127
High Level Waste Storage Room	534	$32,093	$14,342	$3,099		$8,640	$58,173
Clean Equipment Room	53	$3,206	$1,605	$448		$382	$5,641
HEPA Equipment Room	1,078	$64,720	$10,503	$5,765	$766	$10,368	$92,123
Dry Waste Storage Room	1,371	$82,328	$17,581	$5,794	$1,380	$16,553	$123,635
WHUT Room	1,093	$65,642	$18,962	$264,024	$153	$23,429	$372,210
All Other Areas	1,691	$101,569	$18,319	$8,048		$20,300	$148,236
Ship Sources Offsite	64	$4,640		$43,891			$48,531
Building Release Surveys	497	$42,706					$42,706
Outdoor Release Surveys	143	$12,257					$12,257
Planning, Training, Mobilization	624	$26,832					$26,832
Survey Documentation & Report	240	$13,702					$13,702
Contractor Home Office Oversight	385	$29,260					$29,260
AMS Oversight & Licensing	880	$66,880					$66,880
NRC Verification Survey							$15,000
TOTALS	12,193	$758,409	$187,060	$372,591	$3,219	$100,211	$1,436,489
			25% CONTINGENCY				$359,122
				GRAND TOTAL			$1,795,612

4.1 Cost Modifying Factors

There are modifying factors that significantly affect the overall cost for remediation. One of these factors is an adjustment for personnel protection requirements since various levels of personnel protection equipment will be required for remediation work. The degree of protection required depends upon the extent of contamination and specific activities to be performed in a given area. As the level of personnel protection increases, so does the impact on individual productivity and task duration. Adjustments were made to account for the implementation of personnel protective measures where applicable. A description of standardized levels of personnel protection, along with the associated impacts is provided in Table 4-2. The net impact is normalized over an 8 man-hour period.

Table 4-2
Personnel Radiological Protection Summary

Protection Level	Description	Task Impact Summary
Level D, used in uncontaminated areas only.	Hard hats, safety glasses and safety shoes. Respiratory protection and protective clothing are not required to perform work.	No lost time or worker time adjustment is necessary.
Level D (modified), used in areas potentially contaminated.	Hard hats, safety glasses, safety shoes and protective clothing are required, however respiratory protection is not required.	Approximately 15 minutes to don and remove protective clothing accounts for a 3% lost-time adjustment.
Level C, used in areas of elevated airborne activity.	Hard hats, safety shoes and a full face respirator are required in addition to protective clothing.	A 65 minute lost-time adjustment (14%) consists of the following factors: • Safety meeting - 5 min • Don/remove protective clothing - 30 min • Breaks - 30 min A worker's productivity is decreased by 15% due to wearing the full face respirator. Combining this 15% lost time adjustment with the 14% lost-time adjustment yields a net adjustment of approximately 29% or all tasks will take twice as long as Level D work.

The volume of radwaste requiring treatment and disposal can be a very significant modifying factor due to the high cost for radwaste disposal. For the Advanced Medical Systems decommissioning, the radwaste processing, shipping, and disposal costs are about 20% of the total decommissioning cost. Radwaste volume estimates are discussed in detail in the following section.

4.2 Radwaste Volume Estimates

The radwaste volume estimates are key to developing accurate decommissioning costs. Burial costs are based on waste volume and shipping costs are based on waste volume and weight. Spreadsheets were used to estimate the required volumes and weights. A summary of contaminated waste volumes and asbestos waste volumes is presented in Appendix B sheet B-1.

To address structural materials, the spreadsheet incorporated floor and wall dimensions, determined from drawings and direct measurements, along with the percent of the area contaminated. From this information, the volume of rubble for disposal was calculated. Table 4-3 presents a summary of the radwaste volumes calculated for the various areas of the Advanced Medical Systems Site.

Table 4-3
Unprocessed Waste Volume Summary for Advanced Medical Systems

Area Description	Bulk Waste Volume (ft^3)	Concrete Volume (ft^3)	Hardware & Demolition Volume (ft^3)	Lead Volume (ft^3)	Asbestos Volume (ft^3)
Hot Cell		1	337		
Isotope Shop		8	516		35
Decontamination Room		12	147	11	
High Leve. Waste Storage Room		0	319		
Clean Equipment Room		0	65		
HEPA Equipment Room		15	571		28
Dry Waste Storage Room		16	371		52
WHUT Room	14	14	660		9
Miscellaneous Areas	338	5	656	1	
TOTALS	352	70	3,642	12	123

4.3 Radwaste Disposal Costs

A significant portion of the overall decommissioning cost is generally attributed to the burial of radioactive and asbestos waste. The cost for disposal of radioactive waste was estimated to be $181 per cubic foot, and low level asbestos waste was estimated to be $150 per cubic foot at Envirocare in Utah.

The costs to transport waste for disposal are based on a transport distance of 250 miles to an unspecified Midwest Compact site in Ohio. It is assumed that only full loads of waste are transported, that a 40 foot Sea/Land container is the limiting volume and that 44,000 pounds is the limiting weight. The transport charge is $650 per load.

The cost to transport waste the central volume reduction facility in Oak Ridge Tennessee are based on a transport distance of 520 miles at a rate of $2.65 per mile. The costs to transport volume reduced waste for disposal are based on a transport distance of 500 miles from Oak Ridge Tennessee to an unspecified Midwest Compact site in Ohio.

The unit disposal cost factors are listed in Appendix B, sheet B-4.

4.4 Remediation Methods

The goal in choosing remediation methodologies is to select the minimum cost option to accomplish a task. There are many factors which need to be considered when selecting a methodology such as equipment cost, support equipment costs, material and chemical costs, the generation of secondary waste volumes (waste in addition to the removed contaminated material), processing rates, labor requirements, and applicability to various tasks. These factors were utilized in selecting the optimum methods for use at Advanced Medical Systems. The decontamination processes analyzed are summarized in Table 4-4. This table shows the decontamination methodology used, application information, the process cost per square foot of area decontaminated, and the amount of secondary waste generated. These unit factors are applied to specific areas or equipment requiring remediation to determine the most cost effective process.

Table 4-4
Decontamination Methodology Comparison

Methodology	Application	Nominal Penetration depth (in)	Process Rate (ft^2/hr)	Crew Size	Total Process Cost ($/$ft^2$)	Secondary Waste Volume (ft^3/1000 ft^2)
McDonald U-5 Scabbler	Floor concrete	0.25	150	2.0	$0.335	
McDonald U-5 Scabbler	Floor concrete	0.5	75	2.0	$0.575	
McDonald 3WCD Scabbler	Wall concrete	0.125	30	2.0	$1.248	
Blastrac 10D Shot Blaster	Floor concrete	0.063	750	1.1	$0.191	0.26
Blastrac 10D Shot Blaster	Floor concrete	0.125	375	1.1	$0.224	0.26
LTC 10-60Pn Special Vacuum Blaster	All surfaces	0.031	70	1.3	$0.574	0.26
LTC 10-60Pn Standard Vacuum Blaster	All surfaces	0.063	40	1.3	$0.834	0.26
EDCO CPU-10C Floor Plane	Floor concrete	0.50	93	2.0	$0.578	
EET Chemical Decon	Concrete		15	2.0	$10.000	6.68
Hands-on decon	Non-Porus surfaces		150	1.0	$0.162	8.33

4.5 Radwaste Volume Reduction Costs

The volume reduction processes analyzed for use at Advanced Medical Systems are summarized in Table 4-5. This table shows the volume reduction methodology used, application information, transportation charges, the process cost per unit weight or volume, and the total process cost per unit volume. These unit factors are applied to specific items of equipment requiring disposal to determine the most cost effective process.

Table 4-5
Volume Reduction Methodology Cost Information

VR Methodology	Applicability	Transport Container Type	Total Transport Cost ($)	Volume Reduction Factor	Waste Bulk Density (lb/ft³)	VR Process Charge Rate	Total VR Cost ($/ft³)
Super Compaction	Dry active waste	B-25	$10,378	6	20	$0.95	$24.29
Super Compaction	Metal Equipment	B-25	$9,478	6	25	$0.95	$29.12
Super Compaction	Metal Equipment	Custom	$6,778	4	75	$0.95	$90.08
Asbestos Compact	Asbestos	B-25	$10,378	6	20	$1.45	$34.29
Incineration	DAW	B-25	$10,378	100	20	$3.70	$79.29
Metal Melt	Metal (20 lb/ft³)	Custom	$9,478	Note 1	20	$1.95	$56.55
Metal Melt	Metal (75 lb/ft³)	Custom	$9,478	Note 1	75	$1.95	$163.80
Metal Melt	Metal (200 lb/ft³)	Custom	$4,528	Note 1	200	$1.95	$411.56
Lead Brick Decon	Lead Brick	Custom	$6,778	Note 1	650	$1.75	$1,156.33
Wood Incineration	Wood	B-25	$6,778	100	50	$2.00	$105.76

1. These processes recycle the processed material so there is no waste for disposal.

4.6 Unit Costs

There are a number of unit factors used to generate this cost estimate. They are listed here so project costs can be updated when required and the effects of changing units costs can be evaluated.

Table 4-6
Decommissioning Estimate Unit Cost Factors

Unit Cost Factor	Unit Cost Rate	Units
Radioactive Waste Disposal	$181.00	cubic foot
Waste Transportation to Midwest Compact	$650	trip
Waste Transportation to Oak Ridge for Volume Reduction	$2.65	mile
Asbestos Disposal Cost at Envirocare in Utah	$150	cubic foot
B-25 Waste Disposal Container	$450	each
Project Manager	$76	hour
Radiation Safety Officer	$45*	hour
Senior Radiological Engineer	$70	hour
HP Instrument Technician	$39	hour
HP Technician	$18*	hour
Decontamination Specialist	$18*	hour
Airfare	$562	round trip
Car Rental (one)	$22*	day
Per Diem	$116	day

*These costs provided by AMS who will provide there personnel and equipment.

4.7 Final Surveys

Final survey cost estimates are based on the methodology presented in NUREG/CR-2241, *Technology and Cost of Termination Surveys Associated With Decommissioning of Nuclear Facilities* (February 1982). This methodology requires the determination of the number of sample points for the various areas being surveyed and the type of survey being performed. The time to perform each of these surveys is determined, and the product of these two items is the labor time to perform the surveys. Equipment and material cost to perform the surveys is added along with staff support costs to determine a total cost. The survey requirements are based on (Draft) NUREG/CR-5849, *Manual for Conducting Radiological Surveys in Support of License Termination* (June 1992). A spreadsheet was developed which incorporates facility dimensions, labor rates and support cost ratios to estimate the final survey cost. The facility survey labor estimate is summarized in Appendix B, Sheet B-10 and the open land and miscellaneous area survey labor estimate is summarized in Appendix B, Sheet B-11.

5.0 DESCRIPTION OF THE DECOMMISSIONING SCENARIO

Decommissioning of the Advanced Medical Systems London Road site requires that residual radioactive materials be removed from the site to allow termination of the NRC license for this location. For the purposes of this cost estimate, once buildings, structures and soils are remediated to releasable limits, no further decontamination or demolition is required.

The following areas are considered in this cost estimate because they contain radioactive material or have previously contained radioactive material.

5.1 Hot Cell

The hot cell is six feet square and has 5-1/2 foot thick concrete walls and a four foot thick floor and ceiling. There is a stainless steel floor pan in the cell and 1/4 inch thick steel wall plates 11 foot tall. The cell has a six foot wide 42 ton hinged door at the rear. The cell will initially be used for the decontamination and shipping of the Co^{60} sources offsite. Approximately 60% of the sources will be shipped to a facility in California and 40% to a facility in Maryland. In order to accomplish this task, the cell will need to be partially decontaminated to allow handling of the sources without contaminating them. The existing Co^{60} sources in the cell will be moved out of the cell using the AMS cask and the "Transfer Monster". The cell will then be decontaminated by first vacuuming the cell using a remote HEPA system entering the cell through the rear cell door. The HEPA vacuum will be fitted with a shielded prefilter which will retain most of the removed Co^{60}. The vacuuming will be followed by chemical decontamination to remove the remaining surface contamination from the cell. The Hot cell lathe, welding machine, and weighing scale, will then be manually removed and shipped for volume reduction and disposal. Careful monitoring will be performed during this process to minimize exposure to hot spots that may be exposed during equipment removal. The sources will then be returned to the cell where they will be cleaned up using a chemical decontamination process. After verification of decontamination they will be shipped to the facilities in California and Maryland using the AMS cask. The remaining equipment in the hot cell, the hoist, hoist trolley, table, and manipulators will then be manually removed and shipped for volume reduction and disposal. The cell door will then be removed to allow decontamination of inaccessible parts of the door and door drive mechanism. The ventilation duct will be removed in conjunction with removal of the ductwork from adjacent areas. The hot cell will be surveyed as an affected area as part of the decommissioning.

5.2 Isotope Shop Area

The isotope shop is a 680 square foot area with concrete floor, ceiling, and interior walls, the exterior walls are painted brick. The hood, tables, sink, old trash compactor, 3 ton overhead hoist with trolley, wall cabinet, and Tow Motor will be removed and shipped for volume reduction and disposal. The shop floor will be decontaminated using a Blastrac vacuum shot blaster, the walls and ceiling will be decontaminated by manual wipe down. The isotope shop overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be removed and shipped for volume reduction and disposal. The isotope shop will be surveyed as an affected area as part of the decommissioning.

The "storage garden" and irradiation facility is located in the southwest corner of the isotope shop and contains 54 vertical tubes in a six foot square well extending from the first floor level to the basement level. All cobalt sources will have been removed from the hot cell prior to the start of decommissioning work. The "storage garden" tubes and spaces will be removed and shipped for volume reduction and disposal. The interior concrete walls and floor of the "storage garden" will be decontaminated using a vacuum blast unit. The "storage garden" will be surveyed as an affected area as part of the decommissioning.

The stairwell at the back of the Isotope room is constructed of steel with concrete steps. The steps have steel top edges which have a history of contamination in the joint areas. The steel top edges will be removed and shipped for volume reduction and disposal. The stairs will be decontaminated using a vacuum blast unit. The equipment under the stairs, two floor buffers, two buckets, two mops, and a lead sheet will be sent for volume reduction and disposal. The stairwell will be surveyed as an affected area as part of the decommissioning.

5.3 Decontamination Room

The decontamination room is a 135 square foot area with concrete floor, walls and ceiling. This is a high dose rate area and it will be decontaminated by first vacuuming the room and contents using a robotic HEPA system. The HEPA vacuum will be fitted with a shielded prefilter which will retain most of the removed Co^{60}. The vacuuming will be followed by robotic CO_2 blasting to remove accessible hot spots from the room and contents. The robot will be used to transfer hot items from the room and shielded vault to a shielded container for shipping for volume reduction and disposal. The wood blocks, shields and vault will then be manually removed and shipped for volume reduction and disposal. Careful monitoring will be performed during this process to minimize exposure to hot spots that may be exposed during equipment removal. The decontamination room overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be removed and shipped for volume reduction and disposal. The decontamination room will be surveyed as an affected area as part of the decommissioning.

5.4 High Level Waste Storage Room

The High Level Waste Storage Room Area is a 560 square foot area with concrete floors, walls and ceiling. The various shields containing Depleted Uranium (DU) in the front portion of the room will be removed from site as part of the decommissioning. There is no cost included for removal of the DU items as they have a significant value that will offset shipping costs to another location. The 24 drums of waste in the room are significant dose sources and they will be removed using a shielded forklift and moved to a shielded van and shipped for volume reduction and disposal. The 21 used HEPA filters in the room are significant dose sources and they will be moved to shielded containers using the robot and the containers will be moved with a shielded forklift to a shielded van and shipped for volume reduction and disposal. The other equipment in the room including the small cart, portable cabinet and wall cabinets will then be removed and surveyed for unrestricted release. The room floor, walls and ceiling, overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be cleared using a HEPA vacuum cleaner prior to being surveyed for release. The high level waste room will be surveyed as an affected area as part of the decommissioning.

5.5 Clean Equipment Room

The clean equipment room is a 727 square foot area with concrete floors, walls and ceiling. The contaminated air supply blower and the exhaust stack sampling system will be removed, packaged and shipped for volume reduction and disposal. The contaminated air supply blower is large and heavy and it will be sectioned, moved to the roof through a door and removed from the roof with a crane. Minor decontamination of the area will be done using manual wipe down. The clean equipment room will be surveyed as an unaffected area as part of the decommissioning. The contaminated equipment areas and the adjacent areas will be surveyed as affected areas as part of the decommissioning.

5.6 HEPA Equipment Room

The HEPA equipment room is a 240 square foot area with concrete floors, walls and ceiling. This is a high dose rate area and it will be decontaminated by first vacuuming the room and contents using a robotic HEPA system. The HEPA vacuum will be fitted with a shielded prefilter which will retain most of the removed Co^{60}. The vacuuming will be followed by robotic CO_2 blasting to remove accessible hot spots from the room and contents. Temporary shield blankets will be placed over and in front of remaining high dose areas such as the HEPA filters and vent ducts from the hot cell. The HEPA filters will be manually removed and packaged for shipment for volume reduction and disposal. The vent from the hot cell will be opened at the floor level using extension tools and the interior of the duct vacuumed using the robotic HEPA system. The HEPA exhaust blowers,

ductwork, and exhaust stack on the roof will be sectioned and packaged for shipping for volume reduction and disposal. The remaining equipment in the room including the abandoned emergency power generator, the hoist motor for the hot cell hoist, and a wood "A" frame with a small manually operated hoist attached will be removed manually and packaged for shipping for volume reduction and disposal. The duct from the room floor to the hot cell will be removed and packaged for shipping for volume reduction and disposal. The room floor will be decontaminated using a Blastrac vacuum shot blaster, the walls will be decontaminated by using scabbling, and the ceiling will be decontaminated using vacuum grit blasting. The room overhead lights, piping, conduit, and electrical boxes will be removed and shipped for volume reduction and disposal. The HEPA equipment room will be surveyed as an affected areas as part of the decommissioning.

The entry to the HEPA equipment room is a 132 square foot area with concrete floors, walls and ceiling. The portable HEPA filter unit will be used during the decommissioning project to maintain ventilation control and air quality. The ventilation control tent will be packaged for shipping for volume reduction and disposal. The entry area floor will be decontaminated using a Blastrac vacuum shot blaster, the walls and ceiling will be decontaminated by manual wipe down. The HEPA equipment room entry area will be surveyed as an affected areas as part of the decommissioning.

5.7 Dry Waste Storage Room

The dry waste storage room is a 752 square foot room with concrete floors, walls and ceiling. The room will first be HEPA vacuumed to pick up loose contamination. The 17 drums of waste in the room are significant dose sources and they will be moved using a shielded manual drum lift to a floor opening under the isotope shop. The drums will then be hoisted into the isotope shop and moved with a shielded forklift into a shielded van and shipped for volume reduction and disposal. The other equipment in the room including a large shop table with vise, and a 55 gallon waste holding tank will then be manually removed and shipped for volume reduction and disposal. The 650 high density concrete blocks in the room will be removed and shipped off site for decontamination and disposal. The room floor will be decontaminated using a Blastrac vacuum shot blaster, the walls will be decontaminated using a vacuum grit blaster, and ceiling will be decontaminated by manual wipe down. The room overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be removed and shipped for volume reduction and disposal. The dry waste storage room will be surveyed as an affected area as part of the decommissioning.

5.8 WHUT Room

The decommissioning of the WHUT room will not take place until the year 2018 to allow decay of the Co^{60} activity to a manageable level. The Waste Hold-Up (WHUT) room, including entry area, is a 162 square foot area with concrete floors, walls and ceiling. This is a high dose rate area due to sediment on the floor, in pipe traps, and in the waste holding tanks. As a result it will be decontaminated by first using a robot to remove debris from the room to a shielded shipping container and then vacuuming the floor and contents using a robotic HEPA system. The HEPA vacuum will be fitted with a shielded prefilter which will retain most of the removed Co^{60}. The vacuuming will be followed by robotic CO_2 blasting to remove adhered sediment and accessible hot spots from the room and contents. Temporary shield blankets will be placed over and in front of remaining high dose areas such as the waste holding tanks. The other equipment in the room including an abandoned drum compactor, two small ion exchange columns, and a table for the ion exchange columns, will be manually removed and shipped for volume reduction and disposal. The 100 and 500 gallon waste receiving tanks will be flushed with water that is recirculated through a high efficiency shielded filtration system to remove the sediment and Co^{60} activity. The spent filters, and hold up tanks will then be packaged and shipped for volume reduction and disposal. The room floor will be decontaminated using a concrete plane, the walls will be decontaminated using concrete scabbling equipment, and ceiling will be decontaminated by a vacuum grit blaster. The room overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be removed and shipped for volume reduction and disposal. The WHUT room will be surveyed as an affected area as part of the decommissioning.

5.9 Basement Clean Side

The basement clean side consists of three rooms, Air Sampling Room, ISODOSE Curve Room and Unoccupied Room with a total area of 550 square feet. The floors, ceiling, and exterior walls are concrete. The interior walls are standard 2 x 4 wood framed walls with a painted drywall surface. The rooms will first be HEPA vacuumed to pick up loose contamination. The equipment in the rooms, a large plastic tank, an air sampler, large metal shelves, wooden shelf supports, ISODOSE Curves, sink with metal cabinet, two chairs, and two steel doors will be manually removed and shipped for volume reduction and disposal. The 45 high density concrete blocks in the unoccupied room will be removed and shipped off site for decontamination and disposal. The floors will be decontaminated using a Blastrac vacuum shot blaster the walls and ceiling will be decontaminated by manual wipe down. The overhead lights, piping, conduit, electrical boxes, and ventilation ductwork will be removed and shipped for volume reduction and disposal. The basement clean side will be surveyed as affected areas as part of the decommissioning.

5.10 Miscellaneous Areas

The miscellaneous areas at the London road site do not individually contribute significantly to the cost of decommissioning and are therefore presented in less detail than the previous areas. These remediation work for these areas is summarized in table 5-1.

Table 5-1
AMS London Road Site Miscellaneous Area Remediation

Area	Size of Area and Construction Materials	Equipment Removed for Volume Reduction & Disposal	Remediation Methods	Area Survey Category
Air Lock	320 ft², concrete floor & interior walls, metal ceiling & exterior walls.	Power cord for Isotope Room Tow Motor, 30 concrete shield blocks, and a utility cart	Blastrac for floor	Affected
Isotope Warehouse	4,668 ft², concrete floor, concrete block and clay brick walls, and metal ceiling.	Old hot cell shield window	None	Affected
Former Chemistry Lab	220 ft², concrete floor, clay brick walls, and metal ceiling.	None	None	Unaffected
Hot Cell Control Room	170 ft², concrete floor walls and ceiling.	None	None	Unaffected
First Floor Office Areas	4,600 ft², concrete floor and ceiling, and standard drywall.	None	None	Unaffected
Isotope Shop Locker Room	91 ft², concrete floor and ceiling, clay brick and standard drywall.	None	None	Affected
Instrument Calibration Room	988 ft², concrete floor, clay brick and standard drywall, and metal ceiling.	None	None	Affected
Caged Storage Area	1,564 ft², concrete floor, concrete block and clay brick walls, and metal ceiling.	None	None	Affected
Second Floor Office Areas	1,513 ft², concrete floor and ceiling, clay brick and standard drywall.	None	None	Affected
Sewers	121 lineal feet, iron pipe in buildings.	None	Chemical Decontamination	Affected
Outdoor Areas	Mostly paved with some natural soil areas.	None	None	Unaffected

6.0 REFERENCES

6.1 NRC, *Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material*, April 1993.

6.2 Code of Federal Regulations, 10 CFR 70, *Domestic Licensing of Special Nuclear Material*

6.3 NRC Regulatory Guide 1.159, *Assuring the Availability of Funds For Decommissioning Nuclear Reactors*

6.4 NRC, February 20, 1992, Federal Register Vol. 47, No. 34, *Order Establishing Criteria and Schedule for Decommissioning the Bloomsburg Site, Attachment 3.*

6.5 NUREG/CR-1756, *Technology Safety and Costs of Decommissioning Reference Nuclear Research and Test Reactors*, March 1982

6.6 Means Building Construction Cost Data, 52nd Annual Edition, 1994, R.A. Means Company, Inc.

6.7 ORAU 89/B-145, April 1989, Oak Ridge Associated Universities, P.R. Cotten and G.L. Murphy, *Radiation Survey of the Advanced Medical Systems, Inc., London Road Facility, Cleveland, Ohio*

APPENDIX A

Radiological Data

- A-1, Radiological Data for Buildings
- A-2, Radiological Data for Outdoor Areas

Appendix A-1
ADVANCED MEDICAL SYSTEMS SURVEY DATA

AREA	DOSE RATE		TOTAL β-γ CONTAMINATION		SMEARABLE β-γ CONTAMINATION	
	MAX AREA (mR/hr)	AVG AREA (mR/hr)	MAX FLOOR (dpm/100 cm²)	AVG FLOOR (dpm/100 cm²)	MAX FLOOR (dpm/100 cm²)	AVG FLOOR (dpm/100 cm²)
Exterior Structure	0.07	0.07				
Exterior Structure Roof	14.00	2.48				
Isotope Warehouse Exterior Structure	0.05	0.05				
Isotope Warehouse Roof	0.15	0.03	110	46		
Front Stairwell [#2] (1988 data)	0.10	0.10	<710	<710	15	<6
Chemistry Lab [126] (1988 data)	0.10	<0.1	1,200	<1170	18	<6
Test Cell Control Room [123] (1988 data)	0.10	<0.1	1,500	<1170	<6	<6
Office [118] (1988 data)	0.10	0.10	1,200	<1170	7	6
Lobby Stairwell [#3] (1988 data)	<0.1	<0.1	<710	<710	6	<6
Hot Cell (1988 Data)	>20,000	3,000				
Isotope Hot Shop	10.00	1.00	187,560	98,335		
Isotope Hot Shop Source Storage Garden	2.00	<1	269,230	269,230		
Isotope Hot Shop Clean Locker Room (1988 data)	0.30	<0.1	1,700	1,000	<6	<6
Isotope Hot Shop Shower Room (1988 data)	<0.1	<0.1	100,000	1,000	49	10
Isotope Hot Shop Toilet Room (1988 data)	<0.1	<0.1	<710	<710	---	---
Isotope Hot Shop Dirty Locker Room (1988 data)	2.10	0.90	300,000	1,000		
Decon Room		>10	1,199,150	1,199,150	3,000,000	
Isotope Shop Stairwell [#1]	<1	<1	949,900	310,893		
High Level Waste Storage Room	400	400	100	75		
Airlock	1	<1	15,050	7,590		
Isotope Warehouse	50	1	160	128		
Instrument Calibration Room (1988 data)	<0.1	<0.1	<710	<710	<6	<6
Caged Storage Area (1987 data)					1,790	134

Data from "Radiation Survey of the Advanced Medical Systems, Inc. London Road Facility, Cleveland Ohio", Oak Ridge Associated Universities, ORAU 89/B-145, P. Cotten and G. Murphy, April 1989.

Appendix A-1
ADVANCED MEDICAL SYSTEMS SURVEY DATA

AREA	DOSE RATE		TOTAL β-γ CONTAMINATION		SMEARABLE β-γ CONTAMINATION	
	MAX AREA (mR/hr)	AVERAGE AREA (mR/hr)	MAX FLOOR (dpm/100 cm²)	AVERAGE FLOOR (dpm/100 cm²)	MAX FLOOR (dpm/100 cm²)	AVERAGE FLOOR (dpm/100 cm²)
Women's Room (1988 data)	0.10	0.10	<710	<710	10	<6
Second Floor Office Room 1 (1988 data)	0.10	0.10	2,700	1,500	9	<6
Second Floor Office Room 2 (1988 data)	0.10	0.10	2,700	1,350	35	11
Second Floor Office Room 3 (1988 data)	0.10	0.10	1,300	1,200	<6	<6
Second Floor Office Room 4 (1988 data)	0.10	0.10	<1,170	<1,170	7	<6
Second Floor Office Room 5 (1988 data)	0.10	0.10	<710	<710	<6	<6
Clean Equipment Room [207]	30.00	<1.0	190	167		
Men's Room (1988 data)			18,000	8,900	<6	<6
HEPA Equipment Room Entry Area (1988 data)			130,000	30,500	23	10
HEPA Equipment Room [206]	2,000	60	17,170	10,920		
Air Samplling Room [B2]	<1.0	<1.0	150	150		
ISODOSE Curve Room	<1.0	<1.0	210	210		
Unoccupied Room	20	10	3,410	3,410		
Dry Waste Storage Room [B-5]	50	7.17	2,116,280	853,523		
WHUT Room [B3]. (1987 Data)	2,000,000	250,000				
WHUT Room Entry [B3] (1987 Data)	250,000	150,000			1.8 R/hr	1.65 R/hr
Sewer Manhole - 1 each	3.00	0.84				

Data from "Radiation Survey of the Advanced Medical Systems, Inc. London Road Facility, Cleveland Ohio", Oak Ridge Associated Universities, ORAU 89/B-145, P. Cotten and G. Murphy, April 1989.

Appendix A-2
ADVANCED MEDICAL SYSTEMS OUTDOOR SURVEY DATA

No.	AREA	DOSE RATE Contact (µR/hr)	DOSE RATE at 1 meter (µR/hr)	RADIONUCLIDE CONCENTRATIONS Co-60 (pCi/g)	Cs-137 (pCi/g)
1	Blocked Entrance Door on East Side of Building	72	310	2.2	2.2
2	Approx 7 m from the East Side on Old RR Tracks	18	18	0.1	0.3
3	13 m South & 10 m East of NE Corner of Bldg	16	18	0.3	0.2
4	21 m South & 5 m East of NE Corner of Bldg	26	37	2.5	0.4
5	North of Drain on East Side of Bldg	134	310	<0.1	0.1
6	6 m East & 41 m South of NE Corner of Bldg	21	26	<0.1	0.3
7	52 m South & 5 m East of NE Corner of Bldg	14	14	1.3	0.4
8	2.5 m North from SE Corner of Bldg, Against Wall	11	11	2.3	0.4
9	At NE Corner of Bldg	9	9	<0.1	0.5
10	West Side of Sidewalk at Main Entrance Door	10	10	0.6	0.5
11	In Shrub Bed at West side of Front Driveway	7	8	0.2	0.8
12	NW Corner of Bldg at Fence Corner Nearest fo Sidewalk	7	7	<0.1	0.3

Notes:

a. Data from "Radiation Survey of the Advanced Medical Systems, Inc. London Road Facility, Cleveland Ohio", Oak Ridge Associated Universities, ORAU 89/B-145, P. Cotten and G. Murphy, April 1989.

c. A higher dose rate at 1 meter distance than on contact indicates that the source is shine from the structure and not from radioactive material in the soil.

APPENDIX B

Cost Calculation Sheets for Advanced Medical Systems

- B-1, Contaminated and Asbestos Waste Volume Summaries
- B-2, Contaminated Waste Disposal Cost
- B-3, Asbestos Waste Disposal Cost
- B-4, Waste Shipping Container Cost, Unit Disposal Cost Factors, and Waste Disposal Summary
- B-5, Volume Reduction Transportation Summary
- B-6, Building Area Survey Labor Estimate
- B-7, Open Land Areas Survey Labor Estimate
- B-8, Estimated Midwest Compact Burial Charges
- B-9, Hot Cell Decontamination Special Process Charges
- B-10, WHUT Room Decontamination Special Equipment Costs
- B-11, AMS Cobalt-60 Source Decontamination and Shipping Costs
- B-12, Project Instrumentation Costs

APPENDIX B-1

ADVANCED MEDICAL SYSTEMS CONTAMINATED WASTE VOLUME SUMMARY

	Area Description	Reduced Hardware Volume (ft^3)	Decon Waste Volume (ft^3)	Removed Concrete Volume (ft^3)	Generated Waste Volume (ft^3)	Total Waste Volume (ft^3)
1	Hot Cell	10.0	3.1	0.6	5	19
2	Isotope Shop	28.3	16.9	7.9	7	60
3	Decon Room	0.1	15.5	11.5	7	34
4	High Level Waste Storage Room	42.7	1.8	0.0	3	48
5	Clean Equipment Room	0.1	0.0	0.0	2	2
6	HEPA Equipment Room	19.4	15.5	15.1	7	57
7	Dry Waste Storage Room	54.6	17.7	15.7	3	91
8	WHUT Room	8.7	22.8	14.3	83	129
9	All Other Areas	70.4	29.2	5.0	7	112
	TOTALS:	234	123	70	124	551

ADVANCED MEDICAL SYSTEMS

ASBESTOS WASTE VOLUME SUMMARY

	Area Description	Asbestos Volume (ft^3)
1	Hot Cell	
2	Isotope Shop	6
3	Decon Room	
4	High Level Waste Storage Room	
5	Clean Equipment Room	
6	HEPA Equipment Room	5
7	Dry Waste Storage Room	9
8	WHUT Room	1
9	All Other Areas	
	TOTAL:	21

APPENDIX B-2

ADVANCED MEDICAL SYSTEMS CONTAMINATED WASTE DISPOSAL COST

	Area Description	Reduced Hardware Disposal Cost	Decon Waste Disposal Cost	Removed Concrete Disposal Cost	Generated Waste Disposal Cost	Total Waste Disposal Cost
1	Hot Cell	$1,810	$561	$109	$905	$3,385
2	Isotope Shop	$5,122	$3,059	$1,430	$1,267	$10,878
3	Decon Room	$18	$2,806	$2,082	$1,267	$6,172
4	High Level Waste Storage Room	$7,729	$326	$0	$543	$8,598
5	Clean Equipment Room	$18	$0	$0	$362	$380
6	HEPA Equipment Room	$3,511	$2,806	$2,733	$1,267	$10,317
7	Dry Waste Storage Room	$9,883	$3,204	$2,642	$543	$16,471
8	WHUT Room	$1,575	$4,127	$2,588	$15,023	$23,313
9	All Other Areas	$12,742	$5,285	$905	$1,267	$20,200
	TOTALS:	$42,408	$22,173	$12,688	$22,444	$99,713

ADVANCED MEDICAL SYSTEMS CONTAMINATED WASTE PACKAGING & SHIPPING COST

	Area Description	Reduced Hardware Volume (ft^3) ($)	Decon Waste Volume (ft^3) ($)	Removed Concrete Volume (ft^3) ($)	Generated Waste Volume (ft^3) ($)	Total Waste Volume (ft^3) ($)
1	Hot Cell	$9	$3	$1	$5	$17
2	Isotope Shop	$26	$15	$7	$6	$54
3	Decon Room	$0	$14	$10	$6	$31
4	High Level Waste Storage Room	$39	$2	$0	$3	$43
5	Clean Equipment Room	$0	$0	$0	$2	$2
6	HEPA Equipment Room	$18	$14	$14	$6	$51
7	Dry Waste Storage Room	$49	$16	$14	$3	$82
8	WHUT Room	$8	$21	$13	$75	$116
9	All Other Areas	$64	$26	$5	$6	$101
	TOTALS:	$212	$111	$63	$112	$498

APPENDIX B-3

ADVANCED MEDICAL SYSTEMS

ASBESTOS WASTE DISPOSAL COST

	Area Description	Asbestos Waste Cost ($)
1	Hot Cell	$0
2	Isotope Shop	$900
3	Decon Room	$0
4	High Level Waste Storage Room	$0
5	Clean Equipment Room	$0
6	HEPA Equipment Room	$750
7	Dry Waste Storage Room	$1,350
8	WHUT Room	$150
9	All Other Areas	$0
	TOTAL:	$3,150

ADVANCED MEDICAL SYSTEMS

ASBESTOS WASTE PACKAGING & SHIPPING COST

	Area Description	Asbestos Waste Cost ($)
1	Hot Cell	$0
2	Isotope Shop	$20
3	Decon Room	$0
4	High Level Waste Storage Room	$0
5	Clean Equipment Room	$0
6	HEPA Equipment Room	$16
7	Dry Waste Storage Room	$30
8	WHUT Room	$3
9	All Other Areas	$0
	TOTAL:	$69

APPENDIX B-4

ADVANCED MEDICAL SYSTEMS WASTE SHIPPING CONTAINER COST

	Area Description	Waste Volume (ft^3)	B-25 Waste Containers (Ea.)*	Waste Container Cost ($)
1	Hot Cell	19	0	$86
2	Isotope Shop	66	1	$304
3	Decon Room	34	0	$157
4	High Level Waste Storage Room	48	0	$218
5	Clean Equipment Room	2	0	$10
6	HEPA Equipment Room	62	1	$285
7	Dry Waste Storage Room	100	1	$459
8	WHUT Room	130	1	$596
9	All Other Areas	112	1	$512
	TOTALS:	572	6	$2,626

* *Fractional containers used for cost calculations.*

ADVANCED MEDICAL SYSTEMS UNIT DISPOSAL COST FACTORS

Estimated radwaste disposal rate for Midwest Compact :	$181.00	per cubic foot
Estimated asbestos waste rate for Enviriocare in Utah :	$150	per cubic foot
Estimated transport rate to Midwest Compact :	$24	per cubic yard
Estimated transport rate to Midwest Compact :	$650	per load
Estimated mileage rate to Midwest Compact :	$2.65	per mile
Estimated transport distance to Midwest Compact :	250	miles
Estimated average waste density to Midwest Compact :	60	lb/cubic foot
Estimated transport rate to Envirocare in Utah :	$89	per cubic yard
Estimated transport rate to Envirocare in Utah :	$2,927	per load
Estimated transport distance to Enviriocare in Utah :	1,875	miles
Estimated mileage rate to Enviriocare in Utah :	$2.65	per mile
Estimated average waste density to Envirocare in Utah :	30	lb/cubic foot
Truck transport waste weight limit :	44,000	pounds
Estimated cost of used B-25 shipping containers :	$450.00	each

ADVANCED MEDICAL SYSTEMS WASTE DISPOSAL SUPPORT LABOR ESTIMATE

	Area Description	B-25 Waste Containers (Ea.)	Radioactive Waste Shipments (Ea.)	Waste Shipment Labor (man-hr)
1	Hot Cell	0.2	0.0	0.3
2	Isotope Shop	0.7	0.1	0.9
3	Decon Room	0.3	0.0	0.5
4	High Level Waste Storage Room	0.5	0.0	0.6
5	Clean Equipment Room	0.0	0.0	0.0
6	HEPA Equipment Room	0.6	0.1	0.8
7	Dry Waste Storage Room	1.0	0.1	1.4
8	WHUT Room	1.3	0.1	1.8
9	All Other Areas	1.1	0.1	1.5
	TOTALS:	6	0	8

Estimated waste loading operator time :	4	hr per load
Estimated HP Tech time per rad or mixed waste load :	4	hr per load
Estimated HP shipper time per rad or mixed waste load :	8	hr per load
Estimated clean waste shipping volume limit :	1176	ft^3 per load
Estimated radwaste shipping volume limit :	12	B-25 Boxes

APPENDIX B-5

ADVANCED MEDICAL SYSTEMS VR WASTE TRANSPORT SUMMARY

ut Loc. code	Original Contaminated Volume (ft^3)	B-25 Waste Containers (ea.)	Waste Container Cost ($)	Radioactive Waste Shipments (ea.)	Waste Shipment Labor (man-hr)
1.70	327	3.3	$1,499	0.3	4.4
1.71	415	4.2	$1,905	0.4	5.6
1.73	52	0.5	$239	0.0	0.7
1.77	0	0.0	$0	0.0	0.0
1.78	136	1.4	$626	0.1	1.9
1.79	14	0.1	$63	0.0	0.2
1.80	308	3.1	$1,416	0.3	4.2
1.81	9	0.1	$41	0.0	0.1
1.82	234	2.4	$1,074	0.2	3.2
1.85	52	0.5	$239	0.0	0.7
2.16	64	0.6	$292	0.1	0.9
2.20	0	0.0	$0	0.0	0.0
2.21	11	0.1	$49	0.0	0.1
2.22	550	5.6	$2,525	0.5	7.5
3.10	130	1.3	$599	0.1	1.8
3.11	113	1.2	$518	0.1	1.5
3.12	18	0.2	$83	0.0	0.2
3.13	343	3.5	$1,576	0.3	4.7
3.15	630	6.4	$2,891	0.5	8.6
3.16	9	0.1	$40	0.0	0.1
4.12	42	0.4	$193	0.0	0.6
Total	3,455	35	$15,866	2.9	47

PPENDIX B-6
DVANCED MEDICAL SYSTEMS SURVEY COST ESTIMATE FOR BUILDINGS

AREA	WIDTH (ft)	LENGTH (ft)	HEIGHT (ft)	SURFACE AREA FLOOR (m²)	LOWER WALLS (m²)	UPPER WALLS (m²)	CEILING (m²)	ROOF (m²)	TOTAL (m²)	FLOOR + L. WALL SURVEY CODE	U. WALL CEILING SURVEY CODE	FLOOR + L. WALL SURVEY POINTS	U. WALL + CEILING SURVEY POINTS	ROOF SURVEY POINTS	TOTAL SMEAR POINTS	DIRECT SURVEY LABOR (hrs)
ain Bldg Exterior Structure	50.0	70.0	29.0		146	500		325	972	1	4	30	30	30	90	5
esearch Bldg Exterior Structure	56.0	83.0	29.0		169	579		432	1,181	1	4	30	30	30	90	5
otope Warehouse Exterior Structure	60.0	83.0	14.5		174	211		463	848	1	4	30	30	30	90	5
ain Warehouse Exterior Structure	60.0	97.0	14.5		191	232		541	964	1	4	30	30	30	90	5
ain Entrance Hallway [128]	9.0	19.0	14.0	16	34	39	16		105	1	4	30	30		60	4
ont Stairwell [#2]	8.5	16.5	39.5	13	30	153	13		210	1	4	30	30		60	4
ont Office [127]	12.5	17.0	14.0	20	36	41	20		116	1	4	30	30		60	4
hemistry Lab [126]	12.0	18.5	14.0	21	37	42	21		121	1	4	30	30		60	4
st Cell and Radiography Control Room [123]	5.0	34.0	14.0	16	48	54	16		133	1	4	30	30		60	4
esearch Area [120]	35.0	51.0	14.0	156	105	119	166		555	1	4	30	30		60	4
ffice [118]	9.0	11.0	14.0	9	24	28	9		70	1	4	30	30		60	4
ffice [119]	9.0	11.0	14.0	9	24	28	9		70	1	4	30	30		60	4
orridor [103]	6.0	81.0	14.0	45	106	120	45		317	1	4	30	30		60	4
ark Room [117]	7.0	11.0	14.0	7	22	25	7		61	1	4	30	30		60	4
ort Hall [111]	7.5	12.0	14.0	8	24	27	8		67	1	4	30	30		60	4
omens Lounge & Toilet [116]	11.0	13.0	14.0	13	29	33	13		89	1	4	30	30		60	4
nitors Closet [114]	5.0	5.5	14.0	3	13	15	3		32	1	4	30	30		60	4
pe Space [140]	2.0	11.0	14.0	2	16	18	2		38	1	4	30	30		60	4
ens Toilet [113]	10.5	11.0	14.0	11	26	30	11		77	1	4	30	30		60	4
brary [112]	11.0	18.8	14.0	17	34	38	17		107	1	4	30	30		60	4
bby [102]	20.2	29.0	14.0	54	60	68	54		237	1	4	30	30		60	4
bby Closet [105]	4.0	8.0	14.0	3	15	17	3		37	1	4	30	30		60	4
bby Closet [106]	2.0	5.0	14.0	1	9	10	1		20	1	4	30	30		60	4
bby Closet [104]	2.5	5.0	14.0	1	9	10	1		22	1	4	30	30		60	4
bby Stairwell [#3]	9.0	15.0	29.0	13	29	100	13		154	1	4	30	30		60	4
ain Warehouse	81.0	88.0	14.5	662	206	249	662		1,780	1	4	30	30		60	4
omen s Room	7.0	15.0	14.5	10	27	32	10		79	1	4	30	30		60	4
oom 1	14.5	39.0	14.5	53	65	79	53		249	1	4	30	30		60	4
oom 2	16.5	25.5	14.5	39	51	62	39		191	1	4	30	30		60	4
oom 3	11.0	16.5	14.5	17	34	41	17		108	1	4	30	30		60	4
oom 4	10.0	11.0	14.5	10	26	31	10		77	1	4	30	30		60	4
oom 5	10.0	13.0	14.5	12	28	34	12		86	1	4	30	30		60	4
lean Equipment Room [207] - part A	19.0	27.5	14.5	49	57	69	49		222	1	4	30	30		60	4
lean Equipment Room [207] - part B	12.0	17.0	14.5	19	35	43	19		116	1	4	30	30		60	4
TOTALS				1,318	1,940	3,175	1,318	1,760	9,511			1,020	1,020	120	2,160	124

tes: Room number codes from Drawing 635, Sheet A-1, Rev 2, McGeorge-Hargett & Associates

PENDIX B-6

DVANCED MEDICAL SYSTEMS SURVEY COST ESTIMATE FOR BUILDINGS

AREA	WIDTH (ft)	LENGTH (ft)	HEIGHT (ft)	SURFACE AREA FLOOR (m²)	LOWER WALLS (m²)	UPPER WALLS (m²)	CEILING (m²)	ROOF (m²)	TOTAL (m²)	FLOOR + L. WALL SURVEY CODE	U. WALL CEILING SURVEY CODE	FLOOR + L. WALL SURVEY BLOCKS	FLOOR + L. WALL SURVEY POINTS	U. WALL + CEILING SURVEY POINTS	ROOF SURVEY POINTS	GAMMA SURVEY or SMEAR POINTS	DIRECT SURVEY LABOR (hrs)
st Cell	6.0	10.0	14.0	6	20	22	6		53	1	4	25	35	30		55	4
otope Hot Shop	10.3	32.5	14.5	31	52	63	31		178	1	4	83	125	30		113	6
otope Hot Shop	13.3	26.0	14.5	32	46	58	32		170	1	4	80	120	30		110	6
otope Hot Shop Source Storage Garden	8.0	9.7	14.5	7	22	26	7		62	1	4	29	43	30		59	4
otope Hot Shop Clean Locker Room	8.0	9.7	14.5	7	22	26	7		62	1	4	29	43	30		59	4
otope Hot Shop Shower Room	6.5	8.0	14.5	5	18	21	5		49	1	4	23	34	30		53	3
otope Hot Shop Toilet Room	5.7	13.0	14.5	7	23	26	7		64	1	4	30	44	30		60	4
otope Hot Shop Dirty Locker Room	7.0	13.0	14.5	8	24	29	8		71	1	4	33	49	30		63	4
con Room	9.0	15.0	14.5	13	29	35	13		90	1	4	42	63	30		72	4
otope Shop Stairwell [#1]	9.0	17.0	25.0	14	32	89	14		149	1	4	46	69	30		76	5
gh Level Waste Storage Room	16.0	35.0	14.5	52	62	75	52		241	1	4	114	171	30		144	8
tock	10.0	32.0	14.5	30	51	62	30		173	1	4	81	121	30		111	6
otope Warehouse	60.0	77.8	14.5	433	166	203	433		1,238	1	4	601	902	95		697	37
strument Calibration Room	26.0	38.0	14.5	92	78	94	92		358	1	4	170	255	30		200	11
ged Storage Area	34.0	46.0	14.5	145	98	118	145		506	1	4	243	364	39		282	15
mporary Waste Storage Area [SW corner]	9.0	24.0	14.5	20	40	49	20		129	1	4	60	90	30		90	5
n's Room	7.0	13.5	14.5	9	25	30	9		73	1	4	34	51	30		64	4
PA Equipment Room Entry Area	11.0	12.0	14.5	12	28	34	12		86	1	4	40	60	30		70	4
PA Equipment Room [206]	15.0	16.0	11.5	22	38	28	22		111	1	4	60	90	30		90	5
Sampling Room [B2]	13.6	14.6	10.5	19	35	21	19		93	1	4	53	80	30		83	5
DOOSE Curve Room	10.8	16.8	10.5	17	34	20	17		88	1	4	51	76	30		81	5
occupied Room	11.5	14.6	10.5	16	32	19	16		82	1	4	47	71	30		77	5
y Waste Storage Room [B-5], part A	24.0	26.0	10.5	58	61	37	58		213	1	4	119	178	30		149	8
y Waste Storage Room [B-5], part B	8.0	16.0	10.5	12	29	18	12		71	1	4	41	62	30		71	4
uid Waste Holding Tank (WHUT) Room [B3]	10.5	11.0	10.5	11	26	16	11		63	1	4	37	55	30		67	4
HUT Room Entry [B3]	5.5	8.5	10.5	4	17	10	4		36	1	4	21	32	30		51	3
urce Storage Garden Sand Shield [B6]	5.5	19.5	10.5	10	30	18	10		69	1	4	40	61	30		70	4
urce Storage Garden [B6]	6.0	6.0	10.5	3	15	9	3		30	1	4	18	30	30		50	3
wer Manhole - 1 each	4.0	4.0	12.0	1	10	8	1		21	1	4	11	30	30		50	3
wer Catch Basins - 7 each	2.0	2.0	8.0	0	5	1	0		7	1	4	5	30	30		50	23
TOTALS				1,097	1,170	1,269	1,097	0	4,633			2,267	3,439	975	0	3,267	207
GRAND TOTALS				2,415	3,110	4,444	2,415	1,760	14,144				4,459	1,995	120	5,427	331

es: Room number codes from Drawing 635, Sheet A-1, Rev 2, McGeorge-Hargett & Associates

Appendix B-7

ADVANCED MEDICAL SYSTEMS OPEN LAND & MISCELLANEOUS SURVEY LABOR ESTIMATE

UNAFFECTED OPEN LAND AREAS

SURFACE	AREA	WIDTH (ft)	LENGTH (ft)	WIDTH (m)	LENGTH (m)	WIDTH (blocks)	LENGTH (blocks)	AREA (m²)	SURVEY BLOCKS	100% SCANS	100% PLAN SAMPLE POINTS	100% GAMMA SURVEY POINTS	10% SURVEY LABOR (hrs)
Paved/Grass	Front of Building To London Road	30.0	132.5	9.1	40.4	1	5	389	5	5	30	5	7
Paved/Grass	South of Building & Across Railroad Tracks	90.0	170.0	27.4	51.8	3	6	1,421	18	18	30	18	8
Paved/Grass	North of Building to Mandalay Avenue	160.0	250.0	48.8	76.2	5	8	3,718	40	40	30	40	11
Paved/Grass	Rear South of Building to Easement	140.0	220.0	42.7	67.1	5	7	2,881	35	35	30	35	10
Paved/Grass	Rear North of Building to Easement	70.0	250.0	21.3	76.2	3	8	1,626	24	24	30	24	9
	TOTALS							9,994	122	122	150	122	44

SEWER PIPE SURVEY

BUILDING	AREA	DIAMETER (in)	LENGTH (ft)	SURVEY RATE (ft/hr)	CREW SIZE	SURVEY LABOR (hrs)
Hot Cell	12" V.S.P. Sewer Line parallel to Bldg Front	12.0	185	40	2	9
Hot Cell	15" V.S.P. Sewer to 58" Brick Main in Street	15.0	55	40	2	3
Hot Cell	10" V.S.P. Sewer Main Under Building	10.0	215	40	2	11
Hot Cell	6" V.S.P. Sewer Laterals Under Building	6.0	100	40	2	5
Hot Cell	4" V.S.P. Sewer Laterals Under Building	4.0	120	40	2	6
	TOTALS		675	200	10	34

GRAND TOTAL : 78

Appendix E-8

ESTIMATED MIDWEST COMPACT BURIAL CHARGE BASED ON CURRENT BARNWELL RATES FOR AN UNSHIELDED LSA WASTE SHIPMENT

R INPUT DATA SECTION

CASK SHIPMENT (Y/N)	PACKAGE WEIGHT (LBS)	TOTAL CURIES	PACKAGE VOLUME (FT^3)	SHIELDED SHIPMENT (Y/N)?	SNM SHIPMENT (Y/N)?	SNM QUANTITY (g)	BIOLOGICAL WASTE SHIPMENT (Y/N)
N	3600	0.5	96	N	N	0	N

SITE SET-UP REQUIRED (Y/N)?	IRRADIATED HARDWARE SHIPMENT (Y/N)	UNSHIELDED SHIPMENT WITH H-3 or C-14 (Y/N)?	STATE CODE (Two Letters)	CLASS B/C LINER SHIPMENT (Y/N)	CLASS B/C DRUM SHIPMENT (Y/N)?	CLASS B/C OVERPACK SHIPMENT (Y/N)
N	N	N	OH	N	N	N

BARNWELL FEE CALCULATION DATA

CASK HANDLING CHARGE – (Minimum $3,000)	$3,000	per cask
SNM SURCHARGE –	$10.00	per gram
BARNWELL SURCHARGE –	2.4%	
SITE SETUP CHARGE – (Minimum $17,600)	$17,600	per shipment

SOUTHEAST COMPACT RATES

STANDARD VOLUME CHARGE –	$152.00	per cubic foot
BIOLOGICAL WASTE VOLUME CHARGE –	$167.00	per cubic foot
SNM VOLUME CHARGE –	$152.00	per cubic foot
BASE DISPOSAL CHARGE =	*$152.64*	*per cubic foot*
STABILIZATION & CLOSURE CHARGE –	$12.60	per cubic foot
MINIMUM SHIPMENT CHARGE –	$1,000.00	per shipment
IRRADIATED HARDWARE SURCHARGE –	$16,000.00	per liner overpack

WEIGHT SURCHARGE RANGES & COSTS

0 TO 1,000 LBS	--
1,000 TO 6,000 LBS	$1,250
6,000 TO 10,000 LBS	--
10,000 TO 20,000 LBS	--
20,000 TO 30,000 LBS	--
30,000 TO 40,000 LBS	--
40,000 TO 50,000 LBS	--
< 50,000 LBS	--
SURCHARGE:	$1,250

SHIELDED SHIPMENT
CURIE SURCHARGE RANGES & COSTS

0 TO 5 CURIES	--
5 TO 15 CURIES	--
15 TO 25 CURIES	--
25 TO 50 CURIES	--
50 TO 75 CURIES	--
75 TO 100 CURIES	--
100 TO 150 CURIES	--
150 TO 250 CURIES	--
250 TO 500 CURIES	--
500 TO 1000 CURIES	--
> 1,000 CURIES	--
SURCHARGE:	$0

CLASS B/C WASTE SURCHARGES :

Large Liners (82" dia x 79" ht, max)	$12,500	per liner
Overpacks (33" dia x 79" ht, max)	$6,000	per overpack
55-Gal Drum (25.5" dia x 36" ht, max)	$1,500	per drum
SURCHARGE	$0	per cubic foot

SPECIFIC BURIAL FEE CALCULATIONS

COMPACT: **Midwest** COMPACT STATUS CODE: 3 MW Compact Member

BASE DISPOSAL CHARGE –	$166.86	per cubic foot
SITE STABILIZATION AND CLOSURE FUND –	$12.60	per cubic foot
TOTAL VOLUME CHARGE –	$168.25	per cubic foot
RADWASTE VOLUME –	98	cubic feet
RADWASTE VOLUME CHARGE –	$16,486.30	
CURIE SURCHARGE –	$0.00	
WEIGHT SURCHARGE –	$1,250.00	
CASK USE SURCHARGE –	$0.00	
SNM SURCHARGE –	$0.00	
SITE SETUP SURCHARGE –	$0.00	
CLASS B/C WASTE SURCHARGE –	$0.00	
IRRADIATED HARDWARE OVERPACK SURCHARGE –	$0.00	
TOTAL BURIAL FEE –	$17,738.30	
TOTAL ($ / FT^3) –	$181.00	

Cost basis for the Midwest Compact is based on the fact that a disposal site has not been chosen and that no disposal rates for the site have been quoted.
This estimate uses July 1, 1994 Barnwell rates.

Appendix B-9

AMS HOT CELL DECONTAMINATION SPECIAL PROCESS CHARGES
Semi-Remote Decontamination Using Moveable Shields,
Remote Tools Robotics and Chemical Cleaning

Chemical Cleaning Duration	4	weeks	
Cost Category	*Rate*	*Unit*	*Cost*
Mobilization of Chemical Cleaning Contractor	$5,000	each	$5,000
Remote Handling Equipment & Shield	$4,700	per week	$18,800
Chemical Clearing Waste Product Solidification	$3,200	per week	$3,200
TOTAL			$27,000

APPENDIX B-10
AMS WHUT ROOM DECONTAMINATION SPECIAL EQUIPMENT CHARGES
Remote Decontamination Using Robotics and Blast Cleaning

CO2 Blast Cleaning Cost

CO2 Blast Cleaning Duration	4	weeks	
Cost Category	*Rate*	*Unit*	*Cost*
Mobilization of CO2 Blast Cleaning Equipment*	$22,000	each	$22,000
CO2 Blast Cleaning Equipment Lease*	$8,000	per week	$32,000
Ventillation Equipment Lease*	$34,000	each	$34,000
Remote Handling Equipment & Shield*	$4,700	per week	$18,800
CO2 Blast Cleaning Procedure*	$1,500	each	$1,500
Liquid Nitrogen*	$2,415	per week	$9,660
Fuel*	$1,200	per week	$4,800
HEPA Filters*	$1,000	per week	$4,000
Technician Labor (3 techs)*	$5,355	per week	$21,420
TOTAL			$148,180

W.H.U.T. ROOM DECONTAMINATION ROBOTICS SUPPORT

WHUT Room Cleaning Duration	4	weeks	
Cost Category	*Rate*	*Unit*	*Cost*
Mobilization of Robotics Equipment	$10,700	each	$10,700
Robotics Unit	$66,500	each	$66,500
Robotics Tools	$10,700	each	$10,700
Technician Labor	$5,355	per week	$21,420
TOTAL			$109,320

** Costs based on a price quote by Hot Cell Services*

Appendix B-11

AMS COBALT 60 SOURCE DECONTAMINATION AND SHIPPING

Decontamination Using Existing Manipulators and Chemical Cleaning

Shipping via existing AMS cask and comercial carrier

COBALT 60 SOURCE DECONTAMINATION

Co-60 Source Decontamination Duration	1	weeks	
Cost Category	*Rate*	*Unit*	*Cost*
Mobilization of Chemical Cleaning Contractor	$5,000	each	$5,000
Decontamination Chemical & Equipment Costs	$1,500	each	$1,500
Remote Decontamination Labor	$4,500	per week	$4,500
Chemical Cleaning Waste Product Solidification	$500	each	$500
TOTAL			$11,500

COBALT 60 SOURCE SHIPPING

	No.	Curies	
Co-60 Source Shipments to Maryland	2	27,650	
Co-60 Source Shipments Valecetos	3	42,350	
Allowable curies per shipment in cask		13,830	
Cost Category	*Rate*	*Unit*	*Cost*
Mobilization of Shipping Cask	$1,137	one time	$1,137
Labor to Load Cask & Prepare for Shipping	$2,080	per load	$10,400
Shipping distance to Maryland	716	miles	
Shipping distance to GE Valectos and return	4,970	miles	
Cask Transportaion Rate per mile	$1.56	mile	
AMS Cask Lease Rate	$0	per day	
Cask Lease Days for Maryland Shipments	2	days	
Cask Lease Days for GE Valectos Shipments	11	days	
Shipping cost to Maryland			$2,234
Shipping cost to GE Valectos			$23,260
TOTAL			$37,031

Appendix B-12
AMS PROJECT INSTRUMENTATION COSTS
LONDON ROAD FACILITY
DECOMMISSIONING COST ESTIMATE

TN, Sales Tax = 8.75% W/O Roane Co. = 6.00%

TOTAL PROJECT
DURATION (months): 7
Average Onsite Staff: 8

ITEM	RADIATION-PROTECTION INSTRUMENTATION FOR DECOMMISSIONING	LEASE PERIOD Inst-mo	LIFE IN YEARS	LIFE IN MONTHS	UNIT PRICE	TN TAX	UNIT COST	UNIT LEASE RATE	TASK RENTAL
	Instrumentation provided at monthly rental rate								
1	EBERLINE - PORTABLE ALPHA COUNTER MODEL / SAC-4:	1	1	12	$3,380	$246.82	$3,627	$302	$302
2	EBERLINE - PORTABLE BETA COUNTER MODEL / BC-4:	7	1	12	$2,607	$200.45	$2,808	$234	$1,638
3	EBERLINE - PORTABLE ION CHAMBER INSTRUMENT MODEL R02:	7	1	12	$945	$82.65	$1,027	$86	$599
4	BURK'S - HV-1 HIGH VOLUME AIR SAMPLERS W/ SAMPLE HEAD:	6	1	12	$750	$65.63	$816	$68	$408
5	BURK'S - LV-1 LOW VOLUME AIR SAMPLERS W/ SAMPLE HEAD:	12	1	12	$680	$59.50	$740	$62	$740
6	LUDLUM - MODEL 12 FRISKER WITH 44-9 PROBE & HARD CASE:	7	1	12	$653	$57.16	$710	$59	$414
7	LUDLUM - MODEL 19 MICRO R METER WITH HARD CASE:	7	1	12	$867	$75.86	$943	$79	$550
8	LUDLUM - FLOOR MONITOR CART W/ O PROBE MODEL 239-1F FOR USE WITH 2350 MONITOR:	8	1	12	$2,155	$173.29	$2,328	$194	$1,552
9	LUDLUM - FLOOR MONITOR CART W/ O PROBE MODEL 239-1F FOR USE WITH CM7A CONTAMINATION MONITOR:	7	1	12	$1,572	$137.53	$1,709	$142	$997
10	LUDLUM - MODEL 2350 WITH KEYPAD, BARCODE READER, HEADPHONES, HARD CASE AND THE FOLLOWING DETECTORS: 43-68 100 cm2 GAS PROPORTIONAL DETECTOR 43-5 ALPHA SCINTILLATION DETECTOR 44-2 HIGH ENERGY GAMMA SCINTILLATION DETECTOR 44-40 SHIELDED GM PAKCAKE DETECTOR 43-37, 550 cm2 GAS PROPORTIONAL DETECTOR	15	1	12	$3,660	$263.60	$3,924	$327	$4,905
11	LUDLUM - PORTABLE FRISKER MODEL 177 W/ 44-9 PROBE & HARD CASE:	7	1	12	$739	$64.67	$804	$67	$469
12	NE TECHNOLOGY CM7A ALPHA/BETA FRISKER W/ DP5HA PROBE & STAND:	7	1	12	$4,184	$295.05	$4,479	$373	$2,613
13	TENNELEC - LB5100W-2080- III PC BASED ALPHA/BETA COUNTING SYSTEM:	7	3	36	$31,244	$1,918.62	$33,162	$921	$6,448
14	RADIO INTERCOM WITH THROAT AND RESPIRATOR MICROPHONE:	6	1	12	$1,500	$131.25	$1,631	$136	$816
	Instrumentation Sources Provided at Monthly Rental Rate								
15	EFFICIENCY DETERMINATION SOURCE FOR MODEL 2350:	7	1	12	$325	$28.43	$353	$29	$206
16	NaI DETECTOR CHECK SOURCES FOR MODEL 2350:	7	1	12	$45	$3.98	$49	$4	$29
17	CALIBRATION SOURCE FOR MODEL CM7A CONTAMINATION MONITOR:	7	1	12	$1,919	$159.14	$2,078	$173	$1,212
18	ALPHA/BETA COUNTER, BC--4 & SAC-4 6ea SOURCE SET:	7	1	12	$4,600	$319.99	$4,920	$410	$2,870
19	PORTABLE FRISKER 4ea SOURCE SET:	7	1	12	$1,306	$114.25	$1,420	$118	$828
	SUBTOTAL HEALTH PHYSICS INSTRUMENTATION:				$63,131	$4,398	$67,529		$27,596