ANL/ESH-HP-98/01

BUILDING 211 CYCLOTRON CHARACTERIZATION SURVEY REPORT

ARGONNE NATIONAL LABORATORY, ARGONNE, ILLINOIS

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ESH Division, Health Physics Section
Argonne National Laboratory
Argonne, Illinois

March 30, 1998

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BUILDING 211 CYCLOTRON

CHARACTERIZATION SURVEY

REPORT

ESH Division, Health Physics Section
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ACKNOWLEDGMENTS

There are many people who contributed in a variety of different ways to the development of the Building 211 Cyclotron Characterization Survey Report. Special thanks is due to the following people and organizations: to all the members of the Health Physics Technician Field Team who participated in all of the radiological surveys within the facility; to Tony TenKate and Don Graczyk of CMT — Analytical Chemistry for their work in coordinating all the radiological and chemical sample analyses; to Bob Utesch of ESH — Industrial Hygiene for his assistance in coordinating lead paint and asbestos assessments within the facility.

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EXECUTIVE SUMMARY

The Building 211 Cyclotron Characterization Survey includes an assessment of the radioactive and chemical inventory of materials stored within the facility; an evaluation of the relative distribution of accelerator-produced activation products within various cyclotron components and adjacent structures; measurement of the radiation fields throughout the facility; measurement and assessment of internal and external radioactive surface contamination on various equipment, facility structures, and air-handling systems; and an assessment of lead (Pb) paint and asbestos hazards within the facility.

The primary concerns identified during the course of the characterization survey include: (1) contaminated duct work, associated with the exhaust systems serving Room B126 and the cave areas, was identified; (2) the Senior Cave contains a variety of radioactive sources which must be removed from the facility, most notably a shielded 0.5 Ci Ra-226 source; (3) decontamination of the Senior Cave roof will require special precautions in dealing with the amount of loose contamination present; (4) the highest exposure rate measured at the cyclotron itself was 1.6 R/h using an ion chamber (detector window open) at a distance of approximately 10 cm. The measured dose rate at the same distance drops off to 0.3 R/h with the ion chamber window closed.

Other areas of concern include the fact that the cyclotron beamlines in Room C101 and in the basement C001, were found to be internally contaminated as a result of particle activation; the three fume hoods in B126 will require decontamination; and virtually all of the painted surfaces within the facility contain varying levels of lead (Pb).

Using the information contained in Table 13, "Estimate of Activity Inventory in Various Cyclotron Materials," the total activity inventory for the cyclotron proper has been estimated to be almost 3 mCi, with Co-60 contributing to nearly 97% of this activity value.

BUILDING 211
CYCLOTRON CHARACTERIZATION
SURVEY REPORT

I. OBJECTIVE OF THE CHARACTERIZATION SURVEY

A comprehensive Building 211 Cyclotron Facility Characterization Survey was performed by ANL ESH/HP personnel in order to determine the inventory and distribution of radioactive and other hazardous materials within the facility. This information is needed to provide a quantitative basis for preparation of a Decommissioning Plan, to evaluate the relative risks associated with various decommissioning tasks, to estimate the quantities of hazardous materials that are expected to be generated during the course of the decommissioning project, and finally as an aid in estimating the volume of material and equipment that could be salvaged or recycled.

The radiological characterization includes determination of the inventory and distribution of the radionuclides present within the facility; a measurement of the radiation fields for all areas, equipment, and structures associated with the facility; measurement and assessment of contamination levels on various internal and external surfaces, experimental equipment, and other facility structures including cave areas and air handling systems; and activity levels within the facility as a consequence of various accelerator-produced activation products. The radiological characterization provides useful information for the assessment of other decommissioning options, as the basis for radiological and environmental risk assessment, worker dose projections, waste management planning, and cost-benefit analyses associated with defining the actual scope of decommissioning effort.

The Building 211 Characterization Survey included the following individual tasks: (1) radiological surveys throughout the facility; including surface contamination measurements and exposure rate measurements; (2) workplace air sampling for radioactive materials; (3) radioanalysis of samples taken of various facility structures/equipment; (4) in-situ gamma measurements of selected items; (5) analysis of paint samples for lead content; (6) chemical analysis of various liquids and dry media; (7) asbestos measurements and (8) radiological inventory of materials stored within the senior cave.

II. PRINCIPLE OF CYCLOTRON OPERATION

In a cyclotron, a strong magnetic field between the poles of a large electromagnet confines charged particles to travel in a spiral orbit parallel to the surfaces of the poles. The radius of this orbit is proportional to the momentum (i.e. mass and velocity) of the ions and inversely proportional to their charge and the strength of the magnetic field. This means that, for ions of a given mass and charge, the time taken to complete an orbit is always the same, no matter what the velocity. So, as the ions' velocity increases, the orbit must expand to keep the time it takes the ions to complete the revolution constant. It is this property that makes the cyclotron work.

At the heart of every cyclotron is one or more pairs of hollow metal chambers. In the earliest cyclotrons these chambers were shaped like the halves of a pillbox that had been cut along its diameter. These hollow chambers were called "dees" (or "D's") because of their shape.

The dees are located between the poles of the electromagnet and are connected to the terminal of an electric circuit of the same sort used in radio transmitters. The electric potential between the dees alternates rapidly - some millions of times per second - synchronized to the orbiting ions. In this way, ions starting near the center of the cyclotron are accelerated every time they cross the gap between the dees and travel in a kind of spiral composed of semicircular arcs of progressively larger radius (see Figure 1).

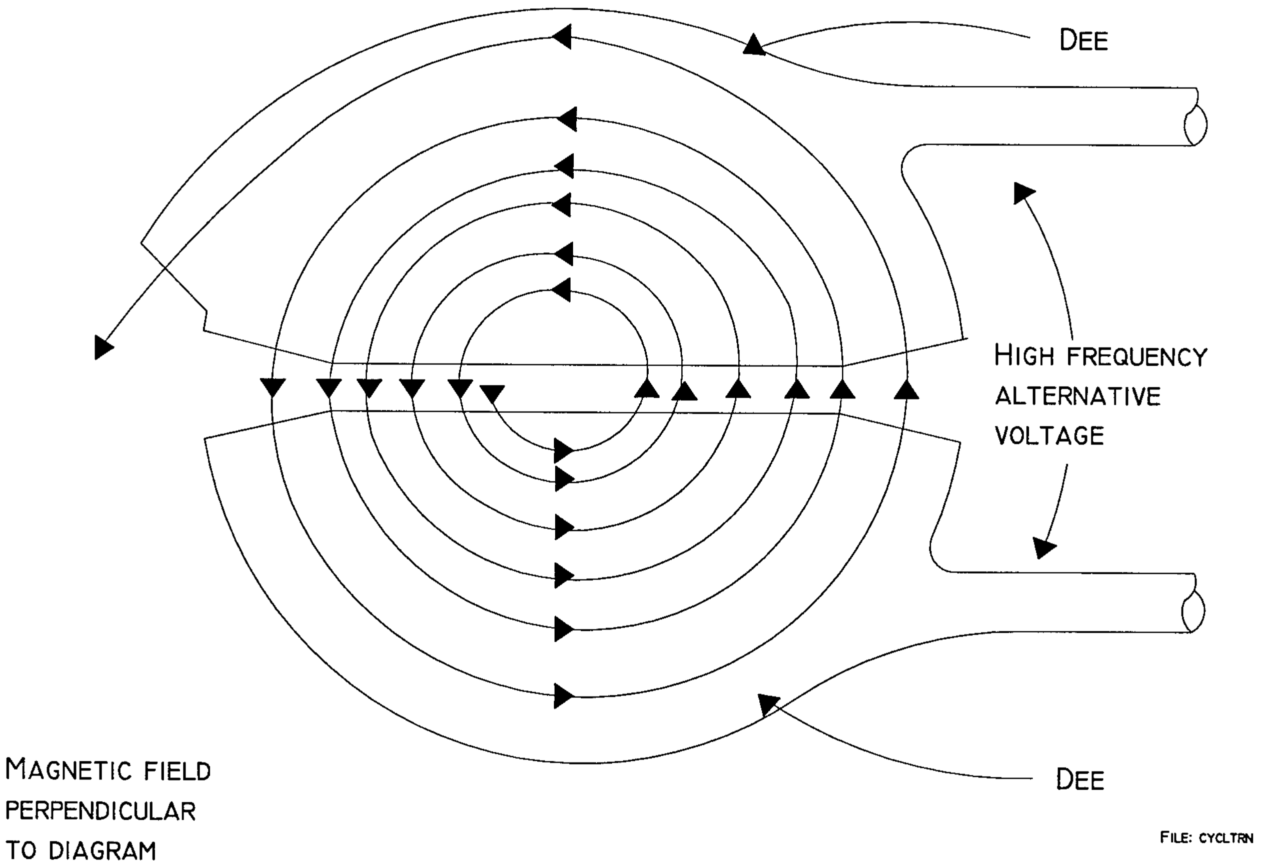

FIGURE 1 Operation of a Cyclotron

III. DESCRIPTION OF THE CYCLOTRON BUILDING

The 60" Cyclotron is housed in Building 211 on two levels. The lower level is shown in Figure 2 along with adjacent rooms. Three rooms on this level are considered part of the characterization, A-020, B-012 and C-001. The only access to C-001 is through C-101 on the main floor. In addition rooms A-004 and A-011 have equipment that are included in the characterization. Figure 3 contains the six main floor rooms that were considered for characterization because they were at one time associated with the cyclotron A-111, A-119, B-102, B-118, B-126 and C-101. The reason for exclusion of any of the rooms from the characterization are also given in the history. There is a 10-ton precision hoist bridge crane in the cyclotron vault. The crane is operational and was last inspected in March 1997. There are three ports between the vault south wall and B-140 north wall; and another three ports between the vault south wall the B-150 north wall. All six holes are plugged with paraffin. Figure 4 contains the roof sections of the cyclotron that are to be included in the characterization.

The description of the cyclotron building given below is taken from "The Argonne 60-inch cyclotron" ANL-5907 and from conversations with personnel who were involved with the cyclotion while it was in operation.

1.0 Design

To house the cyclotron and to provide for its proper and intensive utilization, it was necessary to design and construct a building having many special facilities. Building floor plans were dependent upon machine design, direction of particle rotation, and the contemplated experimental uses of the machine.

The Cyclotron Vault was designed around the major axis of the machine with the walls placed parallel to the axis to simplify building construction. The vault Dee Door was so located to permit the complete withdrawal of the mobile dee assembly to the Dee Repair (A-167) and Dee Storage (A-175) areas. The Machine Shop (A-151) was located adjacent to these areas to facilitate possible machine repair.

The Experimental Tunnel (B-130) location was governed by the position of the external beam, and the Hot Laboratory (B-126) was positioned in close proximity to the target area to facilitate the handling of irradiations. The position of this laboratory determined the location of the chemistry laboratories and experimental areas. To have rapid vault access from the laboratories, the Personnel Vault Access Door was located adjacent to the Hot Laboratory. This door location positioned the Control Room (B-102) so that the accelerator operators could readily enter and visually control the access to the vault.

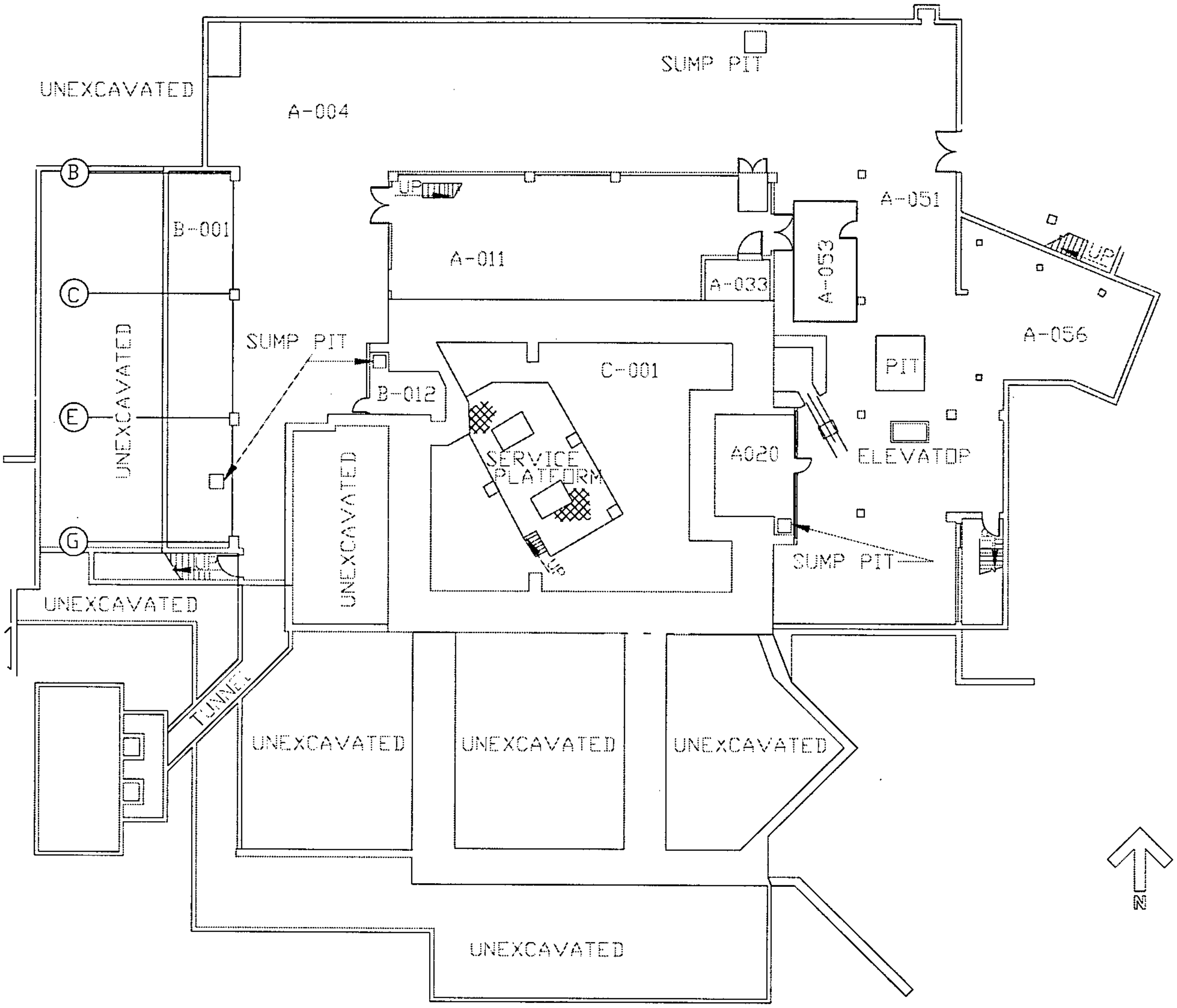

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FIGURE 2 Building 211 Cyclotron Facility; Service Floor

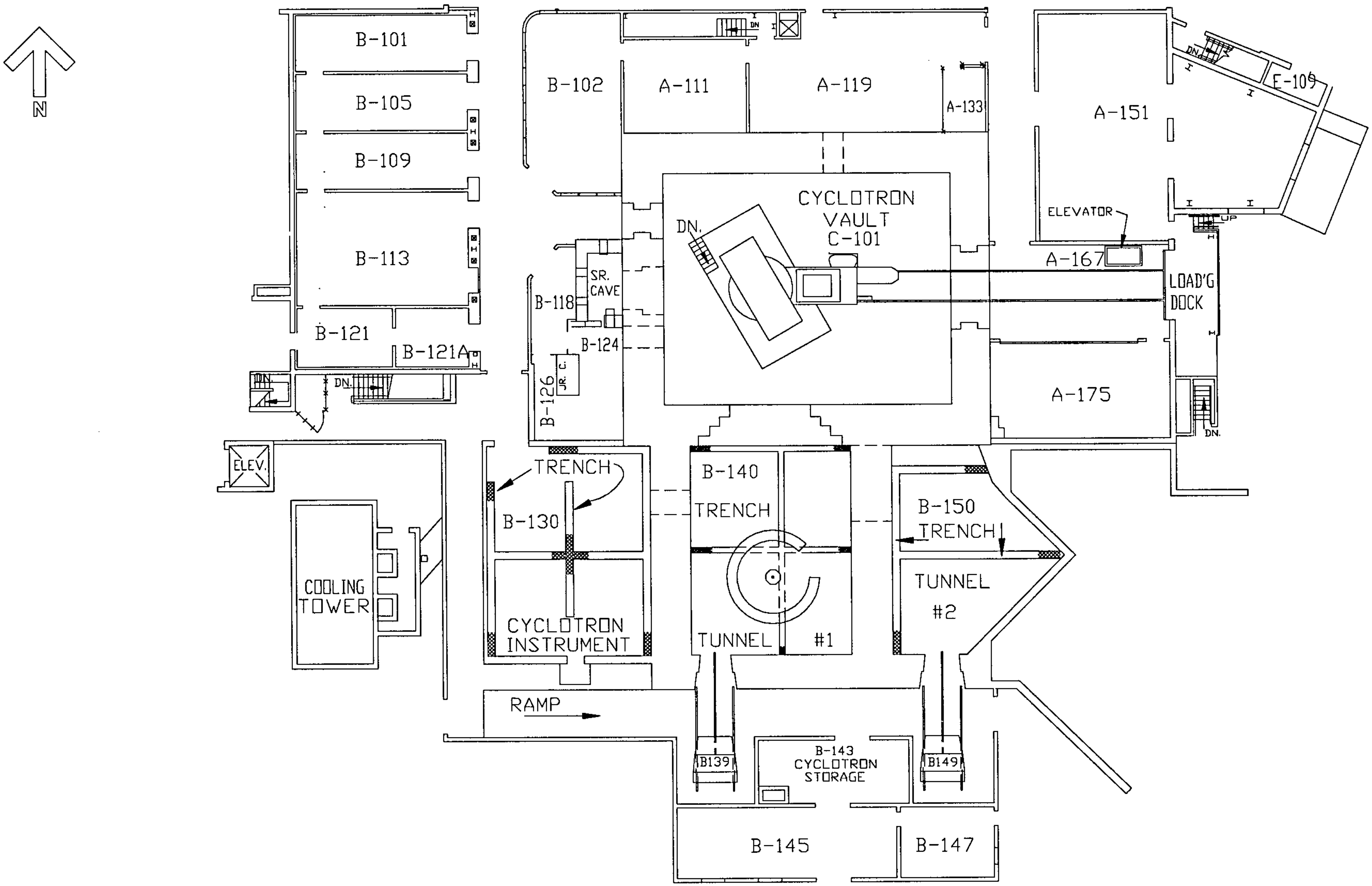

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FIGURE 3 Building 211 Cyclotron Facility; Main Floor

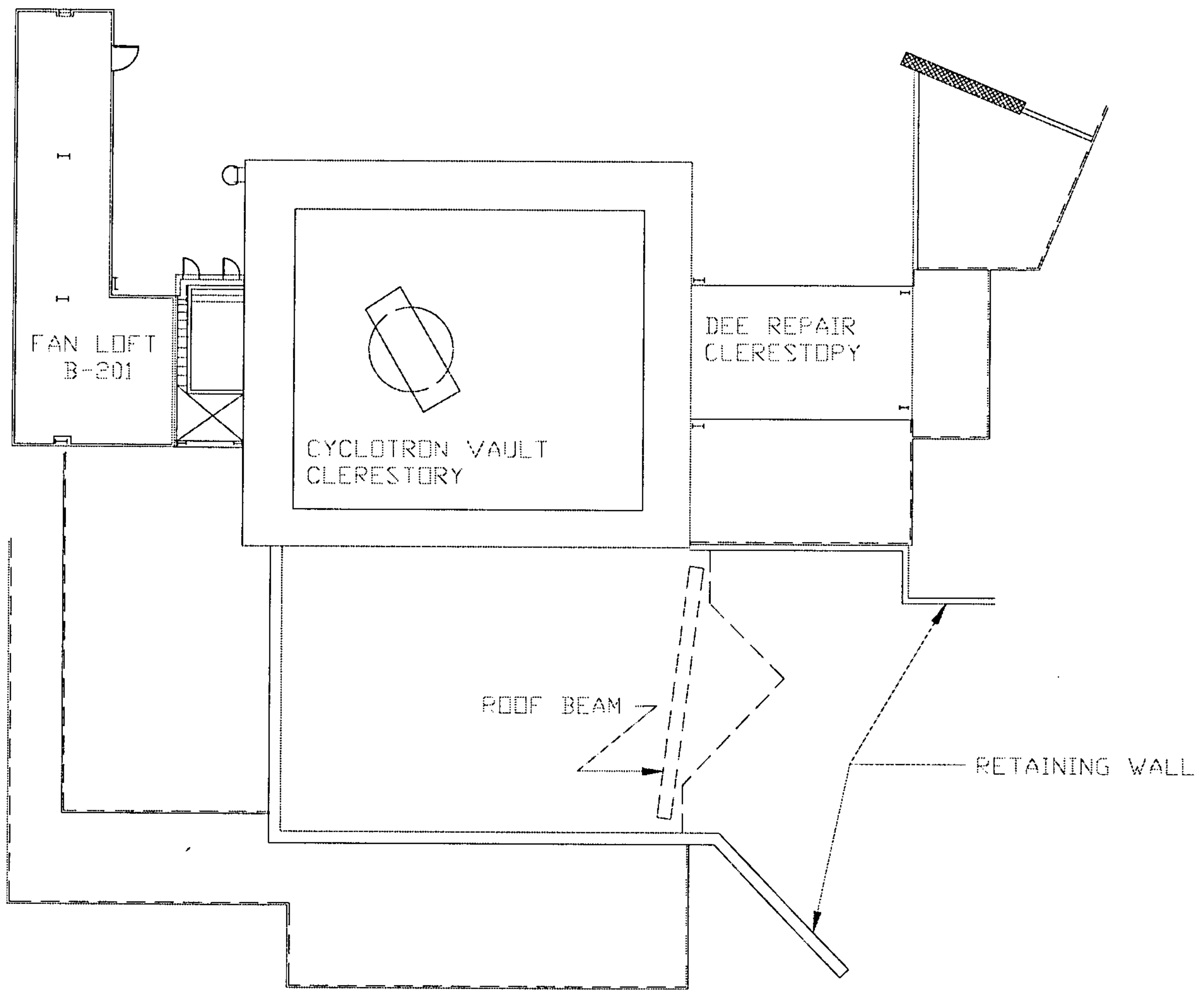

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FIGURE 4 Building 211 Cyclotron Facility; Roof Plan

Installation routes of electrical leads, vacuum lines, etc., to the cyclotron had to be direct, and, insofar as possible, all electrical and mechanical equipment had to be installed external to the vault for ease of routine maintenance and repair. In addition, it was considered essential to have direct access to the electrical and mechanical equipment from the control room. These requirements, coupled with the method of introducing leads to the vault without the use of floor trenches and the consideration of noise and vibration, led to the design of two equipment areas: an Electric Equipment Room (A-111 and A-119) located on the first floor for non–rotating equipment, and a Mechanical Equipment Room (A-011) located directly below on the Service Floor.

The remaining areas of the building were located to effect the most economical utilization of space. The resulting floor plan is as shown in Figure 2 and 3.

2.0 Vault (C-101)

The cyclotron vault is 40 feet by 50 feet, with the axis of the dee assembly parallel to the long dimension and coinciding with the center line of the room. The ceiling height is 28 feet, providing sufficient clearance for a 10-ton precision hoist bridge crane. The vault walls are 7 feet thick, of 150 lb/cu ft concrete, with the foundations designed to carry an additional 3 feet of heavy (300 lb/cu ft) concrete shielding. The roof consists of 4 feet of 150–lb/cu ft concrete, with the structure designed to support an overall thickness of 7 feet. The personnel door, weighing about 38 tons, can be closed in one minute and opened in 30 seconds. The 120–ton Dee Door can be closed in about 5 minutes and opened in 1 minute.

Originally there were two viewing windows, one in the Hot Laboratory to provide for observation of the target area and the internal volume of the acceleration chamber; the second in the electrical equipment room for viewing of the diffusion pumps and the rf oscillator–amplifier which has been blanked off with metal plates. A window consists of two cells, each is filled with a solution and is 3½ feet thick. The cell on the vault side contains water and copper sulfate to eliminate bacterial growth. Zinc bromide in solution with a density of 2.50 gm/cm^3, is the medium of the second cell. The indices of refraction for the water and the zinc bromide units are 1.33 and 1.56, respectively. The overall luminous transmission for each window is about 25% for tungsten light. These windows have been completely free of trouble and have performed excellently in regard to shielding and optical properties. The solutions are not expected to have radioactive contamination.

All service leads to the vault are brought from the Mechanical Equipment Room through sleeves in the 7–foot thick wall. All sleeves are straight–through openings with diameters ranging from 2 to 12 inches. Since the radiation leakage through these sleeves is negligible, shielding material is not used to seal the openings. To distribute the services in the vault, a pattern of floor slots was provided. Such an arrangement permits the connection of equipment without the "vine" effect.

Size	40 × 50 ft, 28 ft high
Shielding	7 ft of 150–lb/cu ft concrete
Doors, two	Hydraulic, vertical life

3.0 Control Room (B-102)

This room contained the control console, relay racks for cyclotron control circuitry, and experimental equipment for cyclotron irradiations. All equipment wiring was through floor slots to raceways located on the ceiling of the room below. The room was air conditioned for both temperature and humidity and is glass enclosed to permit operator control of vault access.

4.0 Electrical Equipment Room (A-111 & A-119)

This area housed the power supplies for the oscillator–amplifier and the ion source. It also contained all of the relays required for control and interlocking. Wiring to the equipment was through floor slots, with raceways located on the ceiling of the room below. This room was not air conditioned, but was ventilated by filtered air.

5.0 Mechanical Equipment Room (A-011)

Here were located the mechanical vacuum pumps, cooling water–circulating system, magnet motor generator set, and an auxiliary air compressor.

6.0 Deflector Vault (A-033)

The deflector fault contained the oil–immersed deflector voltage supply. For safety, this area had a two–hour fire rating and contained a CO_2 fire–extinguishing system. This area was ventilated by filtered air.

7.0 Hot Laboratory (B-118 through B-126)

The Hot Laboratory contains one Senior and one Junior cave. The Junior cave has an inside working area of about 20 × 48 inches with a filtered air intake and a HEPA filtered exhaust. The shielding consists of 3 inches of steel with a 9–inch lime glass viewing window. The unit contains two Model 7 master–slave manipulators.

The Senior cave has an inside working area of 6 × 10 feet with a filtered air intake and a HEPA filtered exhaust. The shielding consists of about 24 inches of ferrophosphorus concrete, having a density of 300 lb/cu ft, with two oil–immersed multiple–layer glass windows. Each window is 24½ x 30½ inches in effective cross–section and 29 inches thick. The target transfer slot, Figure 3, is located in the cave to facilitate the transfer of hot targets from the cyclotron. Four Model 8 master–slave manipulators and a 1–ton bridge crane are provided for material handling. Storage of radioactive materials is accomplished by 6–inch diameter sleeves originally cast in the vault wall.

This room is provided with conditioned air and filtered exhaust.

8.0 Laboratories (B-101 through B-121)

There were originally four laboratories: two radiochemical laboratories (B-105 and B-109 was one and B-113 was the second), one combined dark room–animal room–mechanical laboratory (B121 and B121A), and one counting room (B101). Each radiochemical laboratory had four hoods suitable for handling radioactive materials. All laboratories were provided with conditioned air and have a HEPA filtered exhaust.

9.0 Experimental Tunnel (B-140)

The Experimental Tunnel was an air–conditioned laboratory area about 28 × 36 feet and 12 feet high, into which the cyclotron beam could be directed. The beam entered the room at its vertical center. Floor trenches distributed services throughout the room and these trenches connected directly to the cyclotron vault. An access corridor was provided for movement of equipment and targetry to and from the general laboratory area. Within the room a 3000–pound traveling bridge crane was provided to aid in the movement of equipment. This crane is presently locked out.

Shielding was provided by an earth mound which is 4 feet thick over the ceiling and extends out past the side walls before tapering to the normal ground contour.

IV. DESCRIPTION OF THE 60-INCH CYCLOTRON

The Cyclotron was originally fabricated in 1951. A number of test runs were performed before the acceptance test in July 10, 1952. The septum was replaced in November 1974. Operations ended November 30, 1992. The control room equipment was removed in 1994.

The Cyclotron consists of DEE accelerating cavities between 60 inch diameter iron magnet poles (see Figure 5). The magnet yoke is machined from a single piece of iron (265 tons). There is

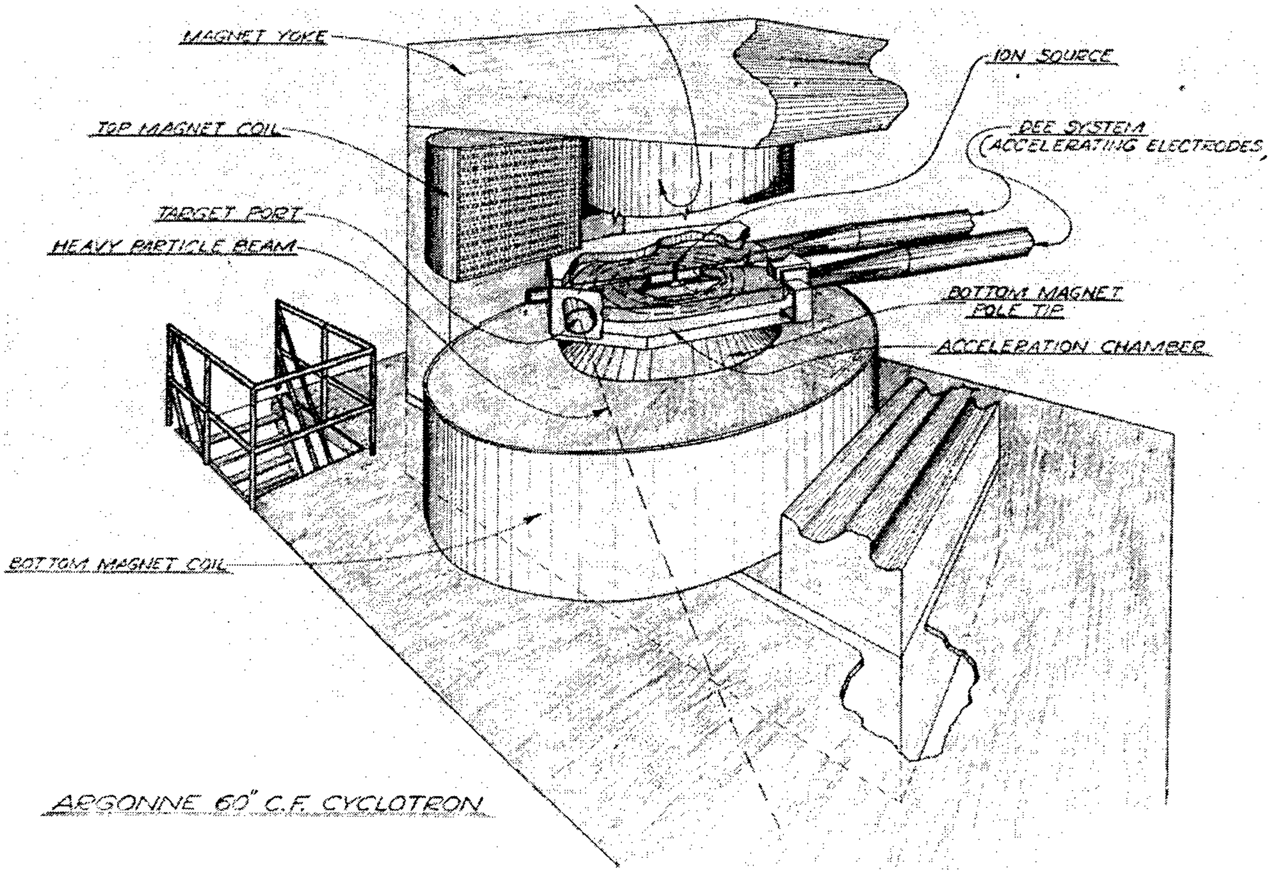

FIGURE 5 Sketch of the Yoke, Magnet, Accelerating Chamber, and Dees

a magnet coil around each pole. The magnet coils are made of hollow aluminum with a square cross section for circulation of cooling water. Each coil weighs 12.87 ton. The magnets were installed while the building was being built. The structure inside the machine contains ~800 lb of copper. The accelerating cavities are evacuated by two 16 inch oil diffusion pumps. The foreline before the diffusion pumps is evacuated by a mechanical pump and a turbo molecular pump. The foreline can be isolated from the diffusion pumps, or it can be used in line with the diffusion pumps. The ion source is a gas discharge into a graphite chimney.

The 60" Cyclotron was a fixed frequency machine capable of accelerating beams of singly charged hydrogen molecules, deuterons, ^{3}He, and ^{4}He ions to 11, 21, 34 MeV, and 45 MeV, respectively. The early work encompassed the fields of heavy element chemistry, nuclear activation studies, nuclear scattering, solid state physics, radiation chemistry, isotope production and biological studies (ANL-5907). The Nuclear Medicine Group (NMG) was a significant later user of this facility. Their major use of the cyclotron was for the production of ^{211}At by the ^{209}Bi (α, 2n) reaction. In addition, the NMG also produced ^{18}F, ^{44}Sc, ^{46}Sc, ^{47}Sc, ^{47}Ca, ^{64}Cu, ^{62}Zn, ^{114}In, ^{205}Bi and ^{206}Bi. Other users were the Physics Division (^{56}Co and ^{178}Hf), and Oak Ridge National Laboratory (^{237}Pu).

The discussion that follows will be sectionalized according to the operating systems. The information is taken from ANL–5907 and from discussions with personnel who were involved with the operation of the cyclotron. A summary of magnet characteristics and power supplies of all beam-transport systems is provided in Table 1.

1.0 Cooling

Liquid cooling of the operating system was obtained by circulation of demineralized water through the cyclotron and, in turn, through the tube-and-shell heat exchanger of which the shell side was connected to an outside cooling tower. The cooling tower was contaminated at one time because of a leak in the heat exchanger. The circulation pumps and heat exchanger were sized to handle a 1000–kw heat load, with the normal operating load being about 300 kw. The cooling tower design was also based upon a heat load of 1000 kw and was such that a 10 °F water temperature differential could be obtained for a 78 ° wet bulb with a 1200-gpm flow rate through the tower. The coolant flow rate was normally 300 gpm at 80 psi. The conductivity was maintained at 10 μmhos or less, with a pH of about seven. Dee system water temperature stability of 1 °F or better was required for steady operation.

TABLE 1 Characteristics of Beam-Transport and Analyzing-System Magnet

	Analyzing Magnets, AM-A and AM-B	Switching Magnet, SM-1	Switching Magnet, SM-2	4-in.-long Quadrupole Sets	8-in.-long Quadrupole Sets	Steering Coils, SC
No. Required	2	1	1	5	2	3
Type	Double focus 120° sector Edge angle 41.7°C-type yoke	H frame Circular pole	H frame Circular pole	Hyperbolic Pole tip	Hyperbolic Pole tip	Special
Manufacturer	Spectromagnetic Industries, Inc.	Pacific Electric Co.	Pacific Electric Co.	ANL	ANL	ANL
Weight, lb	25,000 (17,000 lb ASA-1010 Steel)	4,350	7,270	225	420	53
Pole Dimensions	13.5 in. wide, 39.86-in. radius, 120° bending angle	12-in. diam	12-in. diam	4 in.	8 in.	9 in.
Pole Gap	1.758 in.	1¾ in.	2½ in.	2-in. bore	2-in. bore	2-in. bore
Dimension of Effective Field	Radial width = 4 in. (where n = 0)	14.22-in. (11.6 kG) diam	15.75-in. (17.3 kG) diam	4.9 in. length	9.2-in. length	11.2-in. length
Symbol Designation	AM-A AM-B	SM-1	SM-2	Q-5-6, 7-8, 9-10, 11-12, 13-14, 17-18, 19-20	Q-1-2, 3-4, 15-16	SC-1, -2, -3, and -4

2.0 Vacuum

The physical dimensions and types of materials used were governed both by the rf system and vacuum techniques. The main vacuum system consists of 6 basic parts: the mechanical pumps, diffusion pumps, vacuum take-off box (VTO), "obround," transition section, and acceleration chamber. The transition section and acceleration chamber are mounted in a fixed position; the VTO box and obround are mounted on a motor-driven carriage which operates on a rail system. This permitted the removal of the dee heads from the acceleration chamber and transition section to facilitate maintenance or modification of the dees, deflector system, or ion-source extraction feelers. Mechanical alignment of the system was maintained by the use of one grooved rail and matching tongue on the carriage wheels.

The mechanical vacuum pumps, with capacities of 100 cfm and 300 cfm, were originally located in the mechanical equipment room to minimize the noise in the cyclotron area. The 300–cfm pump was used for the roughing of the tank, and the 100–cfm pump was used for the backing of the diffusion pumps. During normal operation, both units were used for backing. Two 6-inch diameter lines connected these pumps to the forvac manifold of the two diffusion pumps located in the vault.

The two 16–inch oil diffusion pumps were built as a packaged unit, with each pump having remotely air–operated forvac and hivac valves. These pumps are close–coupled to the vacuum tank and have common connections at both the hivac and forvac manifolds. The entire assembly is mounted on wheels, allowing the pumps to be rolled away from the main tank for maintenance or repair purposes.

The diffusion pump baffles, located between the pumps and the 16–inch valves, were cooled by Freon 22 and operated at approximately –30°F. In addition, the manifold section has a removable cold trap for liquid N_2. This trap was never used during routine operations.

The pump manifold connects to the VTO box, which is of welded steel construction (47 x 88½ x 57½ inches) with internal bracing to withstand atmospheric pressure. Seam welds are continuous, with welding only on the atmospheric side. The internal braces are stagger welded to keep virtual leaks at a minimum. The VTO box contains the gimbal mountings for the cantilever suspension of the dee stems.

The obround is a 66-inch long unit with a cross section that is essentially two half-cylinders of 20-inch radius separated and connected by flat parallel sides, 37½ inches in length. This unit is constructed of ¼-inch thick oxygen-free high conductivity (OFHC) copper, rolled into the proper shape with the seams welded with a shielded arc using "Everdur" as a filler rod. A steel framework is welded to the external side of the copper for support of the tank when evacuated. Cooling of this shield was obtained with several loops of ⅜-inch tubing, soft soldered to the copper. On the top of the obround, five pairs of holes were provided for rf power feed-thru to the dee system.

The transition section is 47 inches long and, by means of a taper, makes the transition from the cross section of the obround to the rectangular cross section of the acceleration chamber. The method of construction is similar to the obround and, since the position of this section is in the magnetic field, the framework and flanges are of nonmagnetic type 347 stainless steel.

The acceleration chamber is a composite unit with the basic structure of special 16-14 chrome nickel nonmagnetic stainless steel. The top and bottom portion is a circular opening, 60 inches in diameter, and sealed with discs (lids) of magnet steel to shorten the magnet pole gap. The vertical sides are closed by the transition section, the dee trimmer condenser, the target gate and closure plate, the arc source and the linear water tube closure plate. The inside is lined with water-cooled copper liners to complete the rf shielding circuit.

The total volume of the vacuum system is ~300 cubic feet. Normal operating pressures were 2 to 9×10^{-6} mm Hg, with the upper value limited by the operation of the rf system.

In July 1957, after 6 years of operation, it was required to remove the dees from the acceleration chamber, thereby requiring the breaking of the obround-transition seal. The seal did not show any evidence of heating and was re-used in the closing of the chamber. The operation that followed was quite normal.

3.0 Magnet

The electromagnet, 265 tons in weight, is of a standard "double yoke" design, 206 inches long, 164 inches high, and 74⅜ inches wide. The diameter of the pole base is 74⅜ inches and the diameter of the pole face is 62 inches. The pole gap is twenty-two inches, and, for any given radius, the gap variation is less than 0.005 inch. The 22-inch air gap, excluding shimming, is reduced to 12 inches by the 5-inch thick, 60-inch diameter, top and bottom lids of the acceleration chamber (see Figure 6). This 12-inch dimension is made up of the two 1-inch gaps between the lids and pole faces, and the 10-inch spacing for the acceleration chamber. Upon installation of Rose rings and rf liners the acceleration chamber gap is reduced to 9 inches.

Magnetic shimming consists of internal Rose rings and external stepped shims. The internal rings are fastened to both the top and bottom lids and are radially located at 26 inches and extend outward to 30 inches. The rings are ¼ inch thick and 2 inches wide. External top and bottom shimming consists of a pyramid of twelve discs, each 1/16 inch thick and of the following radii: 2 of 20 inches; 2 of 16 inches; 2 of 10 inches; 2 of 6 inches; 2 of 4 inches; and 2 of 3 inches. The largest disc is located in contact with the lid.

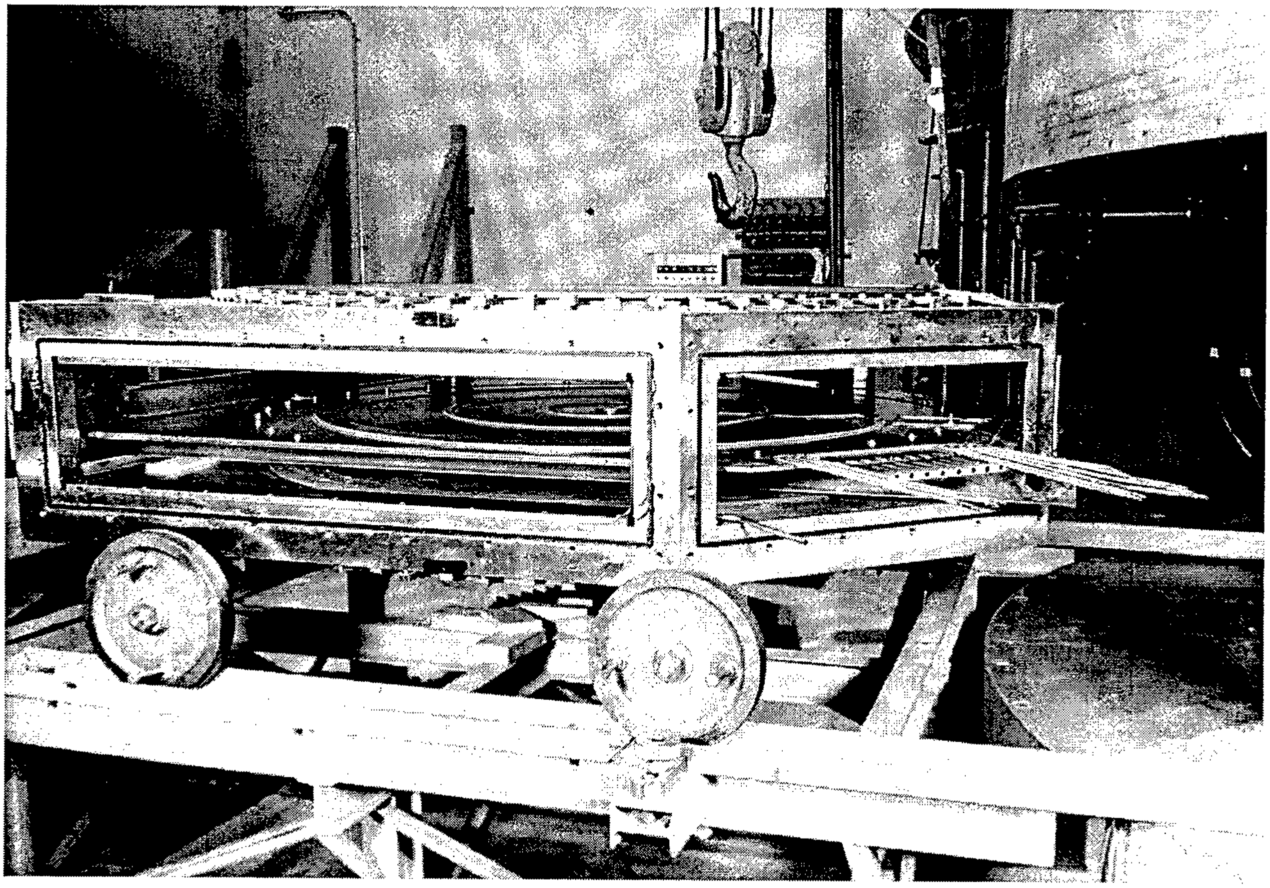

FIGURE 6 Acceleration Chamber Containing Rf Liner

The magnet yoke, poles and tips, acceleration chamber lids, and shims are of soft iron forgings with the impurity analysis as follows:

Carbon	0.12%	Sulphur	0.024%
Silicon	0.17%	Manganese	0.39%
Phosphorus	0.014%		

The two magnet coils, totaling 26 tons in weight, are of extruded 1S aluminum strap, 2⅞ × ½ inches, with a hollow core of ¼ × 1 inch through which passes the water coolant. Each coil consists of 10 pancakes (see Figure 7), approximately 55 turns per pancake, or a total of 1099 turns for both coils. Each pancake consists of one continuous length of conductor, 1550 feet long. Insulation between turns consists of 2 layers of 0.005-inch fish paper impregnated with red Glyptal. The insulation between pancakes consists of 2 layers of Bakelite and Glyptal, each layer 1/32 inch thick. All windings are connected in series by uncooled aluminum strap, heli-arc welded to the conductors. The coils are electrically connected in series, with all hydraulic connections in parallel. The total resistance of both coils is about 0.3 ohm. For mechanical stability protection, the coil

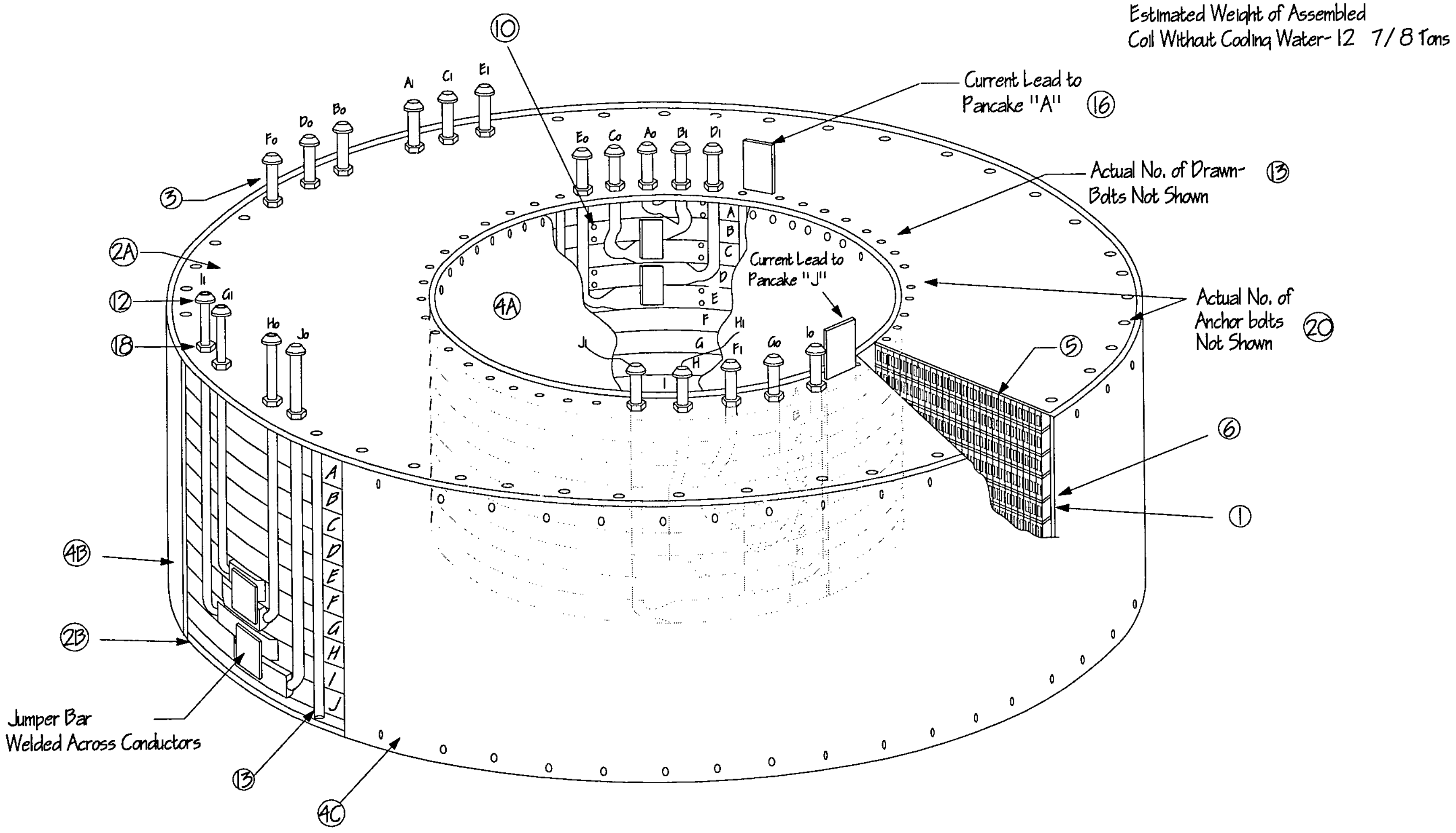

FIGURE 7 Building 211 Cyclotron Magnet Coil

windings are solidly clamped between two annular 1½–inch thick aluminum end plates. The overall dimensions of a complete coil are: OD = 142 inches, ID = 74⅞ inches, and height of 32½ inches.

Weight	265 tons
Magnet pole tip diameter	62 inches
Lids, acceleration chamber, diameter	60 inches
Magnet pole gap	22 inches
Lids, acceleration chamber, thickness	5 inches
Shimming gap, two external	each 1 inch
Gap inside vacuum	10 inches
Effective gap	9 inches
Magnet field, center	14.9 kgauss
Magnet coils, 2	1099 total turns

4.0 Trim Coils

Three coils were required per pole with mean radii of 5.95 (2 turns), 14.55 (3 turns) and 24.70 in. (12 turns). All coils conductors were nominally 3/16 in. square (extruded by Anaconda American Brass Co.) without insulation and had an internal hole diameter of ⅛ in. Insulation was applied by the Anaconda Wire & Cable Co. and consisted of 0.013 in. thick double Silotex Dacron, thus increasing the overall conductor size to 0.200 in.

The outer coil was connected in three portions, a design necessitated by the excessive coolant pressure required for a single continuous coil. These three coil segments were parallel connected for cooling and series connected for power. The other two trim coils were continuous in construction and each had a single cooling loop.

Photographs of a completed liner are given by Figures 8 and 9.

5.0 Arc

The ion source is a conventional DC-type hooded arc, consisting of a ⅛-inch tantalum hairpin filament and a graphite chimney, 5/16 of an inch in diameter with an aperture size of 3/32 × 7/32 of an inch in length. Compressed gas cylinders provide the molecules for the gas discharge. The filament is heated by a 300-400 amp DC supply on top of the main magnet for filament and a typical deuteron arc is maintained at 50 to 120 volts DC, 6 to 8 amperes drain, with a gas flow rate of about 0.1 cc/min.

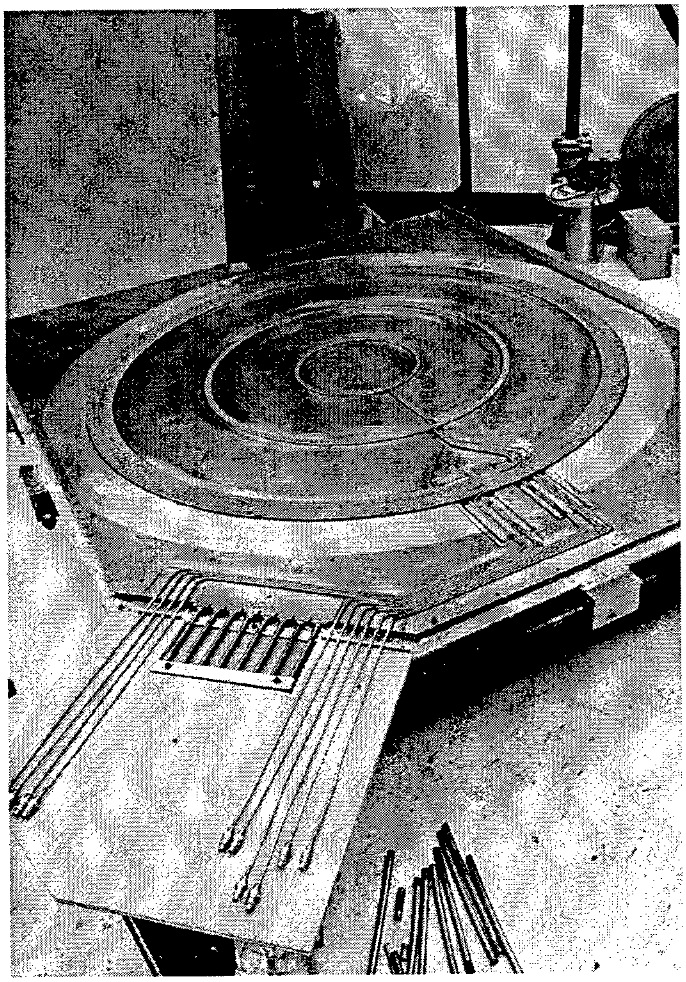

FIGURE 8 Linear-Trim Coil Assembly

6.0 Radio frequency System

The energy imparted to the extracted ions is obtained from the rf system, consisting of the dees and stems, dee shielding, shorting bar, oscillator-power amplifier and the DC power supply. The rf electrodes constitute a conventional twin dee unbiased system with both dee stems mounted in a common evacuated tank.

The dees are 4 inches in height with a 2¾-inch internal depth and a 2½-inch vertical entrance gap. Dee heads have a 12-inch parallel section at the center with an edge flareback of approximately 10°. The vertical spacing between the OFHC copper liners of the acceleration chamber is 9 inches, leaving 2½ inches from each dee surface to ground. The effective capacitance of each dee to ground is about 280 µµf and is dependent upon dee and trimmer plate positions. For each dee, the trimmer condenser plates provide approximately a 25-µµf variation in capacitance. The dees and stems are of ¼ inch thick OFHC copper fabricated from a 12-inch OD, ¼-inch thick tube. Such fabrication resulted in a dee and stem of continuous copper except for the top and bottom lip

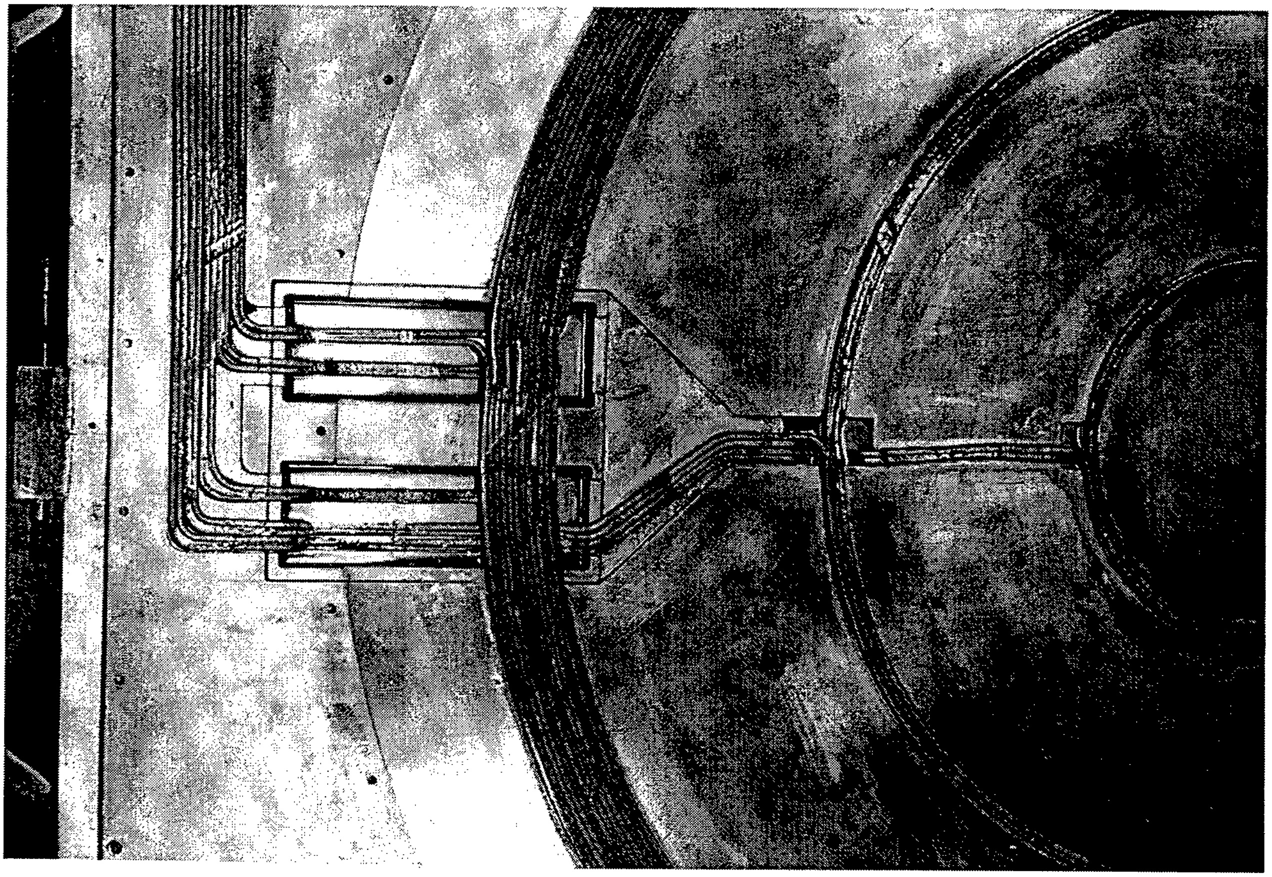

FIGURE 9 Trim-Coil Crossovers and Leads

area of the dee. For this region, OFHC copper was copper welded to the main assembly to give the required shape. Both dees are extensively water cooled with all copper tubing continuously Sil-fos soldered to the interior surfaces. Each dee and stem is mounted on a nickel-plated carbon steel tube that extends from well inside the dee stem to the outside of the VTO box and passes through a stainless steel bellows which acts as a flexible vacuum seal. This tube is supported in a gimbal inside the VTO box, permitting remote control of the dee position in both the horizontal and vertical planes, by means of motor drives located outside of the vacuum.

Dee system	Twin
Dee height	4 inches
Internal dee height, with water tubing	2¾ inches
Dee entrance gap	2½ inches
Dee distance to ground plane	2½ inches

7.0 Deflector

The deflector system is a means of diverting the accelerated ions from their normal orbits of rotation. The Argonne system is a customary internal unit, located in the dee opposite to the ion extraction dee, and consists of two curved OFHC copper planes between which a DC electrostatic field is established to direct the accelerated particles to the exterior of the machine. The two curved planes (Figure 10) are customarily referred to as the septum and deflector.

The septum is mounted between the deflector and the cyclotron center. The septum unit consists of the septum proper and the entrance portion, called the beam splitter. The septum proper is constructed of copper 3¼ wide, ⅜ inches thick, and is water cooled. The beam splitter, 10 inches long, consists of two 0.062–inch thick copper plates with a cooling water line hard soldered to each plate. The plates are so shaped to form a horizontal V notch centered on the median plane. The notch extends the length of the splitter and is about one inch wide at the splitter entrance, tapering to about 1/16 inch at the other end. Both splitter sections are readily removable and are so constructed that they plug into the cooling water lines. This type of unit has been in service for many thousands of hours of operation with negligible maintenance.

The deflector is a hollow copper tube, obround in section, 1¼ inches high, ⅝ inch wide, with a wall thickness of 0.049 inch, and is closed at the end adjacent to the exit of the deflector channel. Cooling is obtained by passing water down a tube positioned in the center of the deflector with the return water forming a cooling sheet on the internal periphery of the unit. The deflector is connected to the deflector stem by means of an "O" ring plug–in technique. Access to the deflector is obtained by removing the dee trimmer box and unbolting a section of the dee side, thereby enabling one to remove or service the unit without pulling the dees from the acceleration chamber.

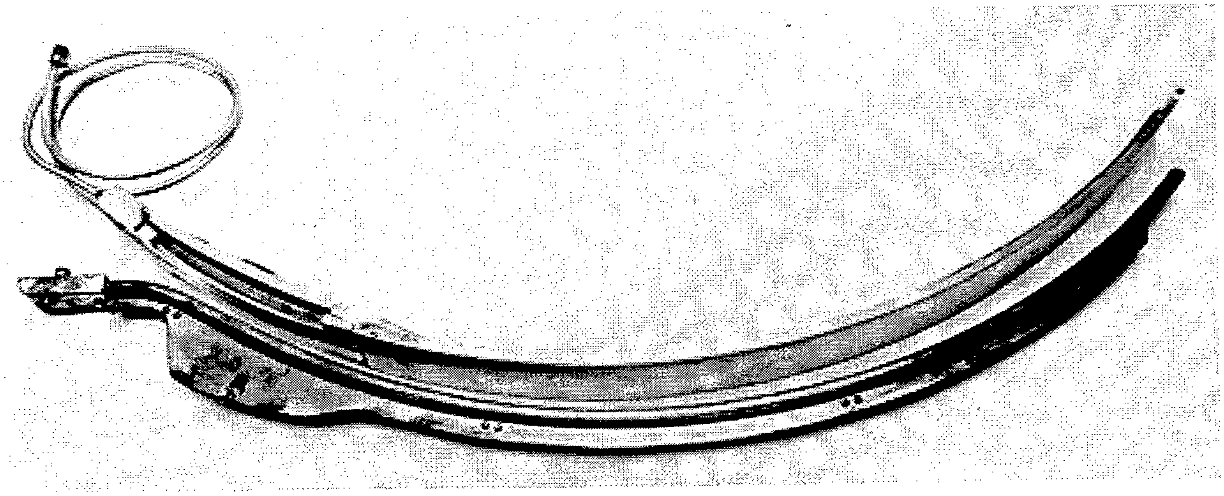

FIGURE 10 Deflector System Showing the Septum and the Deflector

The deflector stem is of type 304 stainless steel, coaxially extending back into the dee stem where it is supported at its midpoint by a porcelain insulator. The deflector stem leaves the vacuum chamber through a stand–off insulator and metal bellows.

The deflector and septum are each approximately forty–seven inches in length, and their shape is that of a circular arc with a radius of curvature of 30 inches. The entrance to the deflector system, nominal ¼–inch width, is located approximately 50°CCW* from the center line of the dee system and is at a radius of about 25¾ inches; the exit, ⅝ inch wide, is at a radius of 30.5 inches, 145°CCW. With the application of a negative 75–kv DC potential to the deflector, the orbital radius of the particles increases 17.5%, thereby enabling the particle to escape to the external target area.

8.0 Beam Line

The diversity of machine operation was increased by an external strong focusing system (see Figure 11). A maximum of 20% of the total deflected beam was accepted and focused by this system. The cross section of the accepted beam was about 5 cm horizontally and 2 cm vertically. The horizontal particle divergence was about 2 degrees from inner to outer edge, and the vertical divergence was about 0.2 degree from top to bottom. Using one magnet set, the beam could be readily focused into an area of 0.1 cm^2, i.e., a particle density of 400 μamp/cm^2 for a total deflected deuteron beam of 200 μamp. If the two quadrupole sets were close coupled, focal spots of 0.02 cm^2 were obtainable. For a total deflected helium ion current of 60 μamp, 6 to 8 μamp could be consistently focused through an aperture of 1 × 2–mm cross section.

This focusing system also enabled one to obtain about 12 to 15% of the total deflected beam in the experimental tunnel, about 30 feet from the cyclotron. The 60–inch nuclear scattering chamber was located in this area, and deuteron currents of 1 μamp (70 μamp total deflected) had been successfully focused into the chamber through a collimating system consisting of two 3–mm diameter apertures, spaced one meter apart.

The external beam focusing system was expanded to increase machine efficiency, flexibility, and experimental endeavor. The new switching magnet provided a total ±25–degree beam orientation about the zero angle beam. Two additional beam ports were installed in the experimental tunnel for a total of three irradiation stations in this area. The physical layout of the system is given in Figure 11. A "squeeze" coil magnet is shown in Figure 11.

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*As viewed by looking down on the acceleration chamber.

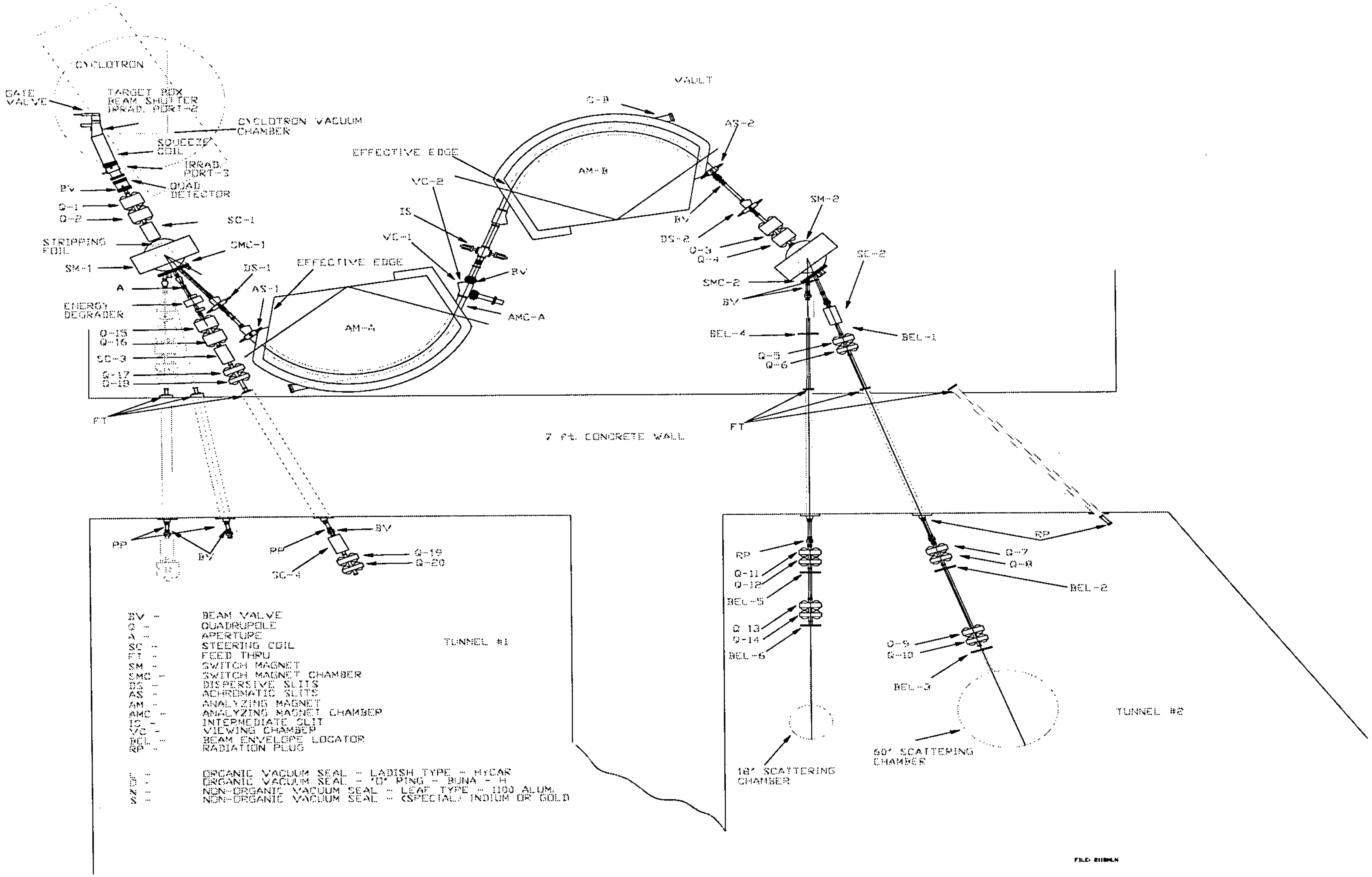

FIGURE 11 Building 211 Cyclotron Beam Line

horizontal particle divergence was about 2 degrees from inner to outer edge, and the vertical divergence was about 0.2 degree from top to bottom. Using one magnet set, the beam could be readily focused into an area of 0.1 cm^2, i.e., a particle density of 400 μamp/cm^2 for a total deflected deuteron beam of 200 μamp. If the two quadrupole sets were close coupled, focal spots of 0.02 cm^2 were obtainable. For a total deflected helium ion current of 60 μamp, 6 to 8 μamp could be consistently focused through an aperture of 1 × 2–mm cross section.

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An energy degradation system, a foil absorber remotely controlled, was installed with the strong focusing quadrupoles to degrade the energy of the primary beam by a factor of 4. Energy-bunching techniques were considered to reduce the energy straggling to a few tenths of one percent, with particle number remaining constant.

Focused beam channeling or positioning is accomplished by a cylindrical–type steering magnet that provides both uniform vertical and horizontal field components. The aperture of the unit is 1⅞ inches in diameter, with the beam entering on the axis of the system. Deflection fields were established by excitation coils located in the radial type winding slot of the core.

Figure 12 shows the arrangement of the beam-transport and energy analyzing system.

This overall system served several functions. First, the extracted projectiles entered the cyclotron's target box, which could be at tank vacuum, isolated and evacuated, or pressurized. This chamber served as an isotope production station, and two target ports were provided. If the required irradiation required sophistication in regard to energy measurements, particle uniformity, particle density, etc., the beam was then allowed to pass through into the beam-transport system. Greater beam concentration was accomplished by the squeeze coil (see Figure 13) which was essentially a device that changed the "n" value of the cyclotron's fringing field and provided only radial focusing. [Such a device enabled 50% of the total extracted beam to be focused onto a 1-cm-diam target at the downstream side of the switch magnet (SM-1).] Vacuum isolation was provided by a 4-in., automatically operated valve (BV). The beam then entered a 1⅞-in.-ID (2-in.-OD) tube, and

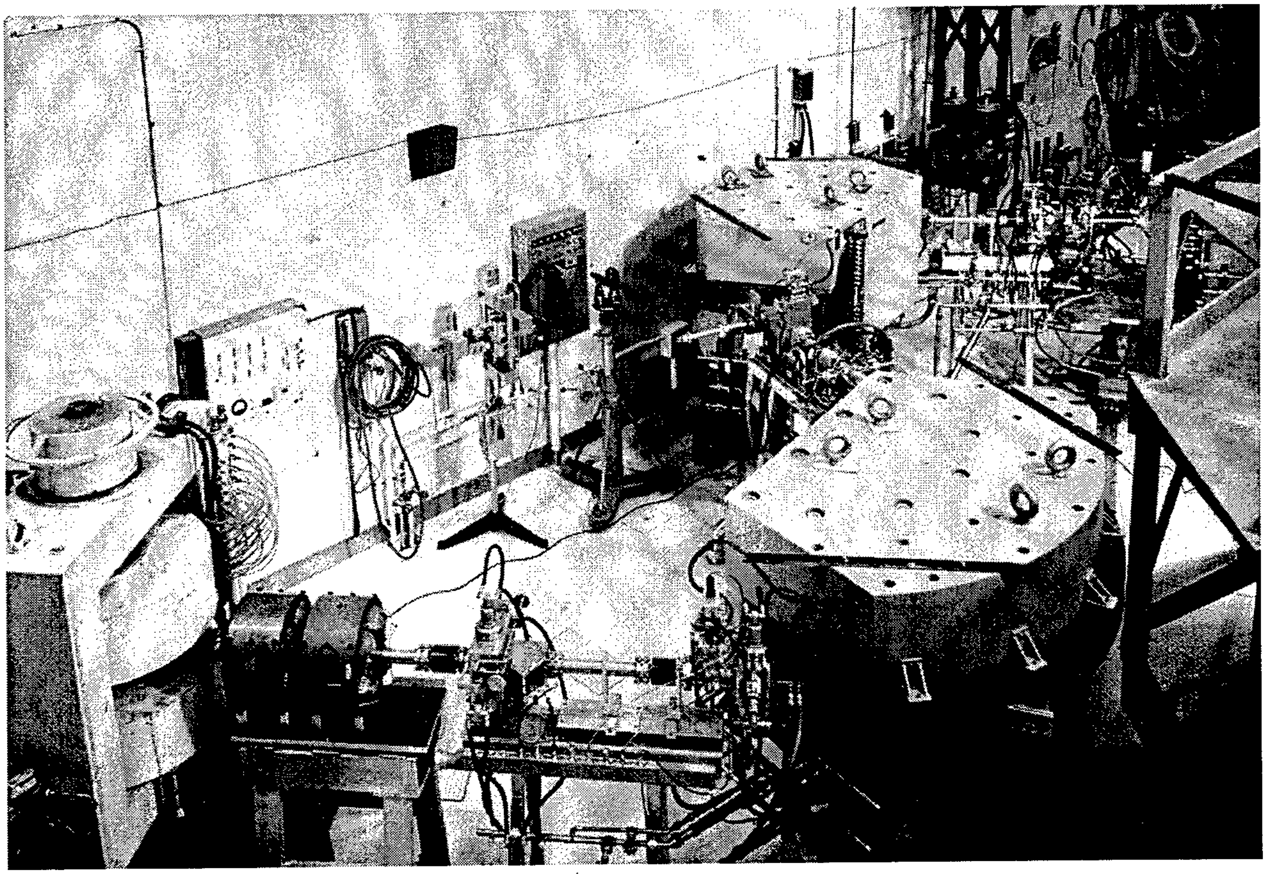


FIGURE 12 View of Analyzing Magnets AM-A and AM-B, and Switch Magnet SM-2

additional focusing was accomplished by the quadrupole doublet (Q-1 and Q-2). Each quadrupole had a bore of 2 in. and a length of 8 in., the separation between quadrupole centers being 12 in. This doublet provided a focal length of 30 in. and an intense beam concentration, such as 500 μA/cm^2, at the stripping foil port. Vertical and horizontal beam positioning was provided by the steering coil (SC-1). The downstream direction of the beam was governed by a 12-in.-diam circular switch magnet (SM-1). It could deflect the beam not at all, to the right (15 and 25°) for irradiations in the cyclotron vault or in experimental tunnel No. 1, or to the left (15 and 30°) so that the particles entered the new energy-analyzing system for use in experimental tunnel No. 2. This latter arrangement is discussed below.

The quadrupole doublet (Q-1 and Q-2), steering coil (SC-1), and switch magnet (SM-1) were necessary to the operation of the analyzing system. About 15% of the extracted beam, without squeeze coil, was accepted by this doublet and focused onto either the dispersive (DS-1) or achromatic slit (AS-1). The steering coil (SC-1) served as a supplementary means of directing the beam into the correct vertical and horizontal position for entrance into the first analyzing magnet. The dispersive and achromatic slits were approximately 48.9 and 11.1 in. upstream, respectively,

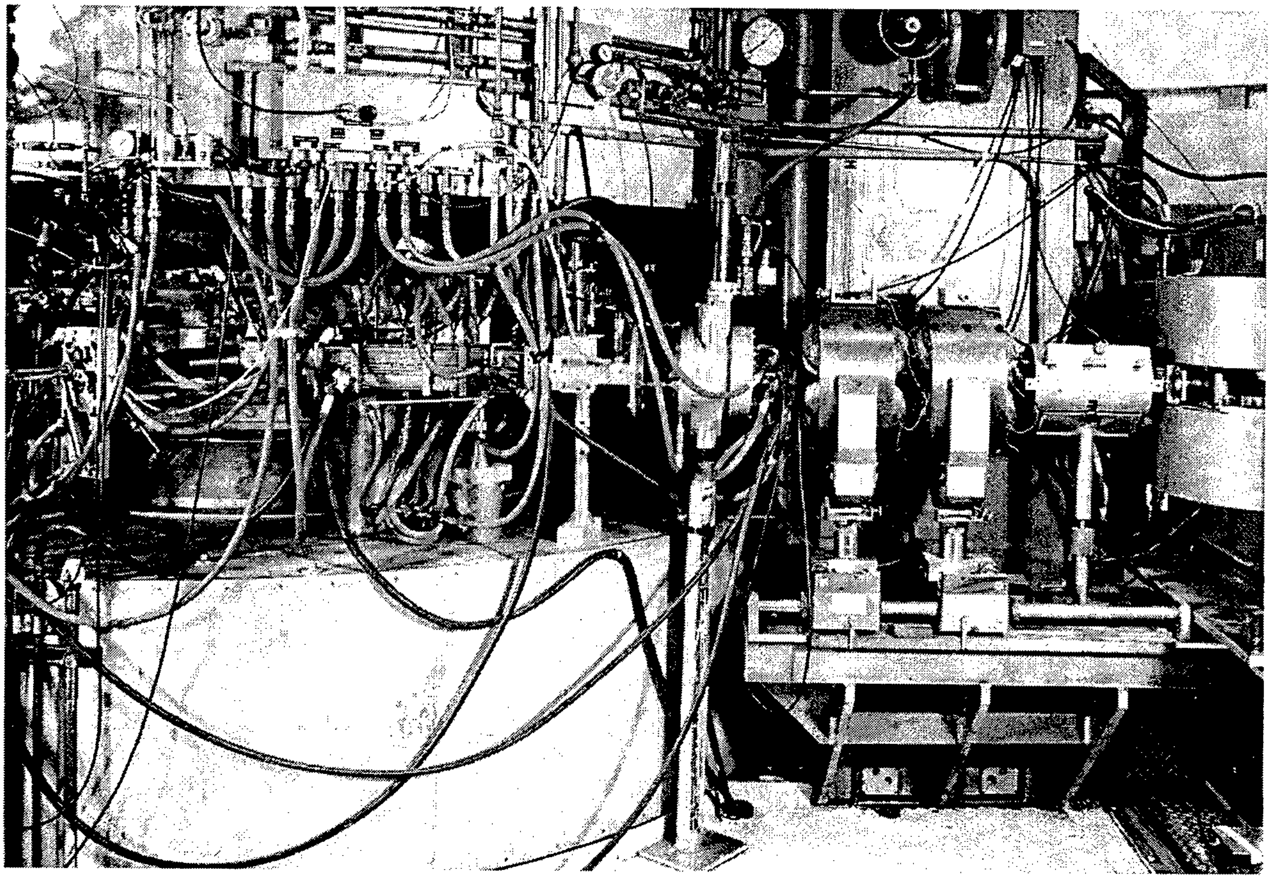


FIGURE 13 Squeeze Coil, Beam Valve, Quadrupole Doublet (Q1 and Q2) and Steering Coil (SC-1)

from the iron edge of this magnet. An arrangement of metal bellows was included on both the up- and downstream side of the dispersive slit to facilitate axial movements of about ±1¾ in. for maximizing the analyzing system. The analyzing magnet (AM-A) accepted the ions (inside chamber width = 4 in.; inside height = 1.438 in.), bent them 120°, and (in the dispersive mode) focused them to an image midway between the two magnets. (A 2⅞-in.-ID tube was used in the region between magnets.) An intermediate slit located at this spot served as both a catcher of unwanted particles and a beam-position monitor. This image then served as an object for the second magnet in which the particles were again bent 120° but in the opposite direction. A second image then occurred at either the dispersive or achromatic slits, depending upon the mode of operations. A quadrupole doublet (Q-3 and Q-4) contained the beam for the focusing by the downstream doublets. After the achromatic slit (AS-2), the beam tube was again 1⅞-in. ID, and this size was maintained throughout the rest of the system.

The direction of the beam into tunnel No. 2 was governed by the second switch magnet (SM-2), which had a 12-in.-diam circular pole. A total deflection of 40° was provided. The beam passed through the 7-ft concrete shielding wall by means of an evacuated tube (1⅞-in. ID), which in turn was mounted in a 6-in.-ID water-filled tube (FT). The ends of the beam tube were supported by movable end plates which permitted vertical and horizontal adjustments for alignment. When work had to be done in the experimental tunnel with the cyclotron operating, internal shielding plugs (RP) were remotely controlled and inserted into the wall beam tube without interrupting the vacuum. These plugs consisted of water-filled bellows, which could be withdrawn into a Y branch of the beam tube for beam passage.

Four beam lines were provided — 0, 10, 25, and 40°. The 25 and 40° lines were routinely used; the 10° line was reserved for the "short-term" type experimenter; the 0° part was provided for alignment purposes as well as beam-energy checks using the foil degrader. When the 40° port was used, the switch magnet provided sufficient vertical and radial focusing so that quadrupoles were not required in the region between the switch and the vault wall. In this line, a steering coil (SC-2) provided radial and vertical adjustments in the beam's position. The 10 and 25° ports both required a steering coil and a quadrupole doublet between the switch and the wall.

In the tunnel, two additional quadrupole doublets were used in each beam line (Figure 14). The upstream doublet (Q-7 and Q-8) maintained a somewhat parallel beam until the final doublet (Q-9 and Q-10) focused the beam into a 3- to 4-mm spot. Beam envelope locators (BEL) facilitated the initial tuning of the accelerator and the transport system, and assisted in monitoring the position of the beam throughout the irradiation.

Controls for all components were centrally located in the control room of the cyclotron, thereby enabling the operators to adjust and maximize the operation of the overall system. Closed-circuit television was used to view beam patterns at the slits or at target positions. When possible, optical viewing was preferred, and the image was projected into the control room by an arrangement of mirrors and water ports in the shielding wall.

8.1 Dispersive Slits (DS)

Each dispersive-slit assembly contained two horizontal and two vertical water-cooled, 5/16-in.-thick jaws, their front sides separated by a distance of about 7/16 in. Slits were constructed of copper with a gold plating of 0.020 in.

The slit housing and numerous components were constructed of Type 310 stainless steel. A viewing port in each of the two assemblies permitted the slits to be inspected.

Overall dimensions of dispersive-slit assembly are 13 in. along the beam path and about 22 in. for both the radial and vertical directions, including the drive mechanisms. Its weight is about 75 lb and an adjustable floor pedestal is used for its support. Argonne Dwg. No. 211-CY-M-1247-E sets forth the mechanical details and Figure 15 is a photograph of the DS-2 assembly in position on the beam line. (The dispersive slit is to the left.)

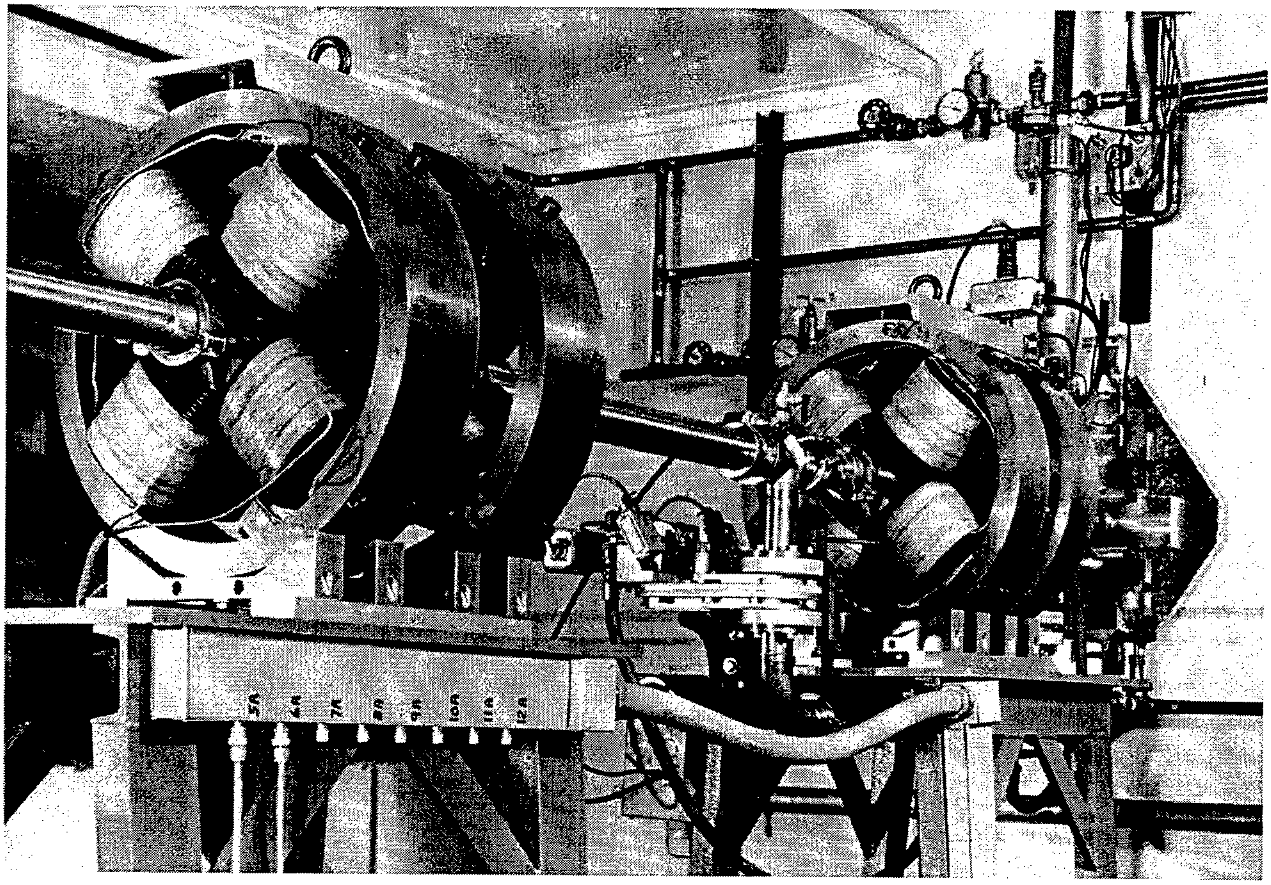


FIGURE 14 Two Quadrupole Doublets in Experimental Tunnel #2

8.2 Achromatic Slits (AS)

The design was identical to that of the dispersive horizontal slits. A slit range from fully closed to a 1-in. opening was provided. Both jaws are of copper (without gold plating).

Each assembly (60 lb) was mounted directly on an analyzing magnet (AS-1 on AM-A), and alignment was achieved by shifting the mounting bracket. All components were constructed of nonmagnetic materials, Type 310 stainless steel being used for the housing. Figure 15 is a photograph of the unit in position (achromatic slit to the right), and Dwg. No. 211-CY-M-1306-E sets forth the details of the assembly.

8.3 Intermediate Slit (IS)

An intermediate slit, located at the image-object plane at the mid-point between the two magnets, provided a variable radial-slit width ranging from 0 to 1½ in. with a dimensional tolerance of 0.010 in. The intermediate slit determined the radial alignment of the beam and acted as a scraper

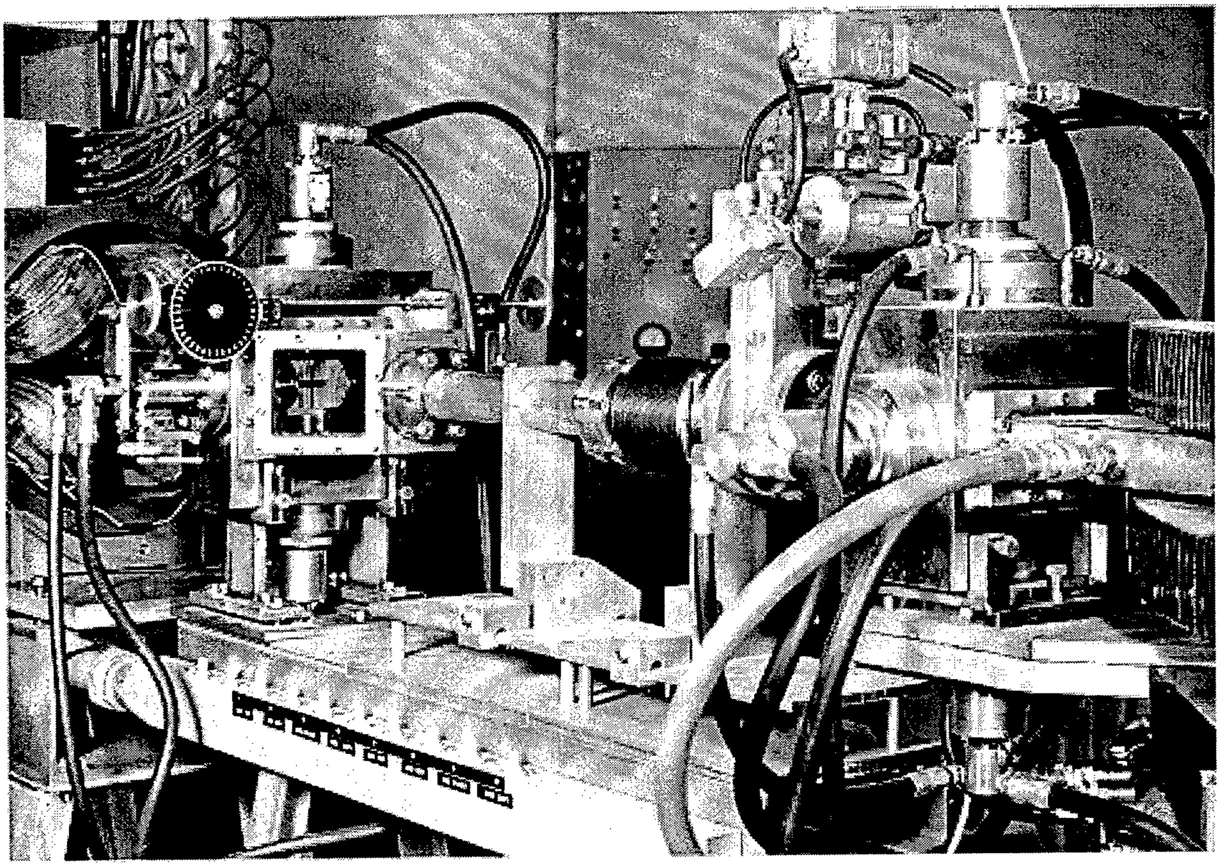


FIGURE 15 View of the Dispersive (DS-2) and Achromatic (AS-2) Slit Assemblies

of unwanted particles, thereby minimizing the radiation effects on the down-stream side of the system. A commercial-type 3-in.-OD Type 304 stainless-steel cross was used as the housing for the two independently controlled, motor-driven jaws. It is shown on the beam tube on the left side of Figure 16. Drawing No. 211-CY-M-1737-D sets forth the mechanical details. The overall dimension along the beam path was 6 in., and about 24 in. was required in the radial direction.

8.4 Beam Envelope Locaters (BEL)

The design of the beam envelope locater was similar to that of the intermediate slit. However, four water-cooled jaws determine the alignment of the beam envelope and its spatial distribution. The displacement of both sets of jaws was such that their front surfaces were 9/16 in. apart. Dwg. No. 211-CY-M-1801-D shows the details. The overall dimensions were 5 in. along the beam path and about 16 in. for both the radial and vertical directions.

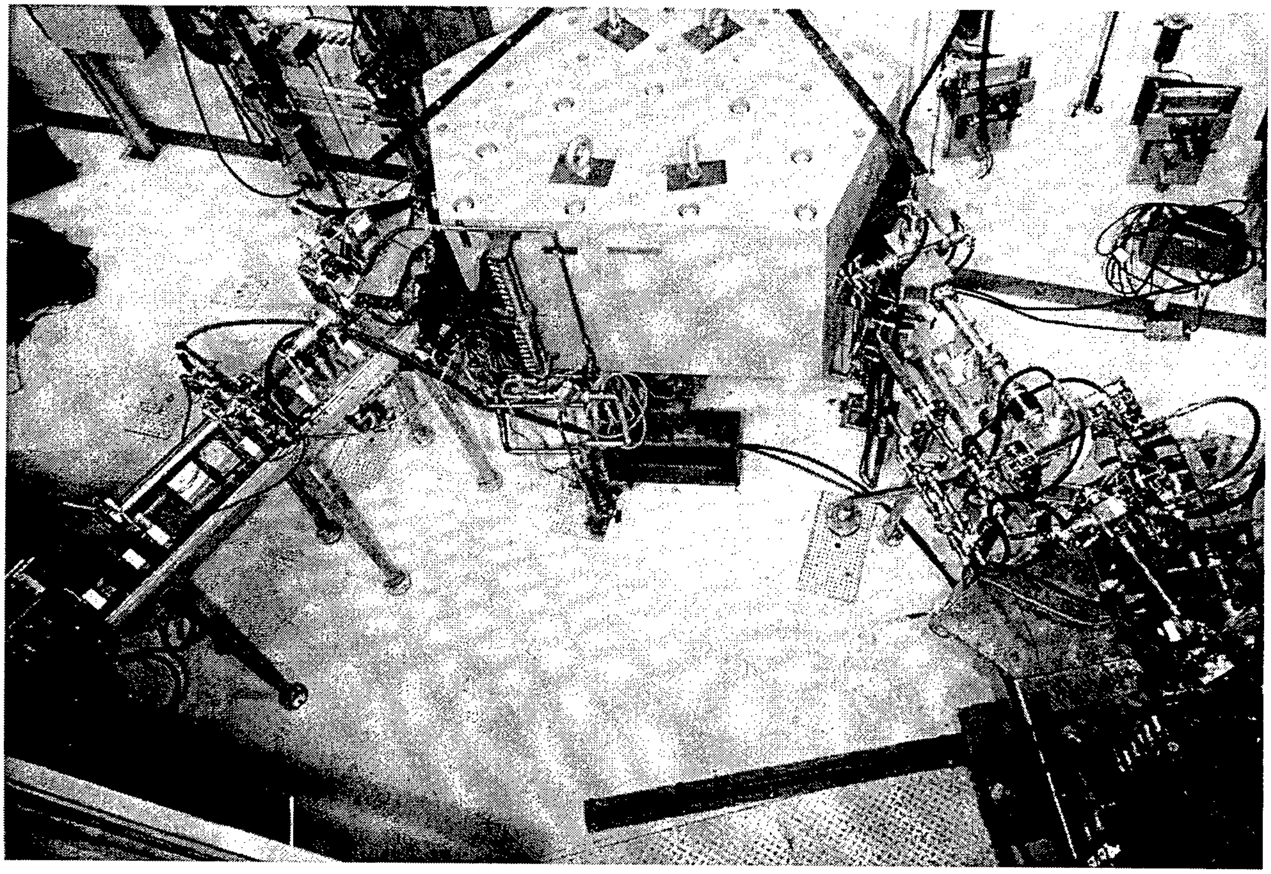


FIGURE 16 View of Switch Magnet SM-1 and Analyzing Magnet AM-A

8.5 Chamber for Analyzing Magnet (AMC)

The vacuum chamber for each analyzing magnet was constructed of Type 310 stainless steel. Construction materials of low permeability were necessary to preserve the quality of the magnetic field, and either Inconel X, K-Monel or some of the stainless-steel alloys would suffice. For this case, the Type 310 alloy was chosen, because it had a permeability of about 1.003 and would remain unchanged in cold-working, whereas the permeability of the Type 304 could increase to a value as great as 7.

Each chamber had a mean radius of 40 in., a maximum outside height of 1.688 in., and a minimum inside dimension of 1.438 in. The top and bottom plates each had a thickness of ⅛ in. The inside radial width was 4 in. The mean radius was based upon original calculations and was a negligible deviation from the magnet curvature of 39.86 in.

At the upstream end, an observation window (2.7-g/cm^3 density, nonbrowning glass) was placed so that a sliding screen could be positioned within the chamber for observing the size and shape of the beam envelope.

End flanges for both chambers were designed for metal seals. Since these regions are difficult to service, gold O rings were chosen to provide greater reliability.

Each chamber was shimmed into the magnet gap and was held in position by having both ends fastened to an aluminum table (Figure 17). After the chamber and table were aligned, the table was bolted directly to the floor.

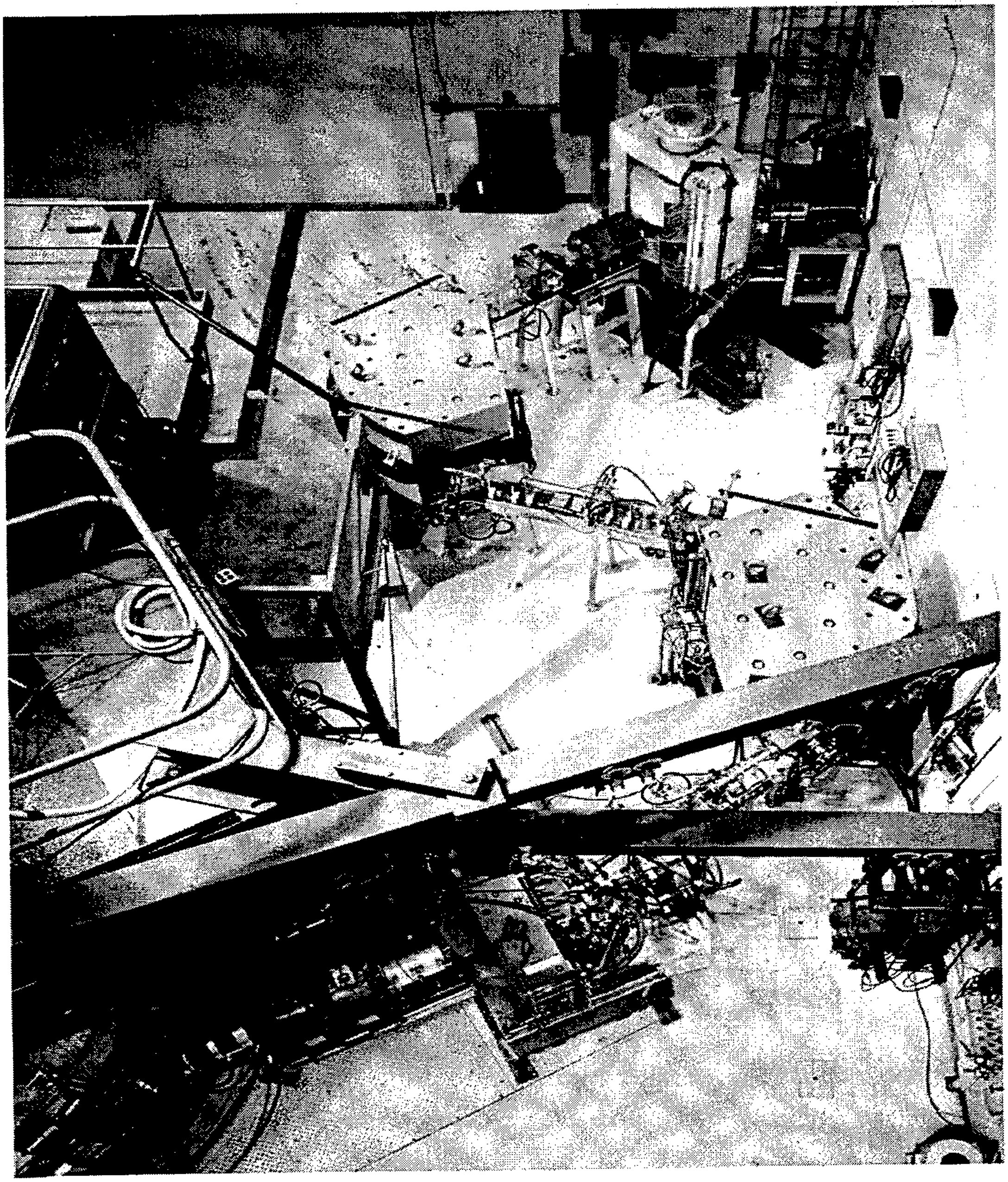


FIGURE 17 Overall View of Beam-Transport and Analyzing System

8.6 Support Structure for Analyzing Magnet

Support was provided by structural I beams, which in turn were mounted on three screw jacks 120° apart. A mounting pad of unique design was placed between the head of each jack and the base of the magnet. Such an arrangement maintains the load on the central axis of the jack screw, thus minimizing side slippage when the magnet was being leveled. Figures 18 and 19 show the support structure for the analyzing magnets (AM-A and AM-B) and the switch magnet (SM-2).

Positioning of these magnets was quite simple. Initially, the optic-beam axis was scribed on the top side of each magnet, and the external beam lines were layed out on the vault floor. In turn, each magnet was moved to a position that approximated the required location and then elevated (jacked) and leveled. Exact positioning was achieved by using the overhead crane to partially lift the magnet off its jacks and sliding it until the required position was achieved; final elevation was achieved by trimming the jacks. Such mounts have proved to be quite satisfactory and inexpensive.

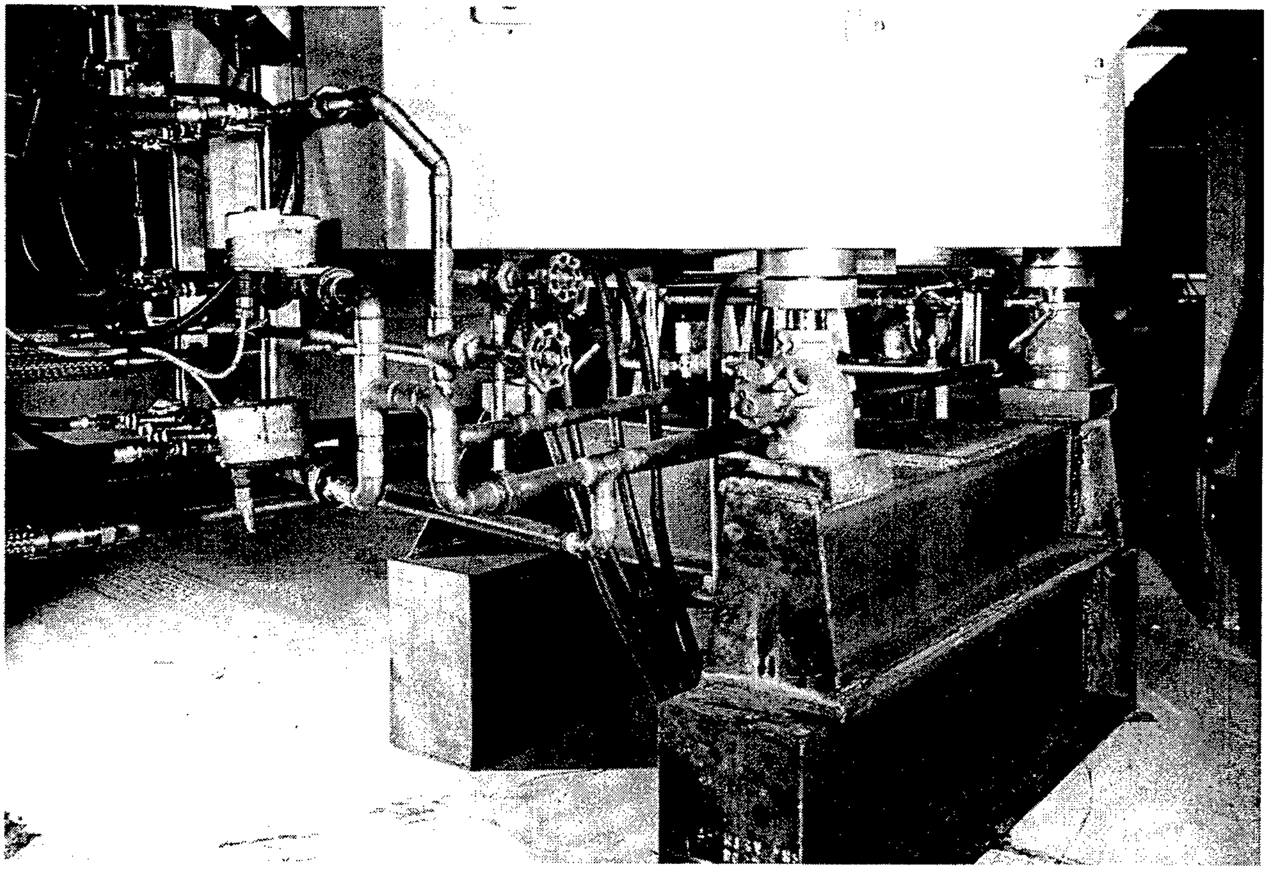


FIGURE 18 Mount for Analyzing Magnet

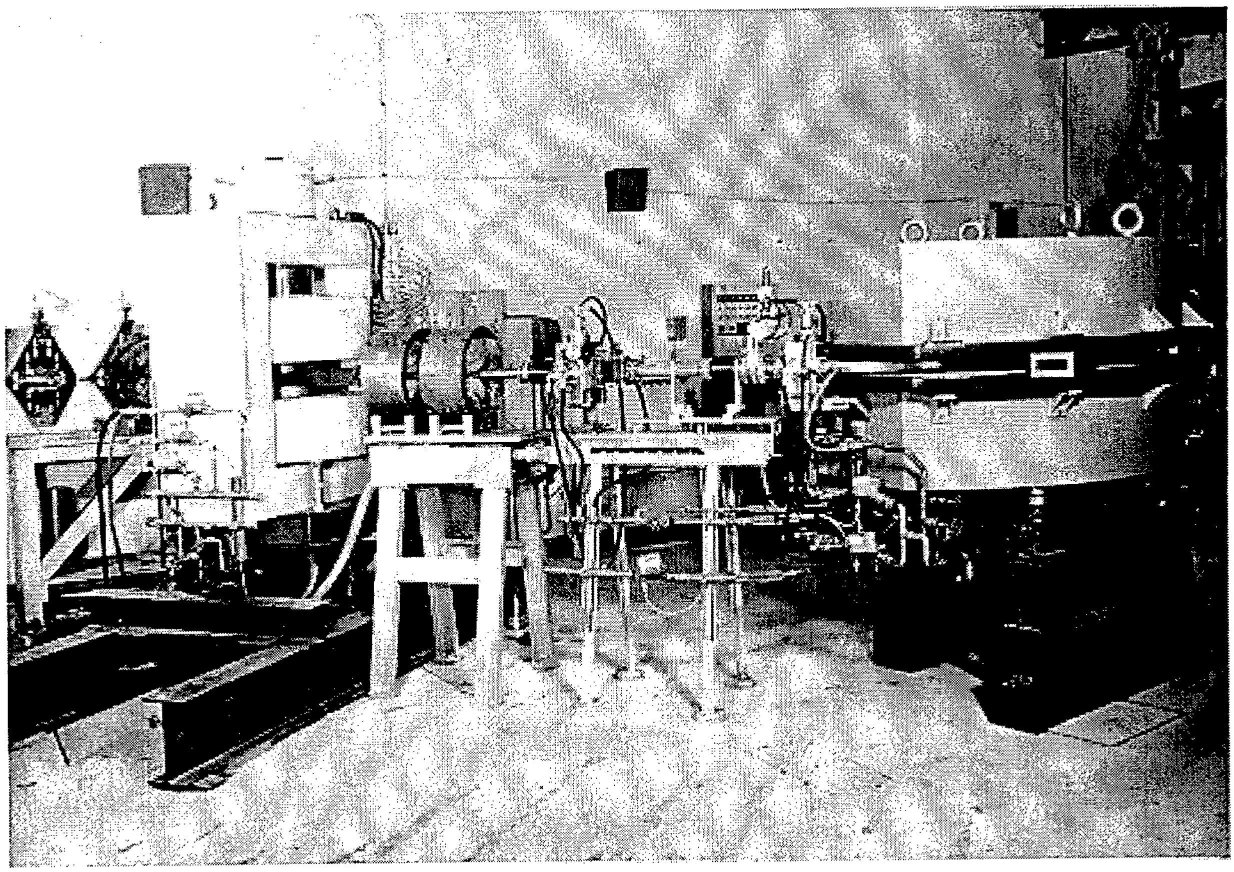


FIGURE 19 View of Analyzing Magnet (AM-B) and Switching Magnet (SM-2)

Additional Notes:

Gimbals move the DEE. In order to get the DEE's out, the platforms have to be moved back and the trimmer on the north side has to be unbolted and swung out of the way. The DEE has big plates with allen head screws. The deflector is held in place by 2 screws. The water line and o-ring pull out. The septum has a saddle on one end and a screw for adjustment. The beam extraction is 27 inches from the center of the magnet. Transition section is all iron. The condenser assembly is expected to have contamination, an oil film, and powdered graphite. The flow box is expected to have little contamination.

V. SCOPE OF THE CHARACTERIZATION SURVEY

The following rooms located on the Bldg. 211 Service Floor were included in the scope of the characterization survey. A map of the service floor is provided in Figure 2.

- A-004; specific surveys involving a large diffusion pump tank containing demineralized/deionized water (M-SCI-A3) and a sump pit.

- A-011 (mechanical equipment room); specific surveys involving two vacuum pumps.

- A-020; specific surveys of the hydraulic equipment associated with the DEE door and the sump pit.

- Steel/Paraffin-lined Vault; general survey of the interior surfaces of the vault which previously house a Cockroft-Walton accelerator.

- B-012; specific surveys of the hydraulics associated with the vertical personnel door.

- C-001; surveys of the room in general and also the quadrupole magnets, cables, motors, and other miscellaneous equipment.

On the main floor of the facility, the following rooms are included in the characterization survey. A map showing their locations within the facility can be found in Figure 3.

- C-101 (cyclotron vault); surveys were performed along beam lines, miscellaneous equipment, and the walls, floors and ceilings of this large room.

- C-101 (service platform supporting the cyclotron proper); surveys were performed on the equipment and components including pumps, a water manifold, electrical services.

- A-111 and A-119 (electrical equipment room); surveys were performed in these rooms to ensure that radioactive contamination had not been inadvertently tracked into these rooms as a consequence of the routine operations conducted within the facility.

- B-102 (control room); surveys were performed to ensure that radioactive contamination had not been inadvertently tracked into this room as a consequence of the routine operations conducted within the facility.

- B-118 (cave access area); surveys were performed in the area, including walls, floors and ceiling.
- B-126 (cave work area); surveys were performed in the Jr/Sr Cave areas and inside the fume hoods.
- Junior cave; limited surveys were performed inside the cave because cave door could not be opened. Surveys were conducted through an open port.
- Senior cave; surveys were performed inside and on the exterior of the cave.
- Cyclotron proper and beam line; surveys were performed on various cyclotron components including various pumps, vacuum lines, the DEEs, the splitter, deflector, septum, the beam line itself including the bending/steering magnets and the beam stop.
- Cyclotron vault clerestory; surveys were performed inside the exhaust ducts located in the fan loft [see Fig. 4].
- DEE repair clerestory; surveys were performed on the roof of the building above the dock area [see Fig. 4].

VI. SURVEY AND SAMPLING DESIGN

The characterization survey consisted of the following radiological surveys for each room identified to be within the scope of the characterization survey:

(1) Direct survey scans of floors, walls, ceilings, exhaust ducts, drains, service lines, for gross alpha and beta contamination using a dual-phosphor scintillation detector.

(2) Gamma scan survey of each room, including exhaust ducts, drains, and service lines for gross contamination using a thin crystal sodium iodide detector.

(3) Large-area surface smears (>100 cm^2) of various room surfaces were taken and analyzed using the Tennelec gas-flow proportional counting system.

(4) Investigative measurements

- If during the course of the direct survey scans contamination was detected, a stationary direct measurement was made at that location noting the results.

- If during the course of the room survey scan using the sodium iodide detector an elevated radiation background was detected, the radiation level was then measured using a micro-R meter.

- Any large-area surface smear revealing the presence of contamination above background levels was investigated further by taking additional smears (100 cm^2 area) of the area in question. All smears were analyzed using a low background gas-flow proportional counting system.

(5) Additional sampling

- Paint samples were taken in various locations and analyzed for gross alpha and beta contamination using a gas-flow proportional counting system.

- A select number of contaminated smears analyzed for gross alpha and beta contamination were subject to alpha spectral and gamma spectral analyses to identify the radionuclide(s) present. If the gamma spectral analysis was unable to account for the total amount of contamination present, a beta-specific analysis was then performed.

- Sludge and water samples were analyzed for PCBs, SVOCs, VOCs, heavy metals, pH determination. Gross alpha/beta and gamma spectral analyses were also performed on these samples.

- Oil samples from various equipment were subject to a gamma spectral analysis, a gross alpha/beta analysis, total metals and PCBs analyses.

- Samples were taken from various ceiling and insulating materials and analyzed for asbestos.

- Samples were taken from equipment containing organic fluids and a chemical analysis was performed.

- In-situ measurements were performed on painted surface to determine lead (Pb) content.

(6) Coordinate system

- A simple rectangular coordinate system was used to identify the locations where samples and/or measurements were made on various walls, floors, and ceilings. For all wall areas, the origin (coordinate 0,0) is referenced to the lower left hand corner when facing the wall. The X coordinate corresponds to the horizontal axis along the wall surface and the Y coordinate the vertical axis. Each coordinate pair are given by the standard notation of the abscissa first followed by the ordinate (X,Y). All numerical values for distance are expressed in feet. The coordinate system used for the floor and ceiling areas is similar to the one described above with the following two exceptions: (1) the origin coordinate 0,0 is reference to the southwest corner of the floor and ceiling and (2) the X-axis traverses the east-west direction and the Y-axis the north-south direction.

(7) Sample identification scheme

- The following scheme was used to identify the locations where samples were taken within the Cyclotron Facility. Samples were identified by a five element code:

Type sample	Element 1
Room no. or Tunnel	Element 2
Location	Element 3
Sequential Number	Element 4
X, Y coordinate	Element 5

Type of sample

• SA Smear (Small Area Smear)	100 cm^2 smears
• LA Smear (Large Area Smear)	>100 cm^2 smears
• Internal Smear	>100 cm^2 smears inside tanks/ducts
• Air	Air samples
• Paint scrapings	Paint samples from walls
• Concrete samples	Concrete scrapings from walls
• Metal shavings	Metal samples collected by drilling into magnet, yoke or pole
• Paraffin sample	Paraffin collected within steel vault

Room No. or Area

• C-101	e.g. cyclotron vault room

Location

- North Wall
- South Wall
- East Wall
- West Wall
- Floor
- Ceiling
- Tank #

Sequential Sample Number

- All samples were assigned an identification number.

X,Y Coordinate (all distances in feet)

- For walls, the origin 0,0 is at the lower left corner.
- For floors and ceilings, the origin 0,0 is at the southwest corner.

VII. INSTRUMENTATION

1.0 Description of Standard Health Physics Instrumentation

- Surface contamination measurements were made using a dual phosphor scintillation detector, sensitive to both alpha and beta/gamma radiation; e.g., NE ELECTRA meter with NE DP6 probe (Code: NE).

- Thin sodium iodide detector for gamma surveys; e.g., Eberline PRM-5-3 meter with PG-2 detector (Code: PG2).

- Floor monitor with large area gas flow proportional counter; e.g., Eberline PAC-4G-3 with AC-22 probe (Code: floor monitor).

- Energy-compensated GM detector for general background gamma exposure measurements; e.g., Eberline ASP-1 (Code: μR).

- Air ion chamber survey instrument with capacity for measurements through 7 mg/cm^2 or 1000 mg/cm^2 windows, e.g., Eberline RO-20 (Code: RO20).

- Manual alpha/beta counting system, based on thin window gas flow proportional detector (Code: DABRAS).
- Tennelec gas flow proportional counting system for both alpha and beta radiation, based on thin window gas flow proportional detector (Code: APC).
- Giraffe — Cart-mounted portable air sampling system, utilizing the ESH-7 air sampling heads and a positive displacement pump with a vacuum manifold.

2.0 Description of Tech Demo Instrumentation

- Portable X-Ray Fluorescence Detector
  The portable Spectrace 9000 unit (TN Spectrace) provides for non-destructive, real-time elemental analysis for solid, liquid, thin film, and powder samples. The system collects x-ray emission spectra from a sample after excitation with one or more radiation sources. The system analyzes elements of atomic number 11 and higher, at concentrations from a few parts per million to percent levels.
- In Situ Gamma Spectrometer utilizing large hyper pure germanium (HPGe) detector, shields and stand, e.g., ANL ESH/HP and Canberra ISOCS.

3.0 Detection and Measurement Sensitivity

- The term "Detection Sensitivity" is used in this report to refer to the surveyor's ability to audibly detect the presence of radioactive contamination during a surface scan survey. The probability of detecting surface contamination depends not only on the sensitivity of the survey instrument, factors related to its probe size, the scanning speed, background count rate, but is also affected by the surveyor's ability to discern audible changes in the instrument's response (i.e., human factors). The surveyor must make a decision whether the audible signals represent only natural radiation background or residual contamination in excess of background. Audible scan sensitivities are subject to wide variability depending on human factors and the surveyor's scanning technique.
- The term "measurement sensitivity" is used here to define the quantity of radioactive material that can be measured with some known or estimated level of confidence for a fixed position measurement over some predetermined time

interval (e.g., a non-scanning measurement). The primary factors affecting "measurement sensitivity" include the detector background counting rate, the counting efficiency of the detector and the counting time interval. When making field measurements, the "measurement sensitivity" will almost always be inferior to that which can be achieved in the laboratory due to the higher radiation background usually encountered in the field and, often times, the significantly lower detection efficiency due to geometry considerations.

- Table 2 contains a list of the measurement and scan sensitivities for the portable survey instruments and the laboratory equipment used in the characterization survey. Figures 20-24 include photographs of the various radiological instrumentation used in characterization survey.

VIII. QUALITY ASSURANCE PLAN

1.0 Policy

Data Quality Objectives have been established to ensure that the characterization survey data acquired are consistent with the goals and purposes of this phase of the project. Quality assurance measures and guidelines were established and implemented throughout the scope of work.

All work was performed in compliance with the QA plans of the ESH Division and the Health Physics Sections of ANL-E Environment Health and Safety Manual, and the ANL-E Waste Handling Procedures Manual.

2.0 Organization

All tasks were performed under the supervision of a cognizant project coordinator, with work reviewed and approved on a daily basis. The project coordinators included a qualified health physicist and a qualified chief technician. HP technicians performing surveys, taking samples, and performing radiological laboratory counting were fully trained and approved for work at ANL-E, according to the site-specific training requirements specified by DOE and ANL-E.

Radiological procedures and data analyses were reviewed and approved by ANL-E Health Physics Management.

TABLE 2 Radiological Instrumentation Used During the Characterization Survey

Purpose	Instrument	Detector Description	Typical Background and Efficiencies	Audible Scan Sensitivity*	Measurement Sensitivity
Total Surface Contamination (α)	NE Technology, Ltd. ELECTRA	Dual Scintillator 100 cm^2 sampling area 0.5 mg/cm^2	21% ^{241}Am efficiency, $\leq$7 cpm background	500 dpm	95 dpm (30 sec. measurement)
Total Surface Contamination (β-γ)	NE Technology, Ltd. ELECTRA	Dual Scintillator 100 cm^2 sampling area - 6 mg/cm^2	29% ^{90}Sr-Y efficiency, $\leq$400 cpm background	1500 dpm	370 dpm (30 sec. measurement)
Removable Surface Contamination (α)	Tennelec APC	Gas Proportional 5 cm dia. 0.1 mg/cm^2	30% ^{241}Am efficiency, $\leq$ 1 cpm background	NA	16 dpm (2 min. measurement)
Removable Surface Contamination (β-γ)	Tennelec APC	Gas Proportional 5 cm dia. 0.1 mg/cm^2	42% ^{90}Sr-Y efficiency, $\leq$40 cpm background	NA	48 dpm (2 min. measurement)
Exposure Rate (γ)	Eberline ASP-1	TGM N378 Energy Compensated High Sensitivity GM	15 μR/h background	5 μR/h net	-
Exposure Rate (γ)	Eberline R0 20	Air Ionization Chamber	0.2 mR/h background	NA	1 mR/h
Total Floor Surface Contamination (α)	Eberline FM-4 (Floor Monitor)	Gas Proportional 330 cm^2 0.85 mg/cm^2	11% ^{239}Pu efficiency, 2 sec residence time, $\leq$5 cpm background	600 dpm	Stationary measurements made with NE Electra
Total Floor Surface Contamination (β-γ)	Eberline FM-4 (Floor Monitor)	Gas Proportional 330 cm^2 0.85 mg/cm^2	28% ^{90}Sr-Y efficiency, 2 sec residence time, $\leq$110 cpm background	1800 dpm	Stationary measurements made with NE Electra
Gamma Scan	Eberline PRM 5-3 or ASP-1 with PG-2 detector	5 cm diameter x 2 mm thick NaI (Tℓ)	500 cpm background	500 cpm net	-

* Note: Audible scan sensitivity refers to the minimum detectable activity that could be audibly recognized by the health physics technician as an instrument response different from that of the ambient background level. Values for the audible scan sensitivities are highly variable and depend on certain human factors involving the surveyor. Scan sensitivities are based on a 2 second probe residence time and proper surface to probe distances. Various surface conditions were not taken into account in estimating any of the field measurements/scan sensitivities.

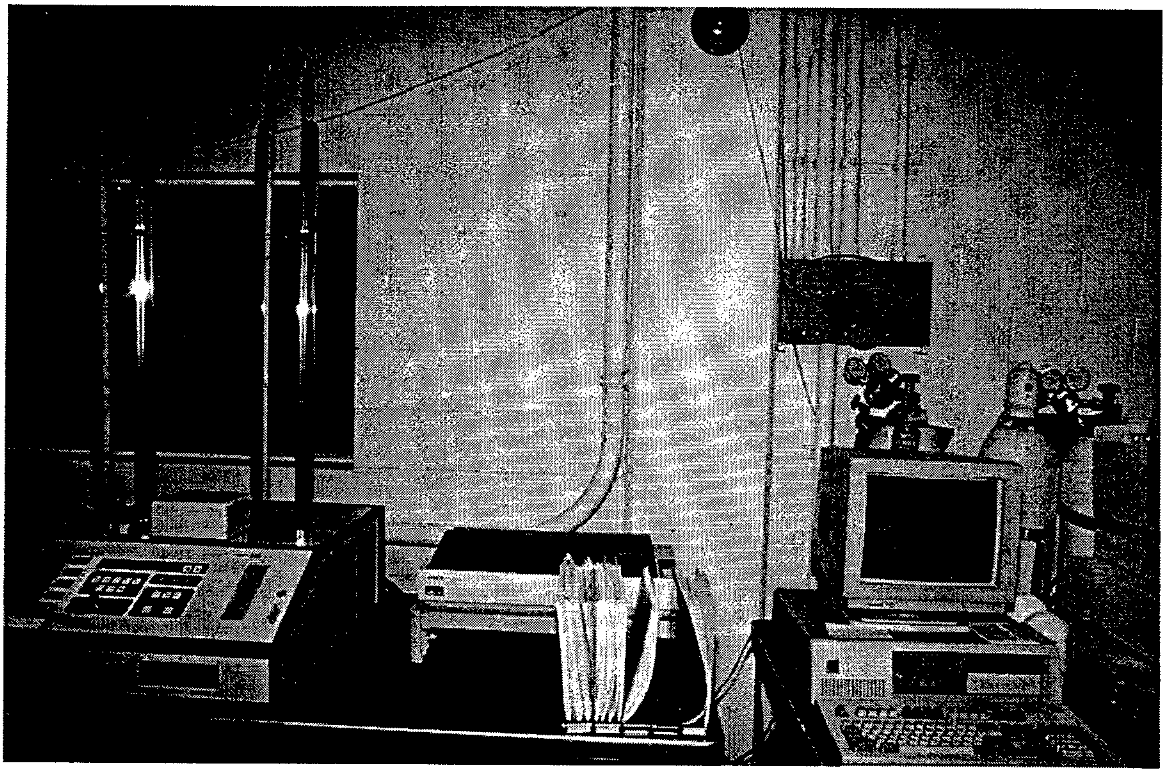


FIGURE 20 Tennelec Gas-Flow Proportional Counting System

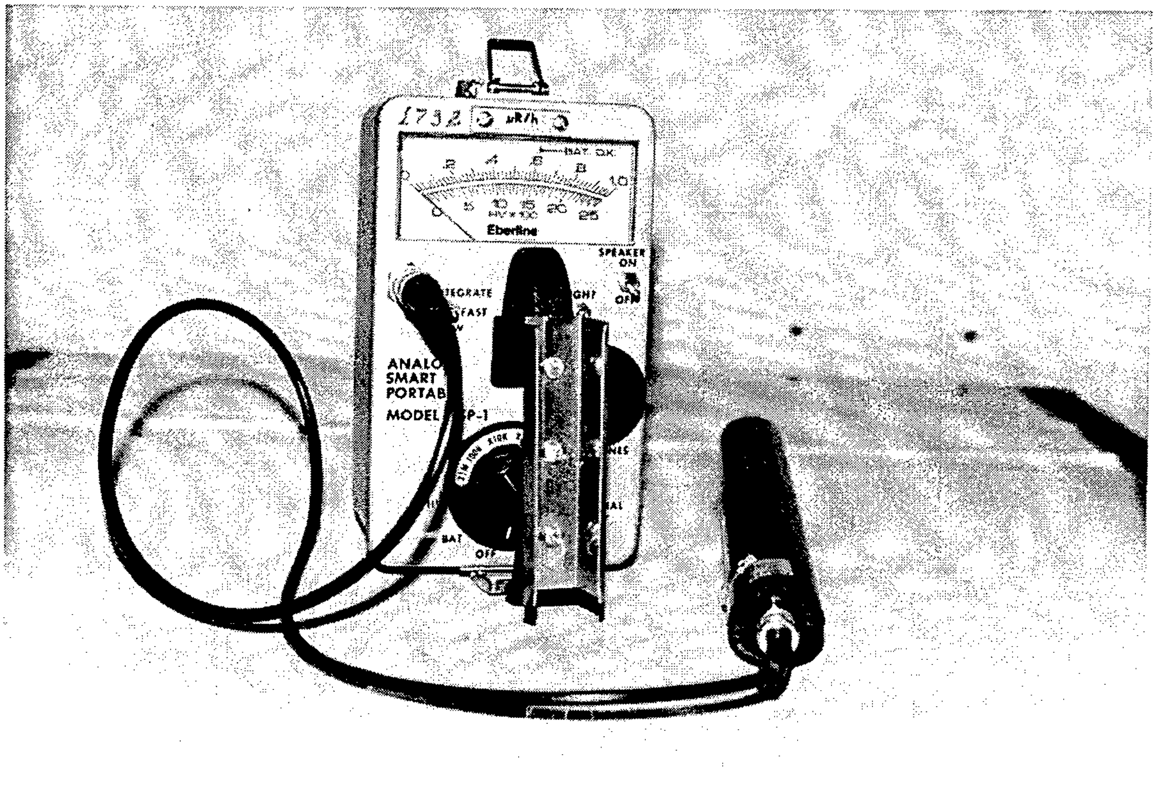


FIGURE 21 Energy Compensated GM Detector for Exposure Rate Measurements

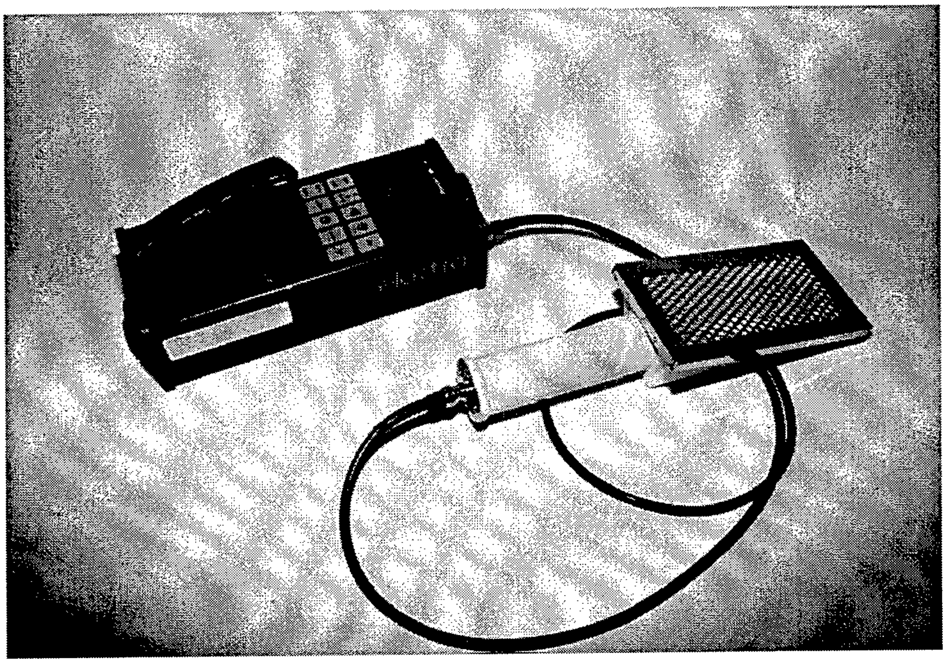


FIGURE 22 NE Dual Phosphor Scintillation Detector for Surface Contamination Scans and Fixed Measurements

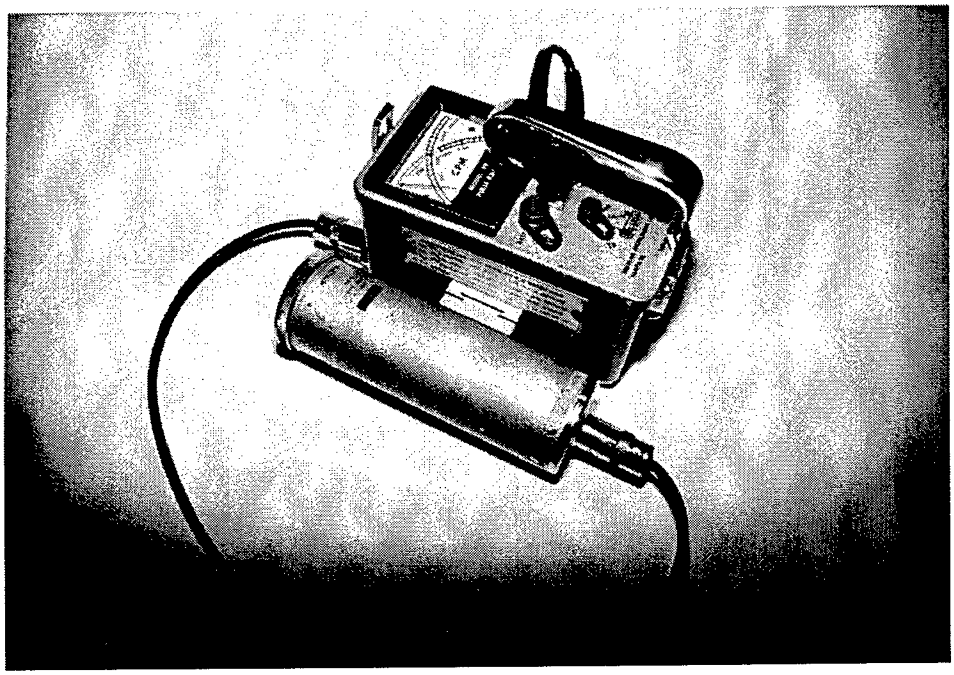


FIGURE 23 Eberline PRM 5-3 with PG-2 Scintillation Detector for Gamma Scan Measurements

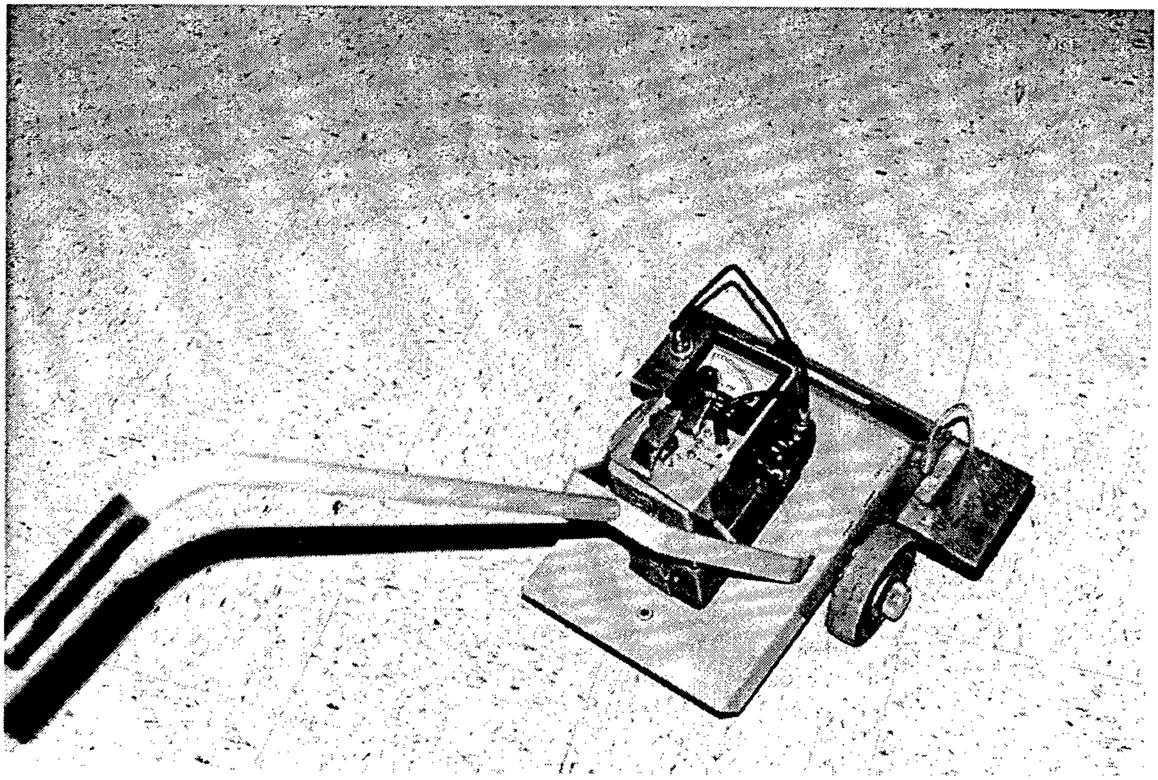


FIGURE 24 Eberline FM-4 Floor Monitor with Gas-Flow Proportional Detector for Surface Contamination Scans

Tasks involving potential exposure to hazardous materials were performed with the participation and cooperation of qualified industrial hygiene safety personnel, and approved as necessary by ANL-E ESH Division personnel.

3.0 Instrument Calibration and QC Protocols

All radiological instruments used in the characterization survey were:

- Maintained and calibrated in compliance with ANSI N323 standards.
- Calibrated at least every six month [Appendix A contains instrument calibration records].
- Checked daily for proper function, with results recorded in a user log. A QC check log for the Tennelec Gas Flow Proportional Counting System is provided in Appendix B.

Surveys, scans, and laboratory counting were performed in compliance with the ANL-E Health Physics Procedures Manual. Counting times for stationary surveys and laboratory analyses were sufficiently long to achieve adequate measurement sensitivities at least comparable to the release levels specified in the ANL-E Health Physics Procedure HPP-610 for transuranic alpha and beta/gamma activity.

Unambiguous identification and chain of custody procedures, as approved by ANL-E ESH, were followed for the handling of all samples.

The possibility of cross-contamination of samples was minimized by proper acquisition, handling and separate packaging of individual samples. Tools used to obtain samples were cleaned between each use.

4.0 Data Quality Objectives

The quality of the characterization survey data, including systematic and statistical precision, was adequate to meet the DQO's. The scope of data collected (i.e. the numbers of samples) was consistent with the desired objectives, in order to achieve optimum cost effectiveness.

Quality Assurance guidelines were established to help ensure that the quality of the data collected was sufficient to meet the following goals:

(1) Identification of the boundaries of all areas which were found to be radiologically contaminated to levels exceeding the specified release guidelines.

(2) Classification of all facility areas into three categories:
- Unaffected
- Possibly affected
- Affected (radiological contamination above guidelines).

(3) For components and equipment found to be contaminated: determination of nuclides, activities and distributions, sufficient to allow subsequent disposal and corresponding disposal costs.

(4) For facility surfaces found to be contaminated: determination of nuclides, activities and distributions, sufficient to allow subsequent selections of remediation techniques and disposal cost estimates.

(5) Toxic and hazardous materials disposal cost estimates.

(6) Identification of characterization data which could be used to supplement the Final Status Survey for the facility.

5.0 Documentation

Radiological surveys were documented in compliance with the requirements of ANL-E Health Physics. Data sheets were reviewed and signed by a staff member of ANL-E Health Physics. All results have been tabulated and organized in the Appendices of this report. Original copies of radiological and laboratory data forms shall be kept in secure files. At the conclusion of the project, original data forms shall be archived with other project records in compliance with DOE requirements.

IX. FACILITY REFERENCE VALUES FOR RADIOLOGICAL SURVEYS

One critical element in the characterization survey is being able to determine whether a set of field data are part of the natural radiation background distribution or are different from this distribution such that one can conclude that contamination is present. A summary of background reference measurements for the instrumentation used in the survey is provided below in Table 3.

TABLE 3 Summary of Instrument Background Reference Values

Instrument	Reference Background Values	
NE Electra (rate mode)	α: 20-100 dpm	βγ: 900-1200 dpm
Eberline FM-4 Floor Monitor (rate mode)*	α: 10-15 cpm	βγ: 825-925 cpm
Energy-compensated GM Survey Meter	10-15 μR/h	
Eberline RO 20 Ion Chamber	0.2-0.5 mR/h	
Eberline PRM 5-3 with PG-2 Detector	500-800 cts/min	
Tennelec Gas-Flow Proportional Counter	α: 0.20-0.33 cts/min	βγ: 27-30 cts/min

*These data were collected from a previous D&D operation conducted in Bldg. 212.

Note: Background measurements taken in the field are subject to significant variability based on ambient radiation levels and the natural radioactivity content of various materials being surveyed.

X. RELEASE GUIDELINES

The following is a summary of the free-release criteria associated with surfaces contaminated with radioactive materials. Also included are guidelines associated with asbestos-containing materials, airborne lead, hazardous material release and airborne radioactivity.

TABLE 4 Surface Contamination Free-Release Criteria (dpm/100 cm^2)

Total (fixed and removable) Radionuclides	Average	Maximum	Removable
Transuranics, I-125, I-129, Ra-226, Ac-227, Ra-228, Th-228 Th-230, Pa-231	100	300	20
Th-Natural, Sr-90, I-126, I-131, I-133, Ra-233, Ra-224, U-232, Th-232	1,000	3,000	200
U-Natural, U-235, U-238, and associated decay product, alpha emitters	5,000	15,000	1,000
Beta-gamma emitters (except Sr-90)	5,000	15,000	1,000

Asbestos release criteria – a material (e.g., insulation, pipe joint compound, floor tile) is considered asbestos-containing if it contains greater than 1% asbestos by weight.

Hazardous material release criteria – RCRA (Resource Conservation Recovery Act) hazardous waste is defined as waste which meets one of the following two criteria:

1. it exhibits the 40 CFR 261.20 (reference 7) specific properties of
   - ignitability
   - corrosivity
   - reactivity
   - toxicity, and
2. it is listed in 40 CFR 265 (reference 7) as a RCRA hazardous waste, and it exceeds the specified concentration limits.

Airborne radioactivity guidelines – Workplace airborne activity concentrations are referenced to the derived air concentrations (DAC) in the DOE rule 10 CFR 835.

Airborne lead limits – the OSHA standard for airborne lead requires personnel blood lead level monitoring when the airborne concentration is greater than 30 $\mu g/m^3$ and requires respiratory protection when the airborne concentration is greater than 50 $\mu g/m^3$.

XI. RESULTS

For the purpose of providing a general orientation, Appendix C contains a variety of facility photographs of the cyclotron hall, the basement area, laboratory fume hoods and associated equipment. Radiological surveys maps of various areas within the facility can be found in Appendix D. A summary of all the removable surface contamination surveys performed are listed in Appendix E. Smear data results reported with a negative numerical value simply reflect the stochastic variability associated with measurements made at or near the background of the instrument used for the analysis.

Survey results associated with the large inventory of miscellaneous equipment currently stored in C101 are tabulated in Appendix F. Workplace air sampling results are shown in Appendix G. A summary of the radiological sample analyses performed and the results are contained in Appendix H. Results of all metal samples collected and analyzed can be found in Appendix I. Paint and concrete sample analyses are tabulated in Appendix J. Appendix K is a tabulation of the samples analyzed for various hazardous chemicals and Appendix L contains a summary of results for all chemical analyses performed.

Appendix M contains an Industrial Hygiene Summary Report for Pb-containing paint within the facility and Appendix N summarizes the results from an asbestos survey of the facility.

1.0 Radiological Surveys of Rooms/Areas Within the Facility

The following is an area by area summary of the surface contamination survey results and the exposure rate measurements made throughout the facility.

A-Wing Areas:

- **Room A-004** Service Floor Tank Room/Pit Area
  - No surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.
  - Eight large area surface contamination smears were taken of various floor locations and the tank itself. No radioactive contamination was detected.

Direct surface scans with a dual phosphor scintillation detector were performed on the tank surface, the pit and the pit rim. No surface contamination was detected.

- The results of a gamma scan of the pit area and rim with a thin window sodium iodide detector were all background levels. Exposure rate measurements made around the tank, the pit area and the rim were all less than 20μR/h.

- **Room A-011** Mechanical Equipment Room
  - No surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.
  - Twenty surface contamination smears were taken on the interior and exterior of pumps #1 and #2. No radioactive contamination was detected. Direct surface scans with a dual phosphor scintillation detector were performed on various pump surfaces, both external and internal. No surface contamination was detected.
  - The results of a gamma scan of the two pumps with a thin window sodium iodide detector were all background levels. Exposure rate measurements made around the pumps were all less than 20μR/h.

- **Room A-020**
  - Isolated spot of surface contamination was identified on the west wall; no exposure rates in excess of the natural ambient background were measured.
  - Eighteen surface contamination smears were taken on the floor, the walls, the hydraulic equipment, and the sump pit. With the exception of one west wall smear which revealed some removable surface contamination (245 dpm βγ; no alpha contamination measured), none of the other smears indicated the presence of contamination. Direct surface scans were performed with a dual phosphor scintillation detector on all wall surfaces. No surface contamination was detected.
  - The results of a gamma scan of the room with a thin window sodium iodide detector were all background levels. Exposure rate measurements made within the room were all less than 20μR/h.

- **Room A-111 and A-119** Electrical Equipment Rooms

  - No surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.

  - Twenty-five smears were taken of the floors and walls. No radioactive contamination was detected. Direct surface scans with a dual phosphor scintillation detector were performed on the walls and floors. No surface contamination was detected.

  - The results of a gamma scan of the rooms with a thin window sodium iodide detector were all background levels. Exposure rate measurements made within the rooms were all less than 20μR/h.

- **A-wing Steel Vault**

  - Floor surface contamination was identified; no exposure rates in excess of the natural ambient background were measured.

  - Fourteen surface contamination smears were taken on the exterior surfaces of the vault and within the vault on the walls, floor, and ceiling. No radioactive contamination was identified on the walls or ceiling, however a section of floor contamination was found with levels of up to 135 dpm βγ. No alpha contamination was identified. Direct surface scans with a dual phosphor scintillation detector were performed on the walls. No surface contamination was detected.

  - The results of a gamma scan of the rooms with a thin window sodium iodide detector were all background levels. Exposure rate measurements made within the vault were all less than 20μR/h.

B-Wing Areas:

- **Room B-012**

  - Floor surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.

  - Eighteen large area surface contamination smears were taken on the floor, the walls, the hydraulic equipment and the sump pit. No radioactive contamination was detected. Direct surface scans with a dual phosphor scintillation detector were performed on the walls and the equipment inside the room. No surface contamination was detected.

- The results of a gamma scan of the walls using a thin window sodium iodide detector were all background levels. Exposure rate measurements within the room were all less than 20μR/h.

- **Room B-102** Control Room
  - No surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.
  - Twenty-one large area surface contamination smears were taken of the air ducts, ceiling, floor, and the walls. No radioactive contamination was detected. Direct surface scans with a dual phosphor scintillation detector were performed on the walls. No surface contamination was detected.
  - The results of a gamma scan of the walls using a thin window sodium iodide detector were all background levels. Exposure rate measurements within the room were all less than 20μR/h.

- **Room B-118**
  - Isolated spot of surface contamination was identified on the east wall; no exposure rates in excess of the natural ambient background were measured.
  - Thirty-five surface contamination smears were taken on the floor, the walls, and inside ductwork. With the exception of one east wall smear which revealed some removable surface contamination (209 dpm α, however no $\beta\gamma$ activity was measured), none of the other smears indicated the presence of contamination. Direct surface scans were performed with a dual phosphor scintillation detector on all wall surfaces and no additional surface contamination was detected.
  - The results of a gamma scan of the room with a thin window sodium iodide detector were all background levels. Exposure rate measurements made within the room were all less than 20 μR/h.

- **Room B-126**
  - Several areas of removable surface contamination were identified; exposure rates varied widely from 8 μR/h to 500 μR/h, particularly in the vicinity of the wall plug on the north side of the room.
  - Surface contamination smears were taken of the ceiling tiles, overheads, and walls. No contamination was detected.
  - Several smears taken on the floor, however, showed low levels of contamination, 27 to 44 dpm α and 125 dpm βγ. A spot of contamination on the north wall revealed low levels of removable contamination, 26 dpm α and 3275 dpm βγ. Room door to 853 dpm α and 2079 βγ; crane 241 dpm βγ, overhead girder 20 dpm α.
  - Smears taken inside three fume hoods revealed 30 to 76 dpm α and 1012 to 1547 dpm βγ. Storage holes in the east wall contained loose contamination of up to 67 dpm α and 2845 dpm βγ.
  - Direct surface scans were performed with the dual phosphor scintillation probe on all walls areas. Surface contamination was detected – floor contamination as shown in Appendix D pg. D-7; south wall and hood on pg. D-8; west wall and hood pg. D-9, north wall pg. D-10, and east wall pg. D-11.
  - The results of a gamma scan of the room with a thin window sodium iodide detector revealed elevated levels ranging typically from 2,700 to 390,000 net cts/min. The room exposure rate ranged from background to 500 μR/h.
- **B-Wing Junior Cave**
  - Several areas of removable surface contamination was identified within the Junior Cave; exposure rates measured on the outside of the cave ranged from 15 to 20 μR/h.
  - Nine surface contamination smears were taken on the exterior walls and roof of the cave. No radioactive contamination was identified. Direct surface scans with a dual phosphor scintillation detector were performed on the exterior walls of the cave. No surface contamination was identified.

- The results of a gamma scan of the exterior of the cave ranged from 500 to 1500 cts/min net, which is approximately two times the instrument background of 500 cts/min. The scan was performed using a thin window sodium iodide detector. Exposure rate measurements outside of the cave were all within the natural background range, <20 μR/h.

- Six surface contamination smears were taken inside the cave on the floor, walls and ceiling. Low levels of βγ contamination were identified on the floor and west wall to a maximum level of 112 dpm/100 cm^2. No alpha contamination was identified.

- Note: Interior surveys of the Junior Cave were not performed due to inaccessibility — cave door could not be open. A complete cave survey will need to be performed. This cave was used for Th-228 work. Alpha contamination under paint is very probable.

- **B-Wing Senior Cave**
  - There is widespread contamination inside the cave.
  - Fourteen surface contamination smears were taken on the exterior walls of the cave and thirty-five on the interior surfaces of the cave.
  - Surface contamination smears were taken on the interior cave walls. Two spots of contamination were identified on the south wall, up to 512 dpm βγ and 64 dpm α and another on the north wall 159 dpm α and 297 dpm βγ.
  - Surface contamination smears were taken on the floor of the cave. Identified contamination ranged from 92 to 8128 dpm βγ and 834 to 3384 dpm α.
  - Surface contamination smears taken inside the cave on overhead fixtures revealed the presence of contamination up to 563 dpm α and 1023 dpm βγ.
  - Surface contamination smears taken inside the cave on the exterior of ductwork surfaces showed contamination present, 4084 dpm α and 4173 dpm βγ.

- Surface contamination smears of manipulators inside the cave revealed the presence of contamination, 93 dpm α and 50 dpm $\beta\gamma$.

- The exterior roof of the senior cave is grossly contaminated up to 126 dpm α and 110 dpm $\beta\gamma$. See figure on Page D-12 for direct measurement results, 60-3500 dpm per 100 cm^2 α and 1700–115,000 dpm per 100 cm^2 $\beta\gamma$. See Table 6 for the analyses performed on the insulation tape on the senior cave roof.

- A section of "wallpaper" tape from the exterior north wall of the cave was removed and analyzed using a gamma spectrometry system. The results showed in presence of Cs-137 and the amount of contamination on the sample was estimated to be 3.9E5 dpm.

- A comprehensive survey of the Senior Cave was difficult because of the presence of miscellaneous sources and contaminated items. The senior cave interior is expected to be contaminated with transuranic materials. Direct floor survey results can be found in Appendix D, pg. D-7.

C-Wing Areas:

- **Room C-001**

  - No surface contamination was detected; no exposure rates in excess of the natural ambient background were measured.

  - A total of 121 surface contamination smears were taken on the floor, walls and various items inside the room and another 24 smears were taken of the service platform. No radioactive contamination was identified. Direct surface scans with a dual phosphor scintillation detector were performed on walls areas. No surface contaminated was detected.

  - On the service platform a turbo pump was identified with a small amount of loose contamination, 20 dpm α per 100 cm^2. Beamlines from C-101 above revealed elevated radiation levels from internal contamination.

  - A gamma scan of the walls and equipment was performed using a thin window sodium iodide detector. All results were within background levels. Exposure rate measurements within the area were all less than 20 μR/h.

- **Room C-101**

  - Surface contamination smears were taken on the walls of the room. No radioactive contamination was identified. North wall lead (Pb) glass window revealed 55 dpm α and 96 dpm βγ.

  - Surface contamination smears were taken on the room ceiling and the crane. No radioactive contamination was identified.

  - Beamline: The interior surfaces of the beamlines were smeared and found to be contaminated. Alpha contamination ranged from 20 to 8474 dpm α. Beta-gamma contamination ranged from 72 to 40,228 dpm βγ. The smears with the highest activity level were taken before the first quadropole magnet. The exterior surfaces of the beamlines were also smeared. The results showed loose contamination present, 18 to 326 dpm α and 128 to 923 dpm βγ. The smear with the maximum amount of loose activity was taken on the switching magnet chamber. Direct surface scans with a dual phosphor scintillation detector were made along the beamline runs from the cyclotron to the turbo pumps on the service platform. Results ranged from 3500 to 27,500 dpm βγ per 100 cm^2 and 700 to 9000 dpm α per 100 cm^2. A gamma scan of the beamlines with a thin window sodium iodide detector showed elevated readings of 1500 to 3500 net counts/min above an ambient background instrument response of 500 counts/min.

  - Cyclotron proper: The cyclotron splitter showed a considerable amount of loose contamination of up to 15,413 dpm βγ. The target ports revealed loose contamination ranging from 2763 to 8782 dpm βγ.

  - Equipment and Miscellaneous Materials:
    Items along the east wall, 80 to 549 dpm α
    46 to 2118 dpm βγ

    Items along the north wall, 1337 dpm βγ
    no loose alpha contamination identified

    Items along the west wall, up to 64 dpm α
    286 dpm βγ

Items along the south wall, up to 53 dpm βγ, no α contamination detected.

Fan Loft Exhaust Duct Surveys:

A survey was performed on five separate exhaust duct systems located in the Bldg. 211 fan loft. The exhaust duct system surveyed include B5-1; B5-2; B5-3A; B5-3B; and B4. All of the exhaust ducts serve Room B126, including the cave areas and the fume hoods. Direct internal measurements were made using a dual phosphor scintillation detector. Large area wipes (>100 cm^2) were taken inside the exhaust ducts to assess levels of loose contamination. The terms "upstream" and "downstream" are survey locations in reference to an in-line HEPA filter. In those instances where no contamination was detected in excess of the instrument background the abbreviation "bkgd" is used. The results are summarized in Table 5.

TABLE 5 Summary of Fan Loft Exhaust Duct Surveys

• Exhaust duct B5-1	[25-30 μR/h net]	
Upstream direct survey:	9,000 dpm/100 cm^2 α	22,500 dpm/100 cm^2 βγ
Upstream loose contamination:	72 dpm	36 dpm
Downstream direct survey:	100 dpm/100 cm^2 α	18,500 dpm/100 cm^2 βγ
Downstream loose contamination:	bkgd.	bkgd.
• Exhaust duct B5-2	[15-20 μR/h net]	
Upstream direct survey:	750 dpm/100 cm^2 α	2,500 dpm/100 cm^2 βγ
Upstream loose contamination:	bkgd.	bkgd.
Downstream direct survey:	17 dpm/100 cm^2 α	3,500 dpm/100 cm^2 βγ
Downstream loose contamination:	bkgd.	bkgd.
• Exhaust duct B5-3A	[10-15 μR/h net]	
Upstream direct survey:	300 dpm/100 cm^2 α	4,200 dpm/100 cm^2 βγ
Upstream loose contamination:	bkgd.	bkgd.
Downstream direct survey:	50 dpm/100 cm^2 α	2,800 dpm/100 cm^2 βγ
Downstream loose contamination:	bkgd.	bkgd.
• Exhaust duct B5-3B	[20-25 μR/h net]	
Upstream direct survey:	450 dpm/100 cm^2 α	5,500 dpm/100 cm^2 βγ
Upstream loose contamination:	bkgd.	bkgd.
Downstream direct survey:	35 dpm/100 cm^2 α	3,500 dpm/100 cm^2 βγ
Downstream loose contamination:	bkgd.	bkgd.
• Exhaust duct B4	[20-35 μR/h net]	
Upstream direct survey:	5,000 dpm/100 cm^2 α	18,500 dpm/100 cm^2 βγ
Upstream loose contamination:	32 dpm	20 dpm
Downstream direct survey:	125 dpm/100 cm^2 α	27,500 dpm/100 cm^2 βγ
Downstream loose contamination:	bkgd.	bkgd.

Cooling Tower, Vault Clerestory and Tunnel:

- Surface contamination smears were taken of the cooling tower, cyclotron vault clerestory, repair clerestory and tunnel. No radioactive contamination was identified.

- Surface contamination smears taken on the back dock revealed up to 22 dpm α and 140 dpm $\beta\gamma$.

2.0 Summary of Air Sampling Measurements

A list of the air sampling data can be found in Appendix G. All air samples were analyzed for alpha and beta contamination using the Tennelec gas-flow proportional counter. Samples were analyzed only after a 7 day "decay period" to ensure that all short-lived radon decay products were no longer a significant contribution to each sample count rate. A sample count time of 10 minutes was used for each sample.

A total of 14 air samples were taken within the facility, the vast majority from either the Cyclotron Hall (C-101) or in the basement below (C-001). The air sample collection periods ranged from 2 to 4 days and the sampling rate was nominally 40 liters per minute.

None of the air samples exhibited any long-lived radioactive materials. Of course, during the D&D project air samples must be taken to ensure that resuspension of radioactivity found on contaminated items in the facility will not contribute to an airborne problem.

3.0 Gamma Spectrometry and Radiochemical Sample Analyses

3.1 Metal Samples

A total of ten samples drilled from the cyclotron yoke were collected and analyzed for activation products using a gamma spectrometer. Cobalt-60 was identified in virtually all of the iron filing samples from the yoke. The results are summarized in Table 6 and the analytical results can be found in Appendix H. Gross alpha/beta analyses are provided in Appendix I.

The trimmer box was smeared and the gamma spectral analysis of the filter paper revealed 1.1E5 pCi of Co-60. An alpha spectral analysis also identified the presence of U-233, U-234, and Np-237. A metal sample from the beam line bellows was analyzed and Co-60 identified with an activity level of 2.5E5 pCi/g. A sample of the pole magnet also identified the presence of Co-60 with an activity level of 114 pCi/g. These results are summarized in Table 6 and the analytical data can be found in Appendix H.

TABLE 6 Summary of Sample Results from Cyclotron Components

Sample #	Item	Results	
• 21 ACL	Iron filings from pole	Co-60	114 pCi/g
• 23 ACL	Iron filings from yoke	Co-60	207 pCi/g
		Mn-54	7 pCi/g
• 26 ACL	Smear of trimmer of box	Co-60	1.1E5 pCi
• 54 ACL	Trimmer box cover	Co-60	2.2E6 pCi/g
		Mn-54	2.7E4 pCi/g
• 55 ACL	Beam line bellow	Co-60	2.5E5 pCi/g
• 56 ACL	Trimmer box smear	Identified U-233, U-234 and Np-237	
• 57 ACL	Iron filings from yoke	Co-60	25.9 pCi/g
• 58 ACL	Iron filings from yoke	Co-60	10.7 pCi/g
• 59 ACL	Iron filings from yoke	Co-60	10.8 pCi/g
• 60 ACL	Iron filings from yoke	Co-60	6.5 pCi/g
• 61 ACL	Iron filings from yoke	Co-60	5.4 pCi/g
• 62 ACL	Iron filings from yoke	Co-60	<0.2 pCi/g
• 63 ACL	Iron filings from yoke	Co-60	5.4 pCi/g
• 64 ACL	Iron filings from yoke	Co-60	7.7 pCi/g
• 65 ACL	Iron filings from yoke	Co-60	<0.2 pCi/g
• Analysis of black tape/insulation from the roof area of the Senior Cave		Cm-244	3.4E6 dpm
		Cs-137	3.8E4 dpm
		Pu-239	3.5E4 dpm
		Am-241	3.8E3 dpm
		Am-243	1.6E3 dpm
		Eu-154	1.8E3 dpm
		Cm-245	500 dpm

3.2 Radioanalysis of Material on Roof of Senior Cave

An analysis of a piece of insulation tape found on the roof of the Senior Cave revealed relatively high levels of various radionuclides: Cm-244; Cs-137; Pu-239; Am-241; Am-243; Eu-154; and Cm-245. Results are provided in Table 6 and the analytical data can be found in Appendix H.

3.3 Miscellaneous Waste Items

Various liquid samples were collected and analyzed from materials located in Room B126. The analytical results can be found in Appendix H. Sample #43 ACL, a ferrous ion solution, revealed an alpha activity level of 2.7 pCi/mL. Sample #45 ACL, glass wool in liquid, indicated an alpha activity level of 190 pCi/mL. An analysis of sample #47 ACL identified isotopes of thorium and Ra-226. Relatively high levels of C-14 were identified in samples #49 ACL and #51 ACL.

4.0 Gross Alpha/Beta Analyses of Paint and Concrete Samples

An analysis was made of paint scrapings and concrete scraping samples within the Facility. A summary of the gross alpha and beta measurements can be found in Appendix J. All of the samples were analyzed using the Tennelec gas-flow proportional counter. Each sample was analyzed for a total of 10 minutes. Virtually all of the samples were taken within the Cyclotron Hall (C-101). None of the 14 paint samples exhibited activity levels appreciably above background. The maximum activities measured in the group of samples were 3 dpm alpha and 20 dpm beta. None of the concrete samples exhibited levels appreciably above background. All four samples were taken from C-101. The alpha activity level measured for each sample was well within the instrument's normal background range. Beta activity levels measured were also low, the maximum level was 30 dpm.

5.0 In-Situ Gamma Measurements

- A series of in-situ gamma measurements were made within the cyclotron facility in order to identify the activation products present and their corresponding activity levels. The first set of measurements were made by personnel from Canberra Inc. using a portable gamma spectroscopy system consisting of a hyper-pure germanium detector with adjustable shield and collimator connected to a portable multi-channel analyzer and laptop computer. The entire counting system is commonly referred to as ISOCS, In-Situ Object Counting System. The ISOCS portable gamma spectroscopy system is designed to identify and quantify gamma-emitting radionuclides in various sized and shaped objects in the field. The following summary was provided by personnel from Canberra.

Measurement ACC-01:

The activity is contained in a set of accelerator "Dees" which have been inactive for several years. The Dees are metal blocks 130 cm by 46 cm in area, with a depth of about 30 cm. The activity is known to be contained within these components as a result of activation from accelerator particles, but the depth and/or location is unknown. The detector was set at a distance of 240 cm with the 25 mm, 90 degree collimator. Exposure rates near the Dees were 200 μR/hr, and not high enough to find any hot spots or elevated areas.

Quantitative results depend on the assumptions made concerning the volume of the Dees that are activated. Two geometries were tested – one assuming the entire volume is activated, and the second assuming a 5 cm depth of activation. The source geometry was a rectangle block of SS with a thickness of source (activation layer) of 30 cm or 5 cm. The results show similar concentrations for each geometry, although total source volume and activity would be different. Unfortunately, there was insufficient activity to allow for analysis of multiple lines to determine which activation depth is most appropriate.

ISOCS Reported Results

ACC01: Geometry 1 - 30 cm depth

Na-22	1.2 E1 pCi/g +/- 25%
Mn-54	3.8 E2 pCi/g +/- 3%
Co-60	4.1 E3 pCi/g +/- 3%
Zn-65	5.1 E2 pCi/g +/- 4%

ACC01: Geometry 2 - 5 cm depth

Na-22	1.4 E1 pCi/g +/- 28%
Mn-54	4.2 E2 pCi/g +/- 3%
Co-60	4.8 E3 pCi/g +/- 2%
Zn-65	5.8 E2 pCi/g +/- 4%

Measurement ACC-02:

The activity is in the form of activated components and parts which have been stored in a 5-gallon pail for waste disposal (sample ID #119). The detector was placed 188 cm from the pail and shielded with the 25 mm, 30 degree collimator.

Efficiency was a pipe simulating a 5-gallon pail filled with SS components. Since the pail was not solid SS, the density was adjusted to account for empty space in the pail. These changes made some differences in the final numbers (i.e. +/- 40%).

ACC02: ISOCS Reported Results

Na-22	8.7 E1 pCi/g +/- 1%
Co-60	1.1 E3 pCi/g +/- 4%

Measurement ACC-03:

Measurement of the activated Dees, as ACC01, except that the detector distance is 188 cm and the angle is slightly different.

ACC03: ISOCS Reported Results

Na-22	1.2 E2 pCi/g +/- 4%
Mn-54	5.1 E1 pCi/g +/- 2%
Co-60	3.3 E3 pCi/g +/- 2%
Zn-65	7.4 E1 pCi/g +/- 14%
Cs-137	8.0 E1 pCi/g +/- 9%

Measurement ACC-04

Same as ACC01 and ACC03 except that the angle is different and the distance is 193 cm.

ACC04: ISOCS Reported Results

Na-22	2.0 E1 pCi/g +/- 40%
Mn-54	2.7 E1 pCi/g +/- 22%
Co-60	3.7 E3 pCi/g +/- 2%
Zn-65	1.7 E2 pCi/g +/- 9%

Efficiency was the same as with ACC01 and ACC03, with similar results.

Measurement ACC-05:

Measurement of stainless steel canisters containing charcoal on the helium cart. Canisters are 53 cm tall by 15 cm diameter, with two side-by-side. The detector was placed at a distance of 75 cm and was shielded with the 50 mm, 90 degree collimator. There were low count rates with hand-held survey instruments at contact with the columns.

ACC05: ISOCS Reported Results

Co-60	9.2 E2 pCi/g +/- 2%

Efficiency was a pipe geometry with a SS casing and charcoal interior, uniform activity. Following this assay, the column was removed and a background counted at this location, with an activity equal to 10% of the column activity reported.

Measurement ACC-06:

Activity is assumed to be on the surface of a vacuum pump assembly, possibly the meter faces. The assembly is 60 cm x 61 cm x 61 cm. The detector was positioned 68 cm from the meter faces with the 50 mm, 90 degree collimator. There were low count rates with hand-held instruments on the face.

ACC06: ISOCS Reported Results

Co-60	2.8 E6 dpm/100 cm^2 +/- 4%
Eu-152	2.0 E3 dpm/100 cm^2 +/- 11%

Efficiency was a rectangle plane with surface contamination/activation. The background for this item was similar to that for ACC05 and was equivalent to the estimated surface contamination. Therefore, it is concluded that activity on the meter faces is below the detection limits of the *in situ* system.

TABLE 7 Canberra and In-Situ Object Counting System Results

Object/ Radionuclides			pCi/g		
Dees	ACC-01 A	ACC-01 B	ACC-03	ACC-04	Average
^{22}Na	12	14	120	20	41.5
^{54}Mn	380	420	51	27	219.5
^{60}Co	4,100	4,800	3,300	3,700	3,975.0
^{65}Zn	510	580	74	170	333.5
^{137}Cs			80		80.0
	5 gallon pail of parts ID# 119 (ACC-02)	SS charcoal canisters (ACC-05)	Vac pump meter fact (ACC-06) (dpm/100 cm^2		
^{22}Na	87				
^{60}Co	1,100	920	2,800,000		
^{152}Eu			2,300		

Note: A and B refer to two different counting geometries of the same object.

- ANL ESH/HP — A separate set of in-situ measurements were made by health physics personnel using a portable gamma spectrometry system. The results are summarized in Table 8. Five separate containers were assayed in order to identify the radionuclides present and to estimate activity levels. The dominant radionuclide identified was Co-60 and in two cases Bi-207, however, trace quantities of Zn-65, Cs-137, and Na-22 were also identified.

  The five gallon pail of waste materials analyzed as Measurement ACC-02 was also analyzed by ANL ESH/HP as Sample ID# 119. Both measurements systems identified the presence of Co-60. The ISOCS system reported 1100 pCi/g and the ESH/HP measurement reported 22 μCi total. The weight of the pail contents is estimated to be 41 lbs (18,614 g). The total activity in the pail using the ISOCS reported value is 20 μCi.

TABLE 8 ANL ESH/HP In-Situ Gamma Measurements

Dates
10/9/1997-10/14/97

Time	Count Time(s)	Exposure Rate @ Detector	Sample ID#	Description	Object Dimensions	Object Weight (lbs)	Calculated Activities (μCi)
1400	300	18 μR/h	114	blickman can filled to top with metal parts	(42 cm 35 od)	48	4.3 Cs-137 9 Co-60
1415	300	160 μR/h	109	plastic bucket filled with metal parts	(30 cm 31 od)	38.5	40 Bi-207 100 Co-60
	300	120 μR/h	109	same as above rotated 180	(30 cm 31 od)	38.5	40 Bi-207 100 Co-60
1340	300	64 μR/h	119	5 gal metal can filled with metal parts	(34 cm 31 od)	41.5	3.6 Zn-65 22 Co-60 54 Na-22
	300	—	119	same as above rotated 180	(34 cm 31 od)	41.5	3.6 Zn-65 22 Co-60 54 Na-22
1429	300	42 μR/h	170	1 ft^3 carton filled with metal parts	(37 cm 29 od)	30.6	2 Cs-137 28 Co-60 1.8 Na-22
	300	30 μR/h	170	same as above rotated 180	(37 cm 39 od)	30.6	2 Cs-137 28 Co-60 1.8 Na-22
1440	300	20 μR/h	115	plastic bucket filled with metal parts	(30 cm 32 od)	49	—
	300	24 μR/h	115	same as above rotated 180	(30 cm 32 od)	49	12 Co-60

6.0 Chemical Analyses of Samples

A listing of the samples submitted for chemical analysis can be found in Appendix K. All of the analytical results can be found in Appendix L.

6.1 Oil Sample Results

Oil samples were collected from the following six locations; the vacuum pumps in A-011 (3ACL), the hydraulic fluid systems in A-020 and B-012 (6ACL), the vacuum pumps in C-001 (13ACL), the cyclotron diffusion pumps (24ACL), the cyclotron ^{3}He pumps (25ACL), and the vacuum pumps on the service platform (32ACL). A comparison of the maximum analytical results to the limit values are given in the table below. These oil samples are not considered contaminated with radionuclides or other hazardous materials. A list of the oil samples and the analytical results above the detection limit is given at the beginning of Appendix L.

TABLE 9 Oil Sample Results

Analysis	Maximum Activity	Limit or Background Values
Aroclor 1016/1242	20,140 ppb	50,000 ppb
Gamma Spectroscopy	1.1 ± 0.11 pCi/g ^{214}Bi	1.22 ± 0.88 pCi/g ^{214}Bi
Gross α	0.8 ± 0.3 pCi/g	
Gross β	<4 pCi/g	
Ba Metal	31.6 μg/g	2,000.0 μg/g
Cd Metal	15.8 μg/g	20.0 μg/g
Pb Metal	77.9 μg/g	100.0 μg/g
Hg Metal	4.7 μg/g	4.0 μg/g

6.2 Water and Sludge Sample Results

Water and sludge samples were collected from the following five locations: the sump area in B-126 (11ACL), the window from C-101 to the Senior cave that contained a ZnBr and water solution (19ACL), the viewing port from the B-102 control room into C-101 (20ACL), the manifold on the service platform (31ACL), and the bottom of the cooling tower (35ACL). A comparison of the maximum analytical results to the limit values are given in the table below. There are low levels of α activity in the sample from the sump are in B-126 and the cooling tower. These water and sludge samples are not considered contaminated with radionuclides or other hazardous materials.

A stable pH reading could not be obtained for two samples, indicating that the sample is deionized. The samples are 11ACL from the B-126 sump area, and 35ACL from the bottom of the cooling tower. The reported values are listed in the summary table at the beginning of Appendix L.

TABLE 10 Aqueous Liquid and Sludge Samples

Analysis	Maximum Activity	Limit or Background Values
pH	5.43 to 7.73	≤2 or ≥12.5
Volatile Organic	None detected	>detection level[a]
Semivolatile Organic bis(2-ethylhexyl)phthalate	40.6 μg/L	1,000,000 μg/L
PCB	mg/L Aroclor 1254	50,000 ppb
Ba Metal	10.0 μg/mL	100.0 μg/mL
Cd Metal	0.11 μg/mL	1.0 μg/mL
Cr Metal	1.00 μg/mL	5.0 μg/mL
Pb Metal	1.08 μg/mL	5.0 μg/mL
Ag Metal	0.06 μg/mL	5.0 μg/mL
Hg Metal	5.73 μg/L	200.0 μg/L
Gamma Spectroscopy	0.60 ± 0.06 pCi/g ^{214}Bi	1.22 ± 0.88 pCi/g ^{214}Bi
Gross α	0.89 ± 0.09 pCi/mL	0.067 dpm/mL
Gross β	0.44 ± 0.04 pCi/mL	2.22 dpm/mL

[a] Current list of compounds regulated by RCRA has individual limits above the detection level

6.3 Unknown Sample Results

There were numerous ampules, buckets, bottles, beakers, vials, and bags unknown material and waste in room B-126, the three hoods in the room, the Senior Cave and the Junior Cave. For the material and waste with sufficient information for Waste Management disposal forms, the appropriate forms were completed and the waste was removed. Material and sources in the Senior Cave that had value to the Chemistry Division were moved from this cave to a Chemistry Material Balance Area. The remaining material was combined where appropriate, sampled and sent to the Analytical Chemistry Laboratory for characterization. Those samples are listed in Table 11 below with a summary of the available information. The complete analyses results are contained in

TABLE 11 Unknown Samples from the Hoods, the Junior Cave and the Floor of B-126

No.	Information from Analyses		Identification on Sample or Process Knowledge
10ACL	<0.04 pCi/g α;	<0.07 pCi/g β.	liquid in poly bottle from hood #1
29ACL	27,500 ± 2,800 pCi ^{22}Na; 599 ± 60 pCi ^{57}Co; 1,200 ± 120 pCi ^{88}Y; 48.7 ± 4.9 pCi ^{241}Am.	126 ± 13 pCi ^{54}Mn; 33.7 ± 3.4 pCi ^{60}Co; 70.3 ± 7.0 pCi ^{137}Cs;	powder from all bottles & beakers from Junior Cave
37ACL	135 ± 14 pCi/g ^{109}Cd;	30.7 ± 3.1 pCi/g ^{228}Th.	Wet crystals from hood #1
38ACL	<1.1 pCi/g α;	1.5 ± 0.5 pCi/g β.	bottle of liquid from hood #1
39ACL	17.5 ± 1.8 pCi/g ^{241}Am; 434 ± 43 pCi /g ^{237}Np.	74.0 ± 7.4 pCi/g ^{243}Am;	1 liter bottle from a 5 gallon waste container
40ACL	32,200 ± 3,200 pCi ^{144}Ce; 36,100 ± 3,600 pCi ^{241}Am; (3.56 ± 0.36) x 10^5 pCi ^{228}Th.	1,340 ± 130 pCi ^{226}Ra; (2.79 ± 0.28) x 10^5 pCi ^{234}Am;	solid crystals from hood #1
41ACL	20,900 ± 2,100 pCi ^{109}Cd; 7,700 ± 770 pCi ^{214}Bi;	12,400 ± 1,200 pCi ^{228}Th; 7,030 ± 700 pCi ^{226}Ra.	3 ampules of liquid from hood #1
42ACL	3,900 ± 600 pCi/mL ^{90}Sr.		liquid in scintillation vials
43ACL	2.7 ± 0.9 pCi/mL α;	0.8 ± 0.3 pCi/mL β.	Ferrous ion in water
44ACL	1.8 ± 0.8 pCi/mL α;	<0.4 pCi/mL β.	$FeHSO_4$ from $FeSO_4$
45ACL	(3.2 ± 0.5) x 10^4 pCi/ml ^{90}Sr.		3 M HNO_3 leached glass wool in water; 65k dpm βγ
46ACL	(1.1 ± 0.2) x 10^9 d/m ^{90}Sr/^{90}Y in -10mL of 2NHNO_3.		sludge in bottom of vial; 6R/h βγ, 2.5 mR/h γ
47ACL	(1.37 ± 0.07) x 10^6 d/m ^{226}Ra; (3.78 ± 0.38) x 10^4 d/m ^{228}Th.	(1.42 ± 0.07) x 10^6 d/m ^{214}Bi;	^{232}Th wet vial (15ml); 0.5 mR/h γ, 4 mR/h βγ: ^{230}Th dry vial; 0.5mR/h
48ACL	(5.2 ± 1) x 10^9 d/m ^{90}Sr/^{90}Y in -15mL of dilute HNO_3\HCl.		^{90}Sr 3 vials: (1) 20 ml; 150 mR/h βγ, 12 mR/h γ (2) dry; 1mR/h γ (3) small vial; 0.3mR/h γ, 200 mR/h βγ
49ACL	4600 ± 900 pCi/mL ^{14}C.		^{14}C vial
50ACL	<2.0 pCi/mL α;	5.7 ± 2.2 pCi/mL β.	4 vials ^{87}Y with liquid in columns (τ_2 = 3.35 days)
51ACL	(9.0 ± 1.8) X 10^5 pCi/mL ^{14}C.		powder ^{14}C (sample used up in the analysis)
52ACL	(1.4 ± 0.4) x 10^3 d/m ^{90}Sr/^{90}Y -80 mL liquid scintillation fluid. Majority of activity is present as the ^{229}Th contaminate.		9 vials scintillation; Exterior of vials 40k dpm α; smears 300 dpm α after decontamination; 11k dpm loose α
53ACL	36.3 ± 11.5 pCi/mL α;	184 ± 9 pCi/mL β.	^{176}Lu

Appendices H and L. The following samples need additional information in order to be removed by Waste Management.

7.0 Lead Paint Sample Analyses

Paint was analyzed for lead (Pb) at 31 locations within the facility including cinder block walls, doors, overhead ductwork, magnet surfaces, the cyclotron yoke, floor areas, and a few of the hydraulic pumps. All measurements were made in-situ using an XRF lead analyzer. Lead-containing paint was identified during the course of the survey. A summary of the survey results can be found in the Memo from M. Bonkalski and R. Utesch ESH/Industrial Hygiene to C. Sholeen which is located in Appendix M. The memo contains a tabulation of the lead survey results and some recommendations for future D&D work involving lead in painted surfaces.

8.0 Asbestos Measurements

A summary of the asbestos measurements made by ESH/IH personnel can be found in Appendix N. Since much of the pipe insulation was identified as asbestos-containing, individuals who may in the future be working near the identified materials should be notified and precautions should be taken during the removal of the material.

9.0 Summary of Areas and Items with Positive Results Greater than Background or Release Criteria

A summary of areas and items within the facility that are contaminated with radioactive materials or are contaminated with activation products is provided in Table 12. Areas include the interior of the Senior Care; the roof outside the Senior Care; fume hoods; the Junior Cave; Room B126; Room B118; Room C001; the cyclotron proper, beam lines, and associated equipment; miscellaneous materials and equipment stored in Room C101. Wall areas of C101 were inaccessible for survey because the shelves that lined the walls as shown in the Appendix C photos. These will have to be surveyed during the D&D.

10.0 Estimate of Activity Inventory in Cyclotron Components

Based on the results obtained from the radiological sample analyses of various cyclotron components, an estimate of the total activity inventory was made and is tabulated in Table 13. The estimated activity inventory for each of five radionuclides is as follows: Co-60, 2.6 mCi; Mn-54, 25 μCi; Na-22, 55 μCi; Zn-65, <10 μCi; and Cs-137, <10 μCi. A list of assumptions made in deriving these activity estimates is also included.

TABLE 12 Summary of Areas and Items with Positive Results Greater than Background or Release Criteria

Room No.	Location in Room	Description*	Removable Surface Activity dpm/100 cm sq	Total Surface Activity dpm/100 cm sq	Measured Exposure Rate
B126	Roof of senior cave	Contamination on tape covering cables (Am-241, Am-243, Pu-239, Eu-154, Cs-137, Cm-244, Cm-245)	4.0E6 α	–	–
B126	Roof of senior cave	Contamination around roof lifting rings	–	1,800 α 115,000 βγ	40 uR/h
B126	Senior cave roof	Crane above senior cave, contamination on cable in crane block	40 α 800 βγ	1,500 α 98,000 βγ	–
B126	Inside Senior Cave	5 gallon pail in plastic bag (Th-230, U-238 unknown quantity)	–	–	100 uR/h
B126	Inside Senior Cave	Six inch long stainless steel sealed pipe contains unknown quantity of Es-254	–	–	100 uR/h
B126	Three fume hoods	Inside of hoods contaminated in spots (Th-228, Th-230, Am-242, Am-243, U-238, U-234, Cm-243, Ra-226, Sr-90, Cd-109, Ni-63, Mn-54, I-129, Cs-137)	–	1,000 α 100,000 βγ	10 uR/h
B126	Along south wall	Sludge in sump (Th-228, Th-230, Am-242, Am-243, U-238, U-234, Cm-243, Ra-226, Sr-90, Cd-109, Ni-63, Mn-54, I-129, Sc-137)	–	1,000 βγ	–
B126	North exterior wall (door) of senior cave	Contaminated spot under large port	–	20 α plug 290 α 490,000 βγ	30 uR/h
B126	Inside senior cave	General contamination on south wall (walls have a wall covering and several layers of paint)	64 α 511 βγ	–	10 mR/h
B126	Inside senior cave	General contamination on floor. Floor is covered with an aluminum plate.	3,400 α 8,100 βγ	–	10 mR/h
B126	Inside senior cave	Contamination on ductwork along north wall	4,000 α 4,000 βγ	–	10 mR/h
B126	Inside senior cave	Contamination on lights and manipulator arms	560 α 1,000 βγ	–	10 mR/h
B126	Inside senior cave	(1D) 2R container of Ra-226 0.5 Ci in 20 mL HCL solution ~35 years old	100 α 1,000 βγ	–	250 mR/h contact with sample 90 mR/h container 10 mR/h @ 30 cm
		(#39) 2R container with set of calibration standards Sr/Y-90, 10 µCi Cs-137, 10 µCi	400 α 1,000 βγ	–	5 mR/h container 1 mR/h @ 30 cm

TABLE 12 (Cont.)

Room No.	Location in Room	Description*	Removable Surface Activity dpm/100 cm sq	Total Surface Activity dpm/100 cm sq	Measured Exposure Rate
B126	Inside senior cave (Cont.)	(1C) 2R container of sources Cm-243 20 μg in jar Ti-44, 10 μCi Cd-109, 10 μCi Ni-63, 2 μCi In-114, 125 μCi Mn-54, 60 μCi	850 α 9,000 βγ	–	2 mR/h container 0.1 mR/h @ 30 cm
		(1B) 2R container of sources Sr/Y-90, 100 mg Ti-44, 10 μCi Cd-109 10 μCi Ni-63, 2 μCi In-114, 125 μCi Mn-54, 60 μCi	2,500 α 6,000 βγ	–	4 mR/h container 0.5 mR/h @ 30 cm
		(1A) 2R container of Sr/Y-90 3 cans containing a total of 300 mg of strontium	1,100 α 2,500 βγ	–	1.5 R/h contact with sample 10 mR/h container 3 mR/h @ 30 cm
		Five gallon pail containing variety of sources Th-230 100 mL liquid Th-230 3 tubes, dry Th-230 solid piece U-238 75 mL liquid U-235 40 mL liquid U-238 300 mg solid	no loose external contamination	–	0.1 mR/h (container)
		Glass bottle containing 2 grams of Am-243 (packed in lead shot)	no loose external contamination	–	1 mR/h (container)
B126	Junior cave	Contamination on exterior wall See page D-7	–	20 α 7,000 βγ	20 uR/h
B126	Inside junior cave	Uniform contamination on interior walls. Note that the walls have several coats of paint. The cave was used for work with transuranics.	8 α 100 βγ	–	10 uR/h
B118	East wall of anteroom	Contamination under window about 1 foot above floor	–	1800 α	10 uR/h
B118	Door to B126	Several contaminated spots on door frame and door handle (no removable)	–	3,500 α 20,000 βγ	10 uR/h
C001/ C101	Cyclotron area	Activation of electrical meters on current regulator and DC generator	–	12,000 βγ	170 uR/h
C001	Along west wall	Ion sources hung on wall	–	16,000 βγ	160 uR/h
C001	Walls	Activation of five public announcement speakers hung on walls	–	2,200 βγ	26 uR/h

TABLE 12 (Cont.)

Room No.	Location in Room	Description*	Removable Surface Activity dpm/100 cm sq	Total Surface Activity dpm/100 cm sq	Measured Exposure Rate
C101	Main floor of cyclotron vault room	Activation of four public announcement speakers on walls	–	33,000 βγ	380 uR/h
C101	Along north wall	Activation of stainless steel helium-3 recovery cart, and dials on gauges. Vacuum pump contains oil. Canisters of Co-60, 920 pCi/g	–	90 α 319,000 βγ	1.5 mR/h
C101	Along north wall	Several spots of contamination on floor of fume hood stored in front of shelving (Sr-90, Y-90) Hood is not connected to ventilation system.	–	2.5E6 βγ	30 mR/h
C101	Along north wall	Activation of tools for opening cyclotron trimmer box, leak tester, and HEPA vacuum cleaner	–	44,000 βγ	200 uR/h
C101	East end of cyclotron	Large diffusion pump connected to cyclotron vacuum chamber. Pump contains oil.	–	27,000 βγ	200 uR/h
C101	North and east walls	Miscellaneous parts on steel shelving. There are also some sheets of lead	–	9,000 βγ	100 uR/h
C101	Along east wall	Activation of piping stacked on floor	–	18,000 βγ	100 uR/h
C101	Along east wall	Ten 5 gallon buckets of targets and beam line parts	–	2.0E6	5 mR/h
C101	South side of cyclotron	Contamination inside of beam pipes connected to south side of cyclotron	8500 α 40,000 βγ	–	5 mR/h
		Contamination on exterior surfaces of beam pipes	326 α 900 βγ	–	1 mR/h
		Beam pipe bellows (135 pico Ci Co-60 per sample weight)	–	–	–
C101	Cyclotron	Steel yoke of cyclotron (207 pico Ci Co-60 per gram, 7.4 pico Ci Mn-54 per gram)	–	–	–
		Inside Dees at splitter support	–	–	1.6 R/h βγ 0.3 R/h γ
		Splitter inside Dees	15,000 βγ	–	4 R/h βγ 0.6 R/h γ
		Trimmer box cover (18.3 pico Ci Mn-54/sample weight, 1460 micro Ci Co-60 /g, 1.0E-5 micro Ci Co-60/smear)	230,000 βγ	–	500 uR/h βγ
		Target ports Pole pieces (114 pCi of Co-60 per gram of material)	8,000 βγ	–	60 mR/h βγ 5 mR/h γ

* Sample activity analyses from various accelerator components and structures represent discrete measurements and cannot be extrapolated to be representative of the entire volume of the object or item.

TABLE 13 Estimate of Activity Inventory in Various Cyclotron Materials

Item	Material	Assumption Number	Approx. Mass (grams)	Approx. Weight (lbs)	Activation Fraction (%)	Co-60 (curies)	Mn-54 (curies)	Na-22 (curies)	Zn-65 (curies)	Cs-137 (curies)
Dees	Copper	1	3.20E+05	706	30%	1.40E-04	1.76E-06			
Acceleration chamber	Steel	2	1.17E+07	25,799	10%	1.71E-03	2.14E-05			
RF liner in acceleration chamber	Copper	3	4.76E+05	1,050	15%	1.04E-04	1.31E-06			
Magnet pole pieces	Steel	4	4.48E+07	98,784	5%	2.55E-04				
Magnet yoke	Steel	5	1.83E+08	403,515	1%	2.09E-04	1.35E-05			
Magnet coils	Aluminum	6	2.76E+07	60,858	No data available to estimate activity content					
Beam pipes	Steel	7	4.24E+04	93	10%	5.72E-07				
Bucket of target holders	Steel	8	1.88E+04	41	–	2.20E-05		5.40E-05	3.60E-06	
Bucket of target holders	Steel	8	1.38E+04	30	–	2.80E-05		1.80E-06		2.00E-06
Bucket of target holders	Steel	8	2.22E+04	49	–	1.20E-06				
Bucket of beam line parts	Steel	8	1.75E+04	39	–	1.00E-04				
Bucket of beam line parts	Steel	8	2.18E+04	48	–	9.00E-06				4.30E-06
Totals						2.58E-03	3.8E-05	5.58E-05	3.60E-06	6.30E-06

Assumptions:

No. 1 To estimate the mass, the Dees are considered to be a hollow, closed end, right circular cylinder which has a outside diameter of 48 inches and is 4 inches long. The wall thickness is 0.25 inches. The two stems are 12 inch diameter (OD) copper pipes with a 0.25 inch wall thickness, and 50 inches long. The density used for copper is 8.96 g/cubic cm. The activity concentrations are 18.3 pico Ci Mn-54/gram of copper, and 1460 pico Ci Co-60/gram of copper. Though smears showed removable activity up to 105,000 pico Ci Co-60, the total removable activity is considered very small compared to the bulk induced activity.

No. 2 The acceleration chamber is considered as a rectangular box which is 60 inches wide, 72 inches long, and 9 inches high. The average thickness of the 9 inch high walls is estimated to be 0.75 inch. The top and bottom lids of the box (the chamber) are discs which are 60 inches in diameter and 5 inches thick. The discs (which shorten the magnet pole gap) are made of magnet steel. The chamber is the vacuum container for the Dees and is constructed of chrome nickel nonmagnetic stainless steel. The average density used in the mass calculation is 7.87 g/cubic cm. Because one end of the box is open and cover plates on the sides are less than 0.75 inches thick, the effective mass of the box (excluding the two lids) is reduced by half. The activity concentration is assumed to be the same as that found in the trimmer box and the Dees (i.e., 18.3 pico Ci Mn-54 per gram of material, and 1460 pico Ci Co-60 per gram of material).

No. 3 The RF liners, attached to the inside top and bottom of the acceleration chamber, are considered to be a solid copper plate which is 60 inches by 72 inches by 0.375 inch. The density is 8.96 g/cubic cm. The activity concentration is assumed to be the same as that found in the trimmer box and the Dees (i.e., 18.3 pico Ci Mn-54 per gram of material, and 1460 pico Ci Co-60 per gram of material).

TABLE 13 (Cont.)

No. 4 Each of the two pole pieces are treated as a right circular cylinder that is 74 inches in diameter and 40 inches long. The poles are made of soft iron (magnet steel). The activity is 114 pico Ci Co-60 per gram of material.

No. 5 The yoke is a 164 inch high, by 206 inch wide, by 74.375 inch deep rectangular solid which has a rectangular hole which is 102 inches high, 144 inches wide, and 74.375 inches deep. The density is 7.87 g/cubic cm. The activity concentration is 207 pico Ci Co-60 per gram of material, and 7.4 pico Ci Mn-54 per gram of material.

No. 6 The two magnet coils are made of hollow core aluminum straps. It is estimated that about 0.82 of the coils in solid aluminum. Each coil is a cylinder 138 inches in diameter by 30 inches long with a hole which is 76 inches in diameter and 30 inches long. The density is 2.698 g/cubic cm. No data available to estimate radioactivity content of the magnet coils.

No. 7 Beam pipes are 2 inch outside diameter by 447 inches long, with 0.124 inch wall. The density is 7.78 g/cubic cm. The activity concentration is assumed to be the same as that for the bellows (i.e., 135 pico Ci Co-60 per gram of material).

No. 8 In situ measurements were made of these items.

11.0 Summary and Key Findings

11.1 Duct work in the fan loft serving the B126 fume hood exhaust systems and the caves was found to be contaminated with alpha and beta activity in excess of natural background. Loose alpha/beta surface contamination was found in the exhaust ducts upstream of the HEPA filters; no loose contamination was found downstream of the HEPA filters. Direct measurements made of the internal surfaces of the duct work with a dual phosphor scintillation detector indicated that fixed alpha/beta contamination was present both upstream and downstream of the HEPA filters.

11.2 Inside the Senior Cave there is an assortment of radioactive sources including a 0.5 Ci Ra-226 source (250 mR/h on contact source unshielded); a total of 300 mg of Sr/Y-90 (1.5 R/h on contact); a five gallon pail containing sources of thorium and uranium; and a variety of small sources in the range of 10-100 uCi.Consult Table 12 for a complete listing.

11.3 The highest exposure rates measured were in close proximity to the splitter in the cyclotron dees, 1.6 R/h (ion chamber window open) and 0.3 R/h (window closed).

11.4 The roof of the Senior Cave is contaminated with curium, cesium, plutonium, americium and europium. Consult Table 12 for a complete description. Removable surface contamination levels vary up to 4E6 dpm alpha per 100 cm^2.

11.5 The three fume hoods in B126 contain varying levels of surface contamination up to 100,000 dpm beta per 100 cm^2 and 1,000 dpm alpha per 100 cm^2.

11.6 The cyclotron beam lines in C101 and in the basement along the ceiling were found to be internally contaminated as a result of activation.

11.7 The radioactive material pails in C001 were never opened. Although external radiation levels were 10-15 μR/h, caution should be used in opening these containers to avoid an airborne problem.

11.8 Using the information in Table 13, the total activity inventory for the cyclotron proper is estimated to be 2.7 mCi with Co-60 contributing to nearly 97% of this value.

11.9 Virtually all of the painted surfaces within the facility contain lead (Pb).

11.10 An estimate cannot be readily made as to the volume of structural materials and components that might be ultimately free-released and recycled. There are two fundamental difficulties with such an assessment: (1) radiation-background levels in many areas make it difficult to perform such estimates and (2) there is a significant amount of uncertainty associated with the spatial distribution of activated materials within various structures. Also, it is not clear whether proper guidance exists pertaining to the free-release of volume-activated structures.

APPENDIX A:

RADIOLOGICAL SURVEY INSTRUMENT CALIBRATION CERTIFICATES

Certificate #029-C1
rev. 1.0, Dec. 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1782 Procedure#: **029** Configuration: **uR Field**
Type: _**X**_ Energy Compensated GM

Unit#: 6486 Mfr/Model: **Eberline ASP-1** S/N: 2463
Unit#: 6575 Mfr/Model: **TGM N378S/BNC** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 545
Electrostatic KiloVoltmeter: ______________________, S/N ______
Gamma Source G137 , S/N 7085

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

High Voltage: 450 Vdc (ref.: 450 V)
HV Cal: ✓
Threshold: 28 mV (ref.: 30 mV); Window: Gross
Range Switch Check: ✓ Audible Function Check: ✓
Integrate Function Check: ✓

Dial: X1M to X10 Rate Unit: uR/h
Dip Switches: 132
Dead Time: ~~200~~ usec Test: Run
Min Sw: Open Hour Sw: Closed
Cal Sw 3: **Closed** Cal Sw 4: **Open**
Audio: Divide by 1

As Found Std. Current: 0.55

Pre-Calibrator Date 9-4-97

II) PRIMARY CALIBRATION:

Range	Field Intensity (uR/h)	Source to Detector Distance (cm)	As Found (uR/h)	As Left (uR/h)	% Diff. Field vs As Left
1K	.5	250x8K	.5	.5	
10K	50	150x800	5.0	5.0	
100K	500	150x80	52	52	
1M	445	150x8	OVERLOAD		

As Left Std. Current: .55
As Left Dead Time: 132 usec

REMARKS: ______________________

Primary-Calibrator Date 9/8/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1787 Procedure#: **015** Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 6403 Mfr/Model: **NE Technology Electra** S/N: 1798
Unit#: 6444 Mfr/Model: **NE Technology DP6D** S/N: 1621

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR90, S/N DP631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.3 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 865, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 33.9K Alpha cpm: 30.1 (e.g., .08 % of beta) ✓
ULD (Parameter #6): 2.0 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 µA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 µsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.2K cpm; .190 % efficiency (alpha)
Alpha Mode Bkgd: 0 cpm (ref.: < 7 cpm)
Response to Beta Std: 33.9K cpm; .331 % efficiency (beta)
Beta Mode Bkgd: 306 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 7/1/97

Certificate #015-A1
rev. 1.1, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 168 Procedure#: **015** Configuration: **Surface Contam**
Type: _X_ 61 sq cm propane flow prop. ctr.

Unit#: 7668 Mfr/Model: **Eberline PAC-4G-3** S/N: 4353
Unit#: 6893 Mfr/Model: **Eberline AC-21** S/N: —

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: Rawson ,S/N 12048
Alpha Sources Pu239 ,S/N 7534, 7686, 7687, 7688
Beta Source Tc99 ,S/N 17

I) MAINTENANCE/PRECALIBRATION:

Batteries: II Cabling: ____ Mechanical/Cleanliness: I
Probe Window: ok Feedthrough Connector: ok

Gas Flow - Operate Flame Height: 1/2 inches (ref.: 3/4")
Flush Flame Height: 2 inches (ref.: 2")
I — Threshold: 2 mV (ref.: 2 mV)
Audible Function Check: ok
Alpha High Voltage: 1600 Vdc (ref.: 1600 V)

Pre-Calibrator Date 5/10

II) PRIMARY CALIBRATION:

Range (cpm)	Alpha Standard (dpm/2)	As Found (cpm)	As Left (cpm)	% Diff. Standard vs As Left
0-500 lin	367	300	350	
500-5k log	4.4K	2.5k	4.5K	
5k-50k lin	29.6K	22K	30 K	
50k-500k log	455K	350K	450K	
Beta Standard:	30K(2π)	45K	30K	

III

Alpha Mode Bkgd: 2-3 cpm reading
Beta Mode Bkgd: 252 cpm reading
Repair
~~REMARKS~~: I - gas reg - & battery pac. II - replace batter.
III - re-cal.

Primary Calibrator Date 10/5/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 140 Procedure#: **018** Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4590 Mfr/Model: **Eberline PRM-5-3** S/N: 2784
Unit#: 2803 Mfr/Model: **Eberline PG-2** S/N: 2775

Pulse Generator, Eberline MP- 1, S/N 515
Electrostatic KiloVoltmeter: NA, S/N ______

Source(s): Pu-239	,S/N 7552	,Activity 4150000 dpm
Am-241	,S/N 7551	,Activity 6028000 dpm
U-235	,S/N 22B6102	,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

Threshold: 13 mV (fixed at 5 to 10 mV)
Window: 16 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ✓

Pre-Calibrator ______ Date 2-8-97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
500	400	400	400	0%
5K	4K	4K	4K	0%
50K	40K	40K	40K	0%
500K	400K	400K	400K	0%

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	15K	15K	N/A
HV- 2	Am-241	150K	300K	N/A
HV- 3	U-235	100K	100K	N/A

Mode of Operation: **HV- 1**, **Gross**
Ambient Bkgd in chosen Oper. Mode: 1K cpm (ref.: > 300 cpm)

REMARKS: ______

Primary-Calibrator ______ Date 2-8-97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 96 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4524 Mfr/Model: **Eberline PRM-5-3** S/N: 2912
Unit#: 2973 Mfr/Model: **Eberline PG-2** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: S Rawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: ok Cabling: ok Mechanical/Cleanliness: ok

Threshold: 10 mV (fixed at 5 to 10 mV)
Window: 12.5 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator

Date 10/97

II) PRIMARY CALIBRATION:

I —

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	400	400	
R3	4K	4K	4K	
R4	40 K	40K	40K	
R5	400K	350K	400K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	14K	15K	N/A
HV- 2	Am-241	300K	300K	N/A
HV- 3	U-235	55K	75K	N/A

Mode of Operation: **HV- 1** , **Gross**
Ambient Bkgd in chosen Oper. Mode: 600 cpm (ref.: > 300 cpm)

repairs
~~REMARKS~~: I - re-cal.

Primary-Calibrator

Date 10/2/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 74 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4514 Mfr/Model: **Eberline PRM-5-3** S/N: 2300
Unit#: 7900 Mfr/Model: **Eberline PG-2** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: Sensor , S/N 15374
Source(s): Pu-239 , S/N 7552 , Activity 4150000 dpm
Am-241 , S/N 7551 , Activity 6028000 dpm
U-235 , S/N 22B6102 , Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

I

Batteries: ok Cabling: ok Mechanical/Cleanliness: ok

Threshold: 14 mV (fixed at 5 to 10 mV)
Window: 17.5 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator Date 9/97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	425	400	
R3	4k	4.3k	4k	
R4	40 K	37k	40K	
R5	400K	360K	400K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	10K	10K	N/A
II — HV- 2	Am-241	110K	200K	N/A
HV- 3	U-235	50K	50K	N/A

Mode of Operation: **HV- 1 , Gross**
Ambient Bkgd in chosen Oper. Mode: 2,5K cpm (ref.: > 300 cpm) 360-k

Repairs ~~REMARKS:~~ I - meter movement sticks occasionally and re-set zero's
II - re-cal.

Primary Calibrator Date 9/08/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 69 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4428 Mfr/Model: **Eberline PRM-5-3** S/N: 2797
Unit#: 7852 Mfr/Model: **Eberline PG-2** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 535
Electrostatic KiloVoltmeter: 6508 , S/N 65-1260
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

Threshold: 8 mV (fixed at 5 to 10 mV)
Window: 10 mV = ✓ % (ref.: 25% of Threshold mV)
Audible Function Check: ✓

Pre-Calibrator

Date 8-4-97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
500	400	400	400	0%
5K	4K	4K	4K	0%
50K	40K	40K	40K	0%
500K	400K	400K	400K	0%

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	10K	10 K	N/A
HV- 2	Am-241	150K	150 K	N/A
HV- 3	U-235	100 K	100 K	N/A

Mode of Operation: HV- 1 , Gross
Ambient Bkgd in chosen Oper. Mode: 1K cpm (ref.: > 300 cpm)

REMARKS: ______

Primary-Calibrator

Date 8-4-97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 16 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4415 Mfr/Model: **Eberline PRM-5-3** S/N: 2911
Unit#: 9162 Mfr/Model: **Eberline PG-2** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: ERawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: OK Cabling: I Mechanical/Cleanliness: I

Threshold: 11 mV (fixed at 5 to 10 mV)
Window: 13.7 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator

Date 2/97

II) PRIMARY CALIBRATION:

II

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	400	400	
R3	4K	5K	4K	
R4	40K	45K	40K	
R5	400K	500K+	400K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

II

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	3.2K	12K	N/A
HV- 2	Am-241	350K	340K	N/A
HV- 3	U-235	50K	52K	N/A

Mode of Operation: **HV- 1 , Gross**
Ambient Bkgd in chosen Oper. Mode: 300 cpm (ref.: > 300 cpm)

REMARKS: I. attach dove tail to det. & repair cable.
II.- recal

Primary-Calibrator

Date 2/3/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 169 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4423 Mfr/Model: **Eberline PRM-5-3** S/N: 3017
Unit#: 6199 Mfr/Model: **Eberline PG-2** S/N: ______

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: S Rawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: I Cabling: ok Mechanical/Cleanliness: ok

Threshold: 11 mV (fixed at 5 to 10 mV)
Window: 13.7 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator

Date 7/97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	400	400	
R3	4K	4.25	4K	
R4	40 K	40K	40K	
R5	400K	400K	400K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
II HV- 1	Pu-239	12K	12.5K	N/A
HV- 2	Am-241	250K	275K	N/A
HV- 3	U-235	52K	55K	N/A

Mode of Operation: **HV- 1** , **Gross**
Ambient Bkgd in chosen Oper. Mode: ~~2K~~ 1K cpm (ref.: > 300 cpm)

REMARKS: I - repair & replace batteries
II - re-cal.

Primary-Calibrator

Date 7/14/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 172 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4612 Mfr/Model: **Eberline PRM-5-3** S/N: 2982
Unit#: 2844 Mfr/Model: **Eberline PG-2** S/N: ―

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: Brawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: I Cabling: ok Mechanical/Cleanliness: II

Threshold: 12 mV (fixed at 5 to 10 mV)
Window: 15 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator 7/97 Date

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	325		
R3	4k	4.2k		
R4	40 K	5K		
R5	400K	40K		

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	12K	12K	N/A
HV- 2	Am-241	275K	275K	N/A
HV- 3	U-235	50K	50K	N/A

Mode of Operation: HV- 1 , Gross
Ambient Bkgd in chosen Oper. Mode: 2.2K cpm (ref.: > 300 cpm) (366-L

REMARKS: I- batteries II- estatic meter rep. on over

Primary-Calibrator 7/24/97 Date

Certificate #018-A0
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 182 Procedure#: 018 Configuration: **Scintillator**

Type: ___ 2 mm NaI X 1x1 NaI ___ 2x2 NaI
___ 1x1 plastic ___ 2x2 plastic ___ Other

Unit#: 4489 Mfr/Model: LUDLUM MODEL 12 S/N: 9023
Unit#: 6921 Mfr/Model: EBERLINE PG-1 S/N: NA

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ____________, S/N ______
Source(s): PU239, S/N 7552, Activity 4,150,000 DPM
____________, S/N ______, Activity ______
____________, S/N ______, Activity ______

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

Threshold: 11 mV (typ.: 5 to 10 mV)
Window: — mV = — % (typ.: 25 to 50% of Threshold mV)
Audible Function Check: ✓

Jerry Letizia
Pre-Calibrator

2/4/97
Date

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
X1	400	400	400	0%
X10	4K	4K	4K	0%
X100	40K	40K	40K	0%
X1K	400K	400K	400K	0%

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV-___	PU-239	24K	24K	—
HV-___				
HV-___				

Mode of Operation: HV-___, — (PHA or Gross)
Ambient Background in chosen Operational Mode: 600 cpm

REMARKS: ______________________________

Jerry Letizia
Primary-Calibrator

2/4/97
Date

Certificate #015-A2
rev. 1.1, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 501 Procedure#: 015 Configuration: **Surface Contam**
Type: X 330 sq cm (floor monitor) propane flow prop. ctr.

Unit#: 4601 Mfr/Model: **Eberline PAC-4G-3** S/N: —
Unit#: 7282 Mfr/Model: **Eberline AC-22** S/N: —

Pulse Generator, Eberline MP- 1 , S/N 203
Electrostatic KiloVoltmeter: Rawson , S/N 15374
Alpha Sources Pu-239 , S/N 7686 - 7534 - 7687 - 7688
Beta Source Tc-99 , S/N 17

I) MAINTENANCE/PRECALIBRATION:

Batteries: I Cabling: II Mechanical/Cleanliness: [illegible]
Probe Window: III Feedthrough Connector: II

Gas Flow - Operate Flame Height: 3/4 inches (ref.: 3/4")
Flush Flame Height: 2.5 inches (ref.: 2")
Threshold: IV mV (ref.: 2 mV)
Audible Function Check: OK
Alpha High Voltage: OK Vdc (ref.: 1600 V)

Pre-Calibrator Date 8/97

II) PRIMARY CALIBRATION:

Range (cpm)	Alpha Standard (dpm/2)	As Found (cpm)	As Left (cpm)	% Diff. Standard vs As Left
0-500 lin	361	200	350	
500-5k log	44k	2K+	4.5	
5k-50k lin	24.6k	46k	30 k	
50k-500k log	455k	500K+	400K	
Beta Standard:	59K	15K	30K	

V

Alpha Mode Bkgd: 3-4 cpm reading
Beta Mode Bkgd: ______ cpm reading

~~REMARKS:~~ Repair I - batteries, replace bulb II - clean connectors III - replace window IV - reset input threshold IIII - re-adjust reg. V - re-cal.

Primary-Calibrator Date 8/27/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 281 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4421 Mfr/Model: **Eberline PRM-5-3** S/N: 2814
Unit#: 2913 Mfr/Model: **Eberline PG-2** S/N: —

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: ERawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: I Cabling: ok Mechanical/Cleanliness: II

III Threshold: 10 mV (fixed at 5 to 10 mV)
Window: 12.5 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator Date 2/97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	400	400	
R3	4K	4K	4K	
R4	40K	40K	40K	
R5	400K	400K	400K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	12K	12K	N/A
HV- 2	Am-241	250K	250K	N/A
HV- 3	U-235	125K	48K	N/A — ~~[illegible]~~ 1st peak

Mode of Operation: **HV- 1** , **Gross**
Ambient Bkgd in chosen Oper. Mode: 150 cpm (ref.: > 300 cpm)

REMARKS: I - replace batteries, II - repair det.
III - re-set window

Primary-Calibrator Date 2/2/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 357 Procedure#: 018 Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4762 Mfr/Model: **Eberline PRM-5-3** S/N: 2793
Unit#: 7990 Mfr/Model: **Eberline PG-2** S/N: ——

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: Rawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

II

I) MAINTENANCE/PRECALIBRATION:

Batteries: ok Cabling: ok Mechanical/Cleanliness: Fair

Threshold: 13 mV (fixed at 5 to 10 mV)
Window: 16.2 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ~~ok~~ I

Pre-Calibrator Date 9/97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	390	400	
R3	4k	3.6k	4k	
R4	40 K	38 K	40 K	
R5	400K	370 K	400 K	

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	16K	19K	N/A
HV- 2	Am-241	300k	325K	N/A
HV- 3	U-235	60k	75K	N/A

Mode of Operation: **HV- 1** , **Gross**
Ambient Bkgd in chosen Oper. Mode: 2K cpm (ref.: > 300 cpm)
Repair/ REMARKS: I - SKI - speaker) II - Repair HV Board

Primary-Calibrator Date 9/3/97

Argonne National Laboratory
Health Physics Instrument Group

Certificate #029-A4
rev. 1.0, Jan. 1994

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 433 Procedure#: **029** Configuration: **uR Field**

Type: _X_ 1x1 plastic scint.

Unit#: 4850 Mfr/Model: **Bicron micro-rem** S/N: A297J

Pulse Generator, Eberline MP- 2, S/N 775

Electrostatic KiloVoltmeter: ESD 9, S/N 13443

Gamma Source CS137, S/N 7083

I) MAINTENANCE/PRECALIBRATION:

Mechanical: ✓ Cleanliness: ✓ Batteries: ✓

Cabling: ✓ Meter Mechanical Zero: ✓

Meter- Zero: ✓; Span: ✓

Threshold: ✓ mV (not adjustable)

On Plateau?: YES (should respond to Am-241 gammas)

High Voltage: ✓ Vdc (typically near 800 V)

High Voltage OK Indication: OK (within checkband)

Pre-Calibrated by: Jerry Lettieri Date: 3/6/97

II) PRIMARY CALIBRATION:

	Range	*****Mid-Field****				**Low-Field***			**High-Field**	
		Field	As Found	As Left		Field	Response		Field	Response
	(0 to 200 urem/h)									
230 X20	x1000	89.78	82	82	230X40	42.33	36	230x10	172.31	165
230 X200	x100	9.02	9	9	230x400	4.49	4.1	230x100	17.55	18.0
270 X2K	x10	1.04	.9	.9	270x8K	.498	.4	270x800	1.53	1.5

Electronic Calibration, referenced to the x10 range as follows: ____ cpm = ____ urem/h

x1	.09	.09	.09	NA	NA	.15	.15
x0.1	.01	.008	.008				

Off-Scale Response?: ✓ (field should be 2x the top range)

Conditions: Pressure 747 ; Temperature 20°C

REMARKS:

Primary-Calibrator: Jerry Lettieri Date: 3/27/97

Re-Calibration Due Date: 9/97

Certificate #018-A1
rev. 1.0, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 443 Procedure#: **018** Configuration: **Scintillator**
Type: _X_ 2 mm NaI

Unit#: 4464 Mfr/Model: **Eberline PRM-5-3** S/N: 2947
Unit#: 2446 Mfr/Model: **Eberline PG-2** S/N: ——

Pulse Generator, Eberline MP- 1 , S/N 200
Electrostatic KiloVoltmeter: SRawson ,S/N 15374
Source(s): Pu-239 ,S/N 7552 ,Activity 4150000 dpm
Am-241 ,S/N 7551 ,Activity 6028000 dpm
U-235 ,S/N 22B6102 ,Activity 1.06 g foil

I) MAINTENANCE/PRECALIBRATION:

Batteries: ok Cabling: I Mechanical/Cleanliness: ok

Threshold: 10 mV (fixed at 5 to 10 mV)
Window: 12.5 mV = 25 % (ref.: 25% of Threshold mV)
Audible Function Check: ok

Pre-Calibrator

Date 7/97

II) PRIMARY CALIBRATION:

Range (cpm)	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
R2	400	375	400	
R3	4K	3.8K	4K	
R4	40K	40K	40K	
R5	400K	400K	400K	

II-

With PHA in, adjust HV to maximize detector response to isotope of interest:

Mode	Isotope	Response As Found (cpm)	Response As Left (cpm)	Efficiency (If Applicable) (%)
HV- 1	Pu-239	15K	22K	N/A
HV- 2	Am-241	140K	400K	N/A
HV- 3	U-235	150K	100K	N/A—set for net go

Mode of Operation: HV- 1 , Gross
Ambient Bkgd in chosen Oper. Mode: 2.5K cpm (ref.: > 300 cpm) (-360

REMARKS: I - repair cable connector.
II - re-cal.

Primary Calibrator

Date 7/23/97

Argonne National Laboratory
Health Physics Instrument Group

Certificate #029-A1
rev. 1.0, Jan. 1994

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 506 Procedure#: **029** Configuration: **uR Field**
Type: _X_ 1x1 NaI scint.

Unit#: 4903 Mfr/Model: **Eberline PRM-7** S/N: 200

Pulse Generator, Eberline MP- 1, S/N 200
Electrostatic KiloVoltmeter: Rawson, S/N 15374
Gamma Source Cs-137, S/N 213

I) MAINTENANCE/PRECALIBRATION:

Mechanical: ok Cleanliness: ok
Batteries: ok Cabling: ok Meter Zero: ok

Threshold: 12 mV (fixed near 15 mV)
PMT Gain Adj.: ok (only if new PMT, then maximize)
On Plateau?: ok (should respond to Am-241 gammas)
High Voltage: I Vdc (typically near 1000 V)
Audible Function Check: ok (divides by 16)

Pre-Calibrated by: Date: 7/3/97

II) PRIMARY CALIBRATION:

Range (uR/h)	*****Mid-Field**** Field	As Found	As Left	**Low-Field*** Field	Response	**High-Field** Field	Response
5000	2.24	2.2	2.2	.9	.9	3.5	3.4
500	.22	.20	.20	.09	.09	.36	.36

Electronic Calibration, referenced to the 500 uR/h range as follows: 40K cpm = 160 uR/h

50		16		8		32	
25		8		4		16	

Off-Scale Response?: ____ (field should be 2x the top range)

Conditions: Pressure 746 ; Temperature 74°F

REMARKS: I- high voltage erratic - re-solder connection

Primary-Calibrator: Date: 7-9-97
Re-Calibration Due Date:

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 504 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 4963 Mfr/Model: **NE Technology Electra** S/N: 290
Unit#: 7565 Mfr/Model: **NE Technology DP6** A S/N: 385

Pulse Generator, Eberline MP- 2, S/N 774
Electrostatic KiloVoltmeter: ESD, S/N 950556
Alpha Source: Am241, S/N DY457, Activity 66,170 dpm
Beta Source: SrY90, S/N DN652, Activity 118,300 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ok Cabling: ok Mechanical/Cleanliness: ok
Battery Voltage (Parameter # 0): 4.5 (ref: > 4)
Threshold: 25mv (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: ok
HV Calib.: ok (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = ~~930~~ 950v, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 35.2K Alpha cpm: 22 (e.g., 0.06 % of beta)
ULD (Parameter #6): 2.05 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): ✓ 10 μA, ✓ then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, ✓ then INHIBIT: ✓
Parameter #8 (Units): cpm ✓
Parameter #A (inhibit bkgd subt): set to ON ✓
Parameter #b (inhibit integrate): set to OFF ✓
Parameter #C (rate mode): set to Auto ✓
Parameter #E (pulse mode): set to dUAL ✓
Parameter #F (ohms): set to S66 ✓

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.7k cpm; 20.7 % efficiency (alpha)
Alpha Mode Bkgd: 4 cpm (ref.: < 7 cpm)
Response to Beta Std: 35.2k cpm; 29.7 % efficiency (beta)
Beta Mode Bkgd: 372 cpm (ref.: < 400 cpm)
Integrate Check: ok Audible Functional Check: ok

Parameter #8 (Units): change from cpm to **dpm** ✓
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF ✓ (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Robert Keen Date: 8/9/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 505 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 4965 Mfr/Model: **NE Technology Electra** S/N: 292
Unit#: 7567 Mfr/Model: **NE Technology DP6**A S/N: 381

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM 241, S/N DV961, Activity 63910 dpm
Beta Source: SR 90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 820, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 30.7K Alpha cpm: 30 (e.g., <.01 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.3K cpm; .208 % efficiency (alpha)
Alpha Mode Bkgd: 5 cpm (ref.: < 7 cpm)
Response to Beta Std: 30.7K cpm; .299 % efficiency (beta)
Beta Mode Bkgd: 342 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Jerry Date: 9/8/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 792 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 6408 Mfr/Model: **NE Technology Electra** S/N: 1830
Unit#: 6497 Mfr/Model: **NE Technology DP6BD** S/N: 1635

Pulse Generator, Eberline MP- 2 , S/N 775
Electrostatic KiloVoltmeter: ESD 9 , S/N 13443
Alpha Source: AM241 , S/N DV961 , Activity 63910 dpm
Beta Source: SR90 , S/N DN631 , Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10000
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 980 , and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 32.3K Alpha cpm: 29 (e.g., .09 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II). PRIMARY CALIBRATION:
Response to Alpha Std: 11.3K cpm; .176 % efficiency (alpha)
Alpha Mode Bkgd: 4 cpm (ref.: < 7 cpm)
Response to Beta Std: 32.0K cpm; .318 % efficiency (beta)
Beta Mode Bkgd: 370 ✓ cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 10/2/97

Certificate #019-A2
rev. 1.1, August 1995

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 881 Procedure#: 019 Configuration: **Neutron Field**

Type: _X_ 9" Hankins Sphere ___ 10" Bonner Sphere
___ Anderson-Braun ___ Leake ___ Other

Unit#: 6270 Mfr/Model: **Eberline ASP-1** S/N: 1811
Unit#: 7747 Mfr/Model: **Ludlum 42-31** S/N: 12028

Pulse Generator, Eberline MP- 1, S/N 545
Electrostatic KiloVoltmeter: ESD 8, S/N ES-1868
Neutron Source Cf 252, S/N Cf-235
Gamma Source Cs 137, S/N 7083

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

High Voltage: 1550 Vdc (ref.: 1600 V w/ N. Wood G-5-1 tube)
HV Cal: ✓
Threshold: 2 mV (ref.: 2 mV w/ G-5-1) ; Window: Gross
Range Switch Check: ✓ Audible Function Check: ✓
Integrate Function Check: ✓

Dial: X100K to X1 Rate Unit: mrem/h
Dip Switches:
Dead Time: 10 usec Test: Run
Min Sw: Open Hour Sw: Closed
Cal Sw 3: **Closed** Cal Sw 4: **Closed**
Audio: Divide by 1

As Found Std. Current: .48 (ref.: 0.48 if initial setup)
Gamma Insensitivity Check: ✓

Pre-Calibrator

8-15-97
Date

II) PRIMARY CALIBRATION:

Range	Field Intensity (mrem/h)	Source to Detector Distance (cm)	As Found (mrem/h)	As Left (mrem/h)	% Diff. Field vs As Left
x100	16.8	50	16	16	
x10	7.8	75	7.0	7.0	
x10	5.1	125	3.0	3.0	

As Left Std. Current: .50

REMARKS:

Primary-Calibrator

8-15-97
Date

Certificate #015-A1
rev. 1.1, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 919 Procedure#: 015 Configuration: **Surface Contam**
Type: _X_ 61 sq cm propane flow prop. ctr.

Unit#: 5403 Mfr/Model: **Eberline PAC-4G-3** S/N: 3885
Unit#: 2559 Mfr/Model: **Eberline AC-21** S/N: —

Pulse Generator, Eberline MP- 1, S/N 200
Electrostatic KiloVoltmeter: Rawson, S/N 12048
Alpha Sources Pu239, S/N 7534, 7686, 7687, 7688
Beta Source Tc99, S/N 17

I) MAINTENANCE/PRECALIBRATION:

Batteries: ok Cabling: ok Mechanical/Cleanliness: ok
Probe Window: ok Feedthrough Connector: ok

Gas Flow - Operate Flame Height: 1/2 inches (ref.: 3/4")
Flush Flame Height: 2 inches (ref.: 2")
Threshold: 2 mV (ref.: 2 mV)
Audible Function Check: ok
Alpha High Voltage: 1600 Vdc (ref.: 1600 V)

Pre-Calibrator

Date 7/97

II) PRIMARY CALIBRATION:

I

Range (cpm)	Alpha Standard (dpm/2)	As Found (cpm)	As Left (cpm)	% Diff. Standard vs As Left
0-500 lin	367	200	350	
500-5k log	4.4K	325	4.5	
5k-50k lin	29.6K	20K	30K	
50k-500k log	455K	490K	450K	
Beta Standard:	30K	24K	30K	

Alpha Mode Bkgd: 2-3 cpm reading
Beta Mode Bkgd: 150 cpm reading

REMARKS: I - re-cal,

Primary-Calibrator

Date 7/9/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#:923 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#:5347 Mfr/Model: **NE Technology Electra** S/N: 931
Unit#:0551 Mfr/Model: **NE Technology DP6A** S/N: 321

Pulse Generator, Eberline MP- 2 , S/N 775
Electrostatic KiloVoltmeter: ESD 9 , S/N 13443
Alpha Source: AM241 , S/N DV961 , Activity 63910 dpm
Beta Source: SR 90 , S/N DN631 , Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 1075 , and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 30.5K Alpha cpm: 22 (e.g., .07 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.2K cpm; .206 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < 7 cpm)
Response to Beta Std: 30.5K cpm; .297 % efficiency (beta)
Beta Mode Bkgd: 305 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:
Calibrated by: Jerry Letizia Date: 10/3/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 924 Procedure#: **015** Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5399 Mfr/Model: **NE Technology Electra** S/N: 293
Unit#: 6885 Mfr/Model: **NE Technology DP6A** S/N: 382

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESP 9, S/N 13443
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR 90, S/N DN631, Activity 100400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.3 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 970V, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 29.5K Alpha cpm: 30 (e.g., .1 % of beta) ✓
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.3K cpm; .192 % efficiency (alpha)
Alpha Mode Bkgd: 4 cpm (ref.: < 7 cpm)
Response to Beta Std: 29.5K cpm; .288 % efficiency (beta)
Beta Mode Bkgd: 345 ✓ cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide).___

REMARKS: RE CAL/NEW TUBE

Calibrated by: Jerry Urtizia Date: 7/15/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 931 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5353 Mfr/Model: **NE Technology Electra** S/N: 479
Unit#: 6884 Mfr/Model: **NE Technology DP6**A S/N: 550

Pulse Generator, Eberline MP- 2, S/N 774
Electrostatic KiloVoltmeter: ESD8, S/N ES-17368
Alpha Source: Am 241, S/N DV965, Activity 60960 dpm
Beta Source: Sr Y90, S/N DV636, Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.2 (ref: > 4)
Threshold: ✓ (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: ✓
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 1015, and INHIBIT:___
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 28.1K Alpha cpm: 9 (e.g., <.1 % of beta)
ULD (Parameter #6): 2.1 V (ref: 2.00 V), then INHIBIT:___

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.9K cpm; .212 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < 7 cpm)
Response to Beta Std: 28.1K cpm; .297 % efficiency (beta)
Beta Mode Bkgd: 357 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS: ___

Calibrated by: ___ Date: 10-9-97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 960 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5348 Mfr/Model: **NE Technology Electra** S/N: 489
Unit#: 6643 Mfr/Model: **NE Technology DP6B** S/N: 1049

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DV96, Activity 63910 dpm
Beta Source: SR90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.5 (ref: > 4)
Threshold: 25 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 790V, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 33K Alpha cpm: 33 (e.g., .1 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.3K cpm; .208 % efficiency (alpha)
Alpha Mode Bkgd: 5 cpm (ref.: < 7 cpm)
Response to Beta Std: 33K cpm; .322 % efficiency (beta)
Beta Mode Bkgd: 370 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:
Calibrated by: Jerry Letizia Date: 8/6/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 964 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5356 Mfr/Model: **NE Technology Electra** S/N: 507
Unit#: 6915 Mfr/Model: **NE Technology DP6**A S/N: 577

Pulse Generator, Eberline MP-2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DU961, Activity 63910 dpm
Beta Source: SR490, S/N DN651, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 850, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 31.8K Alpha cpm: 3 (e.g., .01 % of beta)
ULD (Parameter #6): 2.4 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.5K cpm; .195 % efficiency (alpha)
Alpha Mode Bkgd: 0 cpm (ref.: < 7 cpm)
Response to Beta Std: 31.8K cpm; .310 % efficiency (beta)
Beta Mode Bkgd: 373 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 10/2/97

Certificate #017-A1
rev. 1.0, August 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 994 **Procedure#: 017** **Configuration: Ion Field**
Type: _X_ Ionization Chamber

Unit#: 5465 Mfr/Model: **Eberline RO-20** S/N: 395

Gamma Source CS 137 , S/N 7083

I) MAINTENANCE/PRECALIBRATION:

Mechanical: ✓ Cleanliness: ✓
Detector Window: ✓ Meter Zero: ✓
Batteries: Supply ✓ ; Chamber Bias ✓

Jerry Letizia 9/19/97
Pre-Calibrator Date

II) PRIMARY CALIBRATION (Linear Scales):

	*****Mid-Field*****			**Low-Field***		**High-Field**	
Range	Field	As Found	As Left	Field	Response	Field	Response
(0 to 5 mR/h)							
x1	1.9	1.9	1.9	1.2	1.1	3.5	3.3
x10	23.4	23.0	23.0	7.8	7.5	36.6	36
x100	224	220	220	88	80	358	350
(0 to 5 R/h)							
x1	2.28	2.3	2.3	.85	.85	4.05	4.1
x10	22.6	22.5	22.5	9.0	9.0	36.1	34.0

Off-Scale Response?: ✓ (field should be about 100 R/h)

Integrate Mode - N/A

Conditions: Pressure 747 mm Hg ; Temperature 20°C

REMARKS:

Jerry Letizia 9/23/97
Primary-Calibrator Date

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1047 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5387 Mfr/Model: **NE Technology Electra** S/N: 569
Unit#: 6813 Mfr/Model: **NE Technology DP6**A S/N: 607

Pulse Generator, Eberline MP- 2, S/N 774
Electrostatic KiloVoltmeter: ESD8, S/N E517368
Alpha Source: Am241, S/N DV965, Activity 60960 dpm
Beta Source: Sr90, S/N DV636, Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.2 (ref: > 4)
Threshold: 30mV (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: ✓
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 925, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 28.3K Alpha cpm: 17 (e.g., <.1% of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT:___

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 11.5 K cpm; .187 % efficiency (alpha)
Alpha Mode Bkgd: 2 cpm (ref.: < 7 cpm)
Response to Beta Std: 28.3K cpm; .299 % efficiency (beta)
Beta Mode Bkgd: 358 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 10-2-91

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1050 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 3490 Mfr/Model: **NE Technology Electra** S/N: 579
Unit#: 6815 Mfr/Model: **NE Technology DP6A** S/N: 693

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.4 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = ________, and INHIBIT:___
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 32.8K Alpha cpm: 32 (e.g., .01 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 10.9K cpm; .170 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < 7 cpm)
Response to Beta Std: 32.8K cpm; .320 % efficiency (beta)
Beta Mode Bkgd: 382 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS: ________________

Calibrated by: Jerry Litizia Date: 10/6/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1052 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5492 Mfr/Model: **NE Technology Electra** S/N: 567
Unit#: 6817 Mfr/Model: **NE Technology DP6**A S/N: 605

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESP 9, S/N 13443
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 25 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 850, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 30.2K Alpha cpm: 21 (e.g., .07 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.5K cpm; .211 % efficiency (alpha)
Alpha Mode Bkgd: 7 cpm (ref.: < 7 cpm)
Response to Beta Std: 30.2K cpm; .294 % efficiency (beta)
Beta Mode Bkgd: 385 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 8/12/97

Certificate #030-A2, Page 1
rev. 1.1, July 1994

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1246 Procedure#: 030 Configuration: **Area Monitor**
Type: Multiplying Ion Chamber in Gamma Field
Unit#: 5686 Mfr/Model: **NucResCorp. IP-100(V3)** S/N: IP395021
Readout & Control Unit: **NucResCorp ADM-610A(V7)** S/N: ________

Electrostatic KiloVoltmeter: — , S/N —
Gamma Source: CS137 , S/N 7085

I) MAINTENANCE/PRECALIBRATION:
Mechanical: ✓ Cleanliness: ✓ Other: —
Note: If full precalibration is required, use 2nd page.

II) PRIMARY CALIBRATION:

Depress **MODE** and **SET** of **ADM-610** while powering ON. SET low range calibration **MODE**. Enter and **SET** the calibration field intensity (ref.: 100 mR/h).

Known Field Intensity (mR/h): ________

Start Calibration **MODE**. When **DONE**, enter new scale factor.

HV Change? (R4): _____ turns-CW or CCW? _____

Note : " scale factor too **high** " requires **CW,** whereas " scale factor too **low** " requires **CCW.**

Old Scale Factor: _______ New Scale Factor: _______

Turn ADM-610 OFF, and then ON again. Confirm calibration field reading on ADM: __________ mR/h (ref.: within +/-10%).

Calibration Check:

	Field (mR/h)		ADM Reading (mR/h)	
220 x 100	19.07	(ref.: 20 mR/h)	19.1	(ref.: +/-15 % of field)
220 x 200	9.8	(ref.: 10 mR/h)	10.2	(ref.: +/-15 % of field)
	Field (R/h)		ADM Reading (R/h)	
220 x 4	.391	(ref.: 0.5 R/h)	.426	(ref.: +/-15 % of field)
220 x 0	1.85	(ref.: 2 R/h)	2.08	(ref.: +/-15 % of field)
100 x 0	9	(ref.: 10 R/h)	9.7	(ref.: +/-15 % of field)

REMARKS: ____________________

Calibrated by: __________ Date: 7-24-97
Re-Calibration Due Date: __________

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1048 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5488 Mfr/Model: **NE Technology Electra** S/N: ____
Unit#: 1812 Mfr/Model: **NE Technology DP6A** S/N: 662

Pulse Generator, Eberline MP-29, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 572
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.6 (ref: > 4)
Threshold: 25 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: 015 ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 1000, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 29900 Alpha cpm: 30 (e.g., .1 % of beta)
ULD (Parameter #6): 2.0 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.8K cpm; .200 % efficiency (alpha)
Alpha Mode Bkgd: 6 cpm (ref.: < 7 cpm)
Response to Beta Std: 29.9K cpm; .291 % efficiency (beta)
Beta Mode Bkgd: 338 ✓ cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS: ____

Calibrated by: Jerry Letizia Date: 7/15/97

Certificate #016-A4
rev. 0.0, March 1994

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1095 Procedure#: **016** Configuration: **GM Field**
Type: _X_ Energy Compensated

Unit#: 5560 Mfr/Model: **Ludlum 3** S/N: 88723
Unit#: 6768 Mfr/Model: **Eberline HP-270** S/N: ______

Pulse Generator, Eberline MP- / , S/N 535
Electrostatic KiloVoltmeter: ESD 8 , S/N ES-1268
Gamma Source Cs137 , S/N 20850-108

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Handle: ✓
Meter Zero: ✓ Cleanliness: ✓

Threshold: 30 mV (fixed @ approx. 30 to 50 mV)
High Voltage: 900 Vdc (ref.: 900 V)
Audible Function Check: ✓

Pre-Calibrator 7-10-97 Date

II) PRIMARY CALIBRATION (Linear Scales):

	*****Mid-Field****			**Low-Field***		**High-Field**	
Range	Field	As Found	As Left	Field	Response	Field	Response
(0 to 2 mR/h)							
x0.1	.09	.1	.1	N/A	N/A	.15	.15
x1	.99	1.0	1.0	.3	.2	1.44	1.5
x10	8.5	9.0	9.0	3.5	3.5	14.5	14.0
x100	91	90	90	35	30	145	140

Off-Scale Response?: ✓ (field should be about 400 mR/h)

REMARKS: ________________________

Primary-Calibrator 7-11-97 Date

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1260 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5661 Mfr/Model: **NE Technology Electra** S/N: 961
Unit#: 6649 Mfr/Model: **NE Technology DP6**β S/N: 984

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM941, S/N DV961, Activity 65910 dpm
Beta Source: SR90, S/N DN031, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.4 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 845, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 31.4K Alpha cpm: 30 (e.g., .09 % of beta)
ULD (Parameter #6): 2.0 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.3K cpm; .208 % efficiency (alpha)
Alpha Mode Bkgd: 2 cpm (ref.: ≤ 7 cpm)
Response to Beta Std: 31.4K cpm; .306 % efficiency (beta)
Beta Mode Bkgd: 342 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:
Calibrated by: Jerry Letizia Date: 7/28/97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1264 Procedure#: 015 Configuration: **Surface Contam**
Type: _X_ Dual Scintillator (**dpm units**)
Unit#: 5663 Mfr/Model: **NE Technology Electra** S/N: 967
Unit#: 6651 Mfr/Model: **NE Technology DP6**8 S/N: 998

Pulse Generator, Eberline MP- 1 , S/N 535
Electrostatic KiloVoltmeter: ESD8 , S/N 05-17368
Alpha Source: Am241 , S/N DV965 , Activity 60960 dpm
Beta Source: Sr90 , S/N DV636 , Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): ✓ 9.7 (ref: > 4)
Threshold: ✓ (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: ✓
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 1025 , and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 28K Alpha cpm: 8 (e.g., <.1 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.5K cpm; .205 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < 7 cpm)
Response to Beta Std: 28K cpm; .296 % efficiency (beta)
Beta Mode Bkgd: 361 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 6-19-97

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1265 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 5664 Mfr/Model: **NE Technology Electra** S/N: 975
Unit#: 6652 Mfr/Model: **NE Technology DP6** 6 S/N: 999

Pulse Generator, Eberline MP- 1, S/N 535
Electrostatic KiloVoltmeter: ESP, S/N ES-17368
Alpha Source: Am241, S/N DV965, Activity 60960 dpm
Beta Source: Sr/Y90, S/N DV636, Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.5 (ref: > 4)
Threshold: 25mv (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 900, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 26.5K Alpha cpm: 8 (e.g., <.1% of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.4K cpm; .203 % efficiency (alpha)
Alpha Mode Bkgd: 2 cpm (ref.: < 7 cpm)
Response to Beta Std: 26.5K cpm; .280 % efficiency (beta)
Beta Mode Bkgd: 367 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 8-26-97

Certificate #025
rev. 1.1, June 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1602 Procedure#: 025 Configuration: **H&S Monitor**
Description: **Manual Hand & Shoe Monitor**
Type: ___ Gas Cart ___ Four-Wheel Cart ✓ Wall-Mount
___ Fixed Floor ___ Glove Box ___ Other

Unit#: 6165 Mfr/Model: EBERLINE RM24 S/N: 113
Unit#: 7397 Mfr/Model: ______ S/N: ______
Unit#: ______ Mfr/Model: ______ S/N: ______
Unit#: ______ Mfr/Model: ______ S/N: ______

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N ______
Alpha Source AM241, S/N DV961, Activity 93000 DPM
Beta Source SR90, S/N DN631, Activity 106000 DPM

I) MAINTENANCE/PRECALIBRATION:

Detector Windows: ✓ Cabling: ✓ Batteries: ✓
Gas Regulator: ✓ Needle Valve: ✓ Other Mechanical: ✓

Threshold: 2 mV (ref.: 2 mV) ; Window: Out ;
Response Time: ✓ 5 sec (i.e., 0 to 90%)
HV Calib.: ✓
Audible Function Check: ✓ ; Alarm Function Check: ✓

Range	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Field vs As Left
X1	400	400	400	0 %
X10	4K	4K	4K	0 %
X100	40K	40K	40K	0 %
X1K	400K	400K	400K	0 %

II) PRIMARY CALIBRATION:

Alpha HV: 1600 (typically 900 to 1350 V) ; On Plateau?: YES
Alpha Efficiency: 19 % (hand) ; N/A % (shoe)
Alpha Background: <10 cpm
Alpha Alarm Set Point: 500 cpm (gross or net?)

Beta HV: 1600 (typically 1350 to 1900 V) ; On Plateau?: YES
Beta Efficiency: 22 % (hand) ; N/A % (shoe)
Beta Background: 500 cpm
Beta Alarm Set Point: 5000 cpm (gross or net?)

REMARKS: ______

Calibrated By: Jerry [illegible] Date: 2/27/97

Certificate #029-C1
rev. 1.0, Dec. 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1653 Procedure#: 029 Configuration: **uR Field**
Type: _X_ Energy Compensated GM

Unit#: 651 Mfr/Model: **Eberline ASP-1** S/N: 3075
Unit#: 6203 Mfr/Model: **TGM N378S/BNC** S/N: ______

Pulse Generator, Eberline MP- 2 , S/N 774
Electrostatic KiloVoltmeter: ESD 1K , S/N 132796
Gamma Source GB7 , S/N 2083

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

High Voltage: 450 Vdc (ref.: 450 V)
HV Cal: ✓
Threshold: 30 mV (ref.: 30 mV); Window: Gross
Range Switch Check: ✓ Audible Function Check: ✓
Integrate Function Check: ✓

Dial: X1M to X10 Rate Unit: uR/h
Dip Switches:
Dead Time: 136 ~~200~~ usec Test: Run
Min Sw: Open Hour Sw: Closed
Cal Sw 3: **Closed** Cal Sw 4: **Open**
Audio: Divide by 1

As Found Std. Current: 0.55

Pre-Calibrator

10-8-97
Date

II) PRIMARY CALIBRATION:

Range	Field Intensity (uR/h)	Source to Detector Distance (cm)	As Found (uR/h)	As Left (uR/h)	% Diff. Field vs As Left
1K	494	250x8K	500	500	0
10K	4906	150x800	5000	5000	0
100K	52095	150x80	52000	52000	0
1M	425366	150 x 8	—	—	—

As Left Std. Current: .55
As Left Dead Time: 136 usec

REMARKS: ______

Primary-Calibrator

10-9-97
Date

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1682 Procedure#: **015** Configuration: **Surface Contam**
Type: **X** Dual Scintillator (**dpm units**)
Unit#: 6233 Mfr/Model: **NE Technology Electra** S/N: 1433
Unit#: 6230 Mfr/Model: **NE Technology DP6**BD S/N: 1431

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DV96, Activity 63910 dpm
Beta Source: SLY90, S/N DN631, Activity 102 400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.9 (ref: > 4)
Threshold: 25 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 850, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 31.5K Alpha cpm: 3 (e.g., .01 % of beta)
ULD (Parameter #6): 2.0 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 13.4K cpm; .209 % efficiency (alpha)
Alpha Mode Bkgd: 3 cpm (ref.: < 7 cpm)
Response to Beta Std: 31.5K cpm; .308 % efficiency (beta)
Beta Mode Bkgd: 354 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 6/4/97

Certificate #015-A0
rev. 1.0, Nov. 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1687 Procedure#: 015 Configuration: **Surface Contam**

Type: ___ 100 sq cm prop. ctr. ___ 100 sq cm dual scint. ___ ZnS Scint ___ Pancake GM X Other: HP100 GAS SEALED

Unit#: 6251 Mfr/Model: EBERLINE E600 S/N: 158
Unit#: 6190 Mfr/Model: " " HP-100A S/N: —

Pulse Generator, Eberline MP- 2 , S/N 775
Electrostatic KiloVoltmeter: ESD 9 , S/N 13443
Alpha Source AM241 , S/N DV961 , Activity 63910 DPM
Beta Source SRY90 , S/N DN631 , Activity 102400 DPM

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Probe Window: ✓
Rate Unit: cpm
Audible Function Check: ✓ ; Audio: Divide by 1 (ref.: 1)

Noise Threshold: .5 mV (typ.: PC=2 mV, PMT=10 mV, GM=30 mV)
Secondary Threshold: 60 mV (if applicable)
High Voltage: 1650 Vdc (see specifications table)
Secondary High Voltage: — Vdc (if applicable)

Pre-Calibrator 9/26/97 Date

II) PRIMARY CALIBRATION:

Range	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
A	400	400	400	0
U	4K	4K	4K	0
T	40K	40K	40K	0
O	400K	400K	400K	0

Integrate Function Check: ✓ (if applicable)

Response to Alpha Std: 14.04K cpm; 22 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < about 7 cpm)
Response to Beta Std: 44.4K cpm; 43 % efficiency (beta)
Beta Mode Bkgd: 306 cpm (ref.: < about 400 cpm)

REMARKS:

Primary-Calibrator 9/26/97 Date

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1697 Procedure#: 015 Configuration: **Surface Contam**
Type: _X_ Dual Scintillator (**dpm units**)
Unit#: 6281 Mfr/Model: **NE Technology Electra** S/N: 895
Unit#: 6281 Mfr/Model: **NE Technology DP6**B S/N: 975

Pulse Generator, Eberline MP- 1 , S/N 545
Electrostatic KiloVoltmeter: ESD 8 , S/N 65-12368
Alpha Source: Am241 , S/N DU965 , Activity 60960 dpm
Beta Source: Sr90 , S/N DU636 , Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 3.9 (ref: > 4)
Threshold: 89v ✓ (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10K
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 886 , and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 37.8 K Alpha cpm: 26 (e.g., .07 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 10.3K cpm; .169 % efficiency (alpha)
Alpha Mode Bkgd: 1 cpm (ref.: < 7 cpm)
Response to Beta Std: 33.8 k cpm; .294 % efficiency (beta)
Beta Mode Bkgd: 333 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Date: 6-13-97

Certificate #015-A0
rev. 1.0, Nov. 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1771 Procedure#: 015 Configuration: **Surface Contam**

Type: ___ 100 sq cm prop. ctr. ___ 100 sq cm dual scint.
___ ZnS Scint ___ Pancake GM X Other: 100 SQ CM GAS SEALED

Unit#: 5876 Mfr/Model: EBERLINE E600 S/N: 129
Unit#: 6647 Mfr/Model: EBERLINE HP-100 S/N: —

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source AM241, S/N DV961, Activity 63910 DPM
Beta Source SR90, S/N DN631, Activity 102400 DPM

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Probe Window: ✓
Rate Unit: cpm
Audible Function Check: ✓; Audio: Divide by 1 (ref.: 1)

Noise Threshold: .5 mV (typ.: PC=2 mV, PMT=10 mV, GM=30 mV)
Secondary Threshold: 60 mV (if applicable)
High Voltage: 1660 Vdc (see specifications table)
Secondary High Voltage: — Vdc (if applicable)

Jerry Littizia
Pre-Calibrator

9/8/97
Date

II) PRIMARY CALIBRATION:

Range	Pulser Rate (cpm)	As Found (cpm)	As Left (cpm)	% Diff. Pulser vs As Left
AUTO	400	400	400	0
	4K	4K	4K	0
	40K	40K	40K	0
	400K	400K	400K	0

Integrate Function Check: ✓ (if applicable)

Response to Alpha Std: 14.59K cpm; 23 % efficiency (alpha)
Alpha Mode Bkgd: 0 cpm (ref.: < about 7 cpm)
Response to Beta Std: 44.7K cpm; 44 % efficiency (beta)
Beta Mode Bkgd: 305 cpm (ref.: < about 400 cpm)

REMARKS:

Jerry Littizia
Primary-Calibrator

9/8/97
Date

Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1758 Procedure#: 015 Configuration: **Surface Contam**
Type: X Dual Scintillator (**dpm units**)
Unit#: 6404 Mfr/Model: **NE Technology Electra** S/N: 1801
Unit#: 6495 Mfr/Model: **NE Technology DP6**BDD S/N: 1625

Pulse Generator, Eberline MP- 2, S/N 775
Electrostatic KiloVoltmeter: ESD 9, S/N 13443
Alpha Source: AM241, S/N DV961, Activity 63910 dpm
Beta Source: SR90, S/N DN631, Activity 102400 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.3 (ref: > 4)
Threshold: 30 (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: 10
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 940, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 326K Alpha cpm: 311 (e.g., <.1 % of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

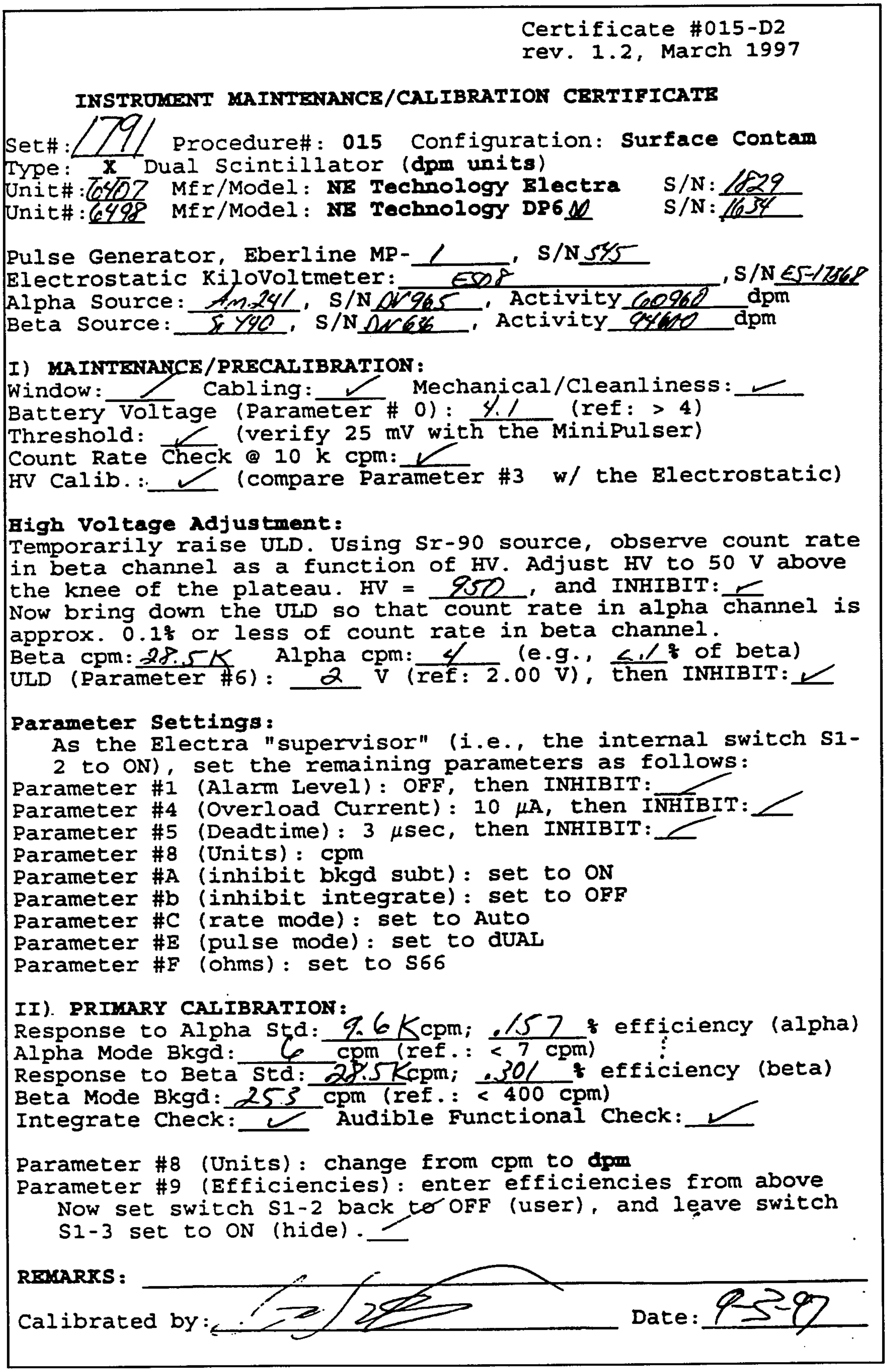
Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 12.5K cpm; .195 % efficiency (alpha)
Alpha Mode Bkgd: 2 cpm (ref.: < 7 cpm)
Response to Beta Std: 32.6K cpm; .318 % efficiency (beta)
Beta Mode Bkgd: 346 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:

Calibrated by: Jerry Letizia Date: 9/15/97



Certificate #015-D2
rev. 1.2, March 1997

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1791 Procedure#: **015** Configuration: **Surface Contam**
Type: **X** Dual Scintillator (**dpm units**)
Unit#: 6407 Mfr/Model: **NE Technology Electra** S/N: 1829
Unit#: 6498 Mfr/Model: **NE Technology DP6**AD S/N: 1634

Pulse Generator, Eberline MP- 1, S/N 545
Electrostatic KiloVoltmeter: ESD, S/N ES-1368
Alpha Source: Am-241, S/N DV965, Activity 60960 dpm
Beta Source: Sr 90, S/N DV686, Activity 94600 dpm

I) MAINTENANCE/PRECALIBRATION:
Window: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓
Battery Voltage (Parameter # 0): 4.1 (ref: > 4)
Threshold: ✓ (verify 25 mV with the MiniPulser)
Count Rate Check @ 10 k cpm: ✓
HV Calib.: ✓ (compare Parameter #3 w/ the Electrostatic)

High Voltage Adjustment:
Temporarily raise ULD. Using Sr-90 source, observe count rate in beta channel as a function of HV. Adjust HV to 50 V above the knee of the plateau. HV = 950, and INHIBIT: ✓
Now bring down the ULD so that count rate in alpha channel is approx. 0.1% or less of count rate in beta channel.
Beta cpm: 28.5K Alpha cpm: 4 (e.g., <.1% of beta)
ULD (Parameter #6): 2 V (ref: 2.00 V), then INHIBIT: ✓

Parameter Settings:
As the Electra "supervisor" (i.e., the internal switch S1-2 to ON), set the remaining parameters as follows:
Parameter #1 (Alarm Level): OFF, then INHIBIT: ✓
Parameter #4 (Overload Current): 10 μA, then INHIBIT: ✓
Parameter #5 (Deadtime): 3 μsec, then INHIBIT: ✓
Parameter #8 (Units): cpm
Parameter #A (inhibit bkgd subt): set to ON
Parameter #b (inhibit integrate): set to OFF
Parameter #C (rate mode): set to Auto
Parameter #E (pulse mode): set to dUAL
Parameter #F (ohms): set to S66

II) PRIMARY CALIBRATION:
Response to Alpha Std: 9.6K cpm; .157 % efficiency (alpha)
Alpha Mode Bkgd: 6 cpm (ref.: < 7 cpm)
Response to Beta Std: 28.5K cpm; .301 % efficiency (beta)
Beta Mode Bkgd: 255 cpm (ref.: < 400 cpm)
Integrate Check: ✓ Audible Functional Check: ✓

Parameter #8 (Units): change from cpm to **dpm**
Parameter #9 (Efficiencies): enter efficiencies from above
Now set switch S1-2 back to OFF (user), and leave switch S1-3 set to ON (hide). ✓

REMARKS:
Calibrated by: Date: 9-5-97

Certificate #029-C1
rev. 1.0, Dec. 1993

INSTRUMENT MAINTENANCE/CALIBRATION CERTIFICATE

Set#: 1833 Procedure#: 029 Configuration: **uR Field**
Type: _X_ Energy Compensated GM

Unit#: 6508 Mfr/Model: **Eberline ASP-1** S/N: 2815
Unit#: 6474 Mfr/Model: **TGM N378S/BNC** S/N: 1594

Pulse Generator, Eberline MP- 1, S/N 535
Electrostatic KiloVoltmeter: ESD 1K, S/N 932296
Gamma Source Cs137, S/N 2083

I) MAINTENANCE/PRECALIBRATION:

Batteries: ✓ Cabling: ✓ Mechanical/Cleanliness: ✓

High Voltage: 450 Vdc (ref.: 450 V)
HV Cal: ✓
Threshold: 30 mV (ref.: 30 mV); Window: Gross
Range Switch Check: ✓ Audible Function Check: ✓
Integrate Function Check: ✓

Dial: X1M to X10 Rate Unit: uR/h
Dip Switches:
Dead Time: 200 usec Test: Run
Min Sw: Open Hour Sw: Closed
Cal Sw 3: **Closed** Cal Sw 4: **Open**
Audio: Divide by 1

As Found Std. Current: 0.55

Pre-Calibrator

5-27-97
Date

II) PRIMARY CALIBRATION:

Range	Field Intensity (uR/h)	Source to Detector Distance (cm)	As Found (uR/h)	As Left (uR/h)	% Diff. Field vs As Left
1K	.497	250 x 8K	500	500	0
10K	993	150 x 800	5000	5000	0
100K	52.4	150 x 80	52000	52000	0
1 M	928	150 x 8			

As Left Std. Current: .55
As Left Dead Time: 132 usec

REMARKS:

Robert Kear
Primary-Calibrator

5/28/97
Date

APPENDIX B:

QC MEASUREMENTS FOR THE TENNELEC GAS-FLOW PROPORTIONAL COUNTING SYSTEM

TABLE B.1 QC Source Check Data for Tennelec

		Detector Count Rate Counts/min		Counting Efficiency		% cross talk	
Date	Time	Alpha	Beta	Alpha	Beta	a to ß	ß to a
9/23/97	20:44:25	15,247 ± 87	7,985 ± 63	0.274		34.4	
9/23/97	20:46:35	2 ± 1	43,836 ± 148		0.455		0.0034
9/24/97	11:09:36	15,550 ± 88	7,662 ± 62	0.280		33.0	
9/24/97	11:11:46	4 ± 1	44,223 ± 149		0.459		0.0090
9/25/97	18:44:25	16,180 ± 90	7,479 ± 61	0.291		31.6	
9/25/97	18:46:35	5 ± 2	44,508 ± 149		0.462		0.0112
9/29/97	15:22:45	15,765 ± 89	7,646 ± 62	0.284		32.7	
9/29/97	15:24:54	9 ± 2	44,105 ± 149		0.458		0.0193
9/30/97	17:47:15	15,873 ± 89	7,720 ± 62	0.285		32.7	
9/30/97	17:49:24	4 ± 1	44,194 ± 149		0.459		0.0079
10/9/97	12:10:48	15,153 ± 87	8,178 ± 64	0.273		35.1	
10/9/97	12:12:57	1 ± 1	43,812 ± 148		0.455		0.0011
10/10/97	16:59:55	15,364 ± 88	7,952 ± 63	0.276		34.1	
10/10/97	17:02:05	1 ± 1	43,605 ± 148		0.453		0.0011
10/11/97	18:12:57	15,519 ± 88	7,799 ± 62	0.279		33.4	
10/11/97	18:15:07	1 ± 1	43,963 ± 148		0.456		0.0011
11/22/97	11:33:47	16,076 ± 90	7,518 ± 61	0.289		31.9	
11/22/97	11:35:57	9 ± 2	43,765 ± 148		0.454		0.0194

Note: Alpha source used was Am-241.
Beta source used was Sr/Y-90

TABLE B.2 QC Background Check Data for Tennelec

				Detector Count Rate Counts/min	
	Date	Time	Count Time (min)	Alpha	Beta
	9/23/97	20:42:13	200	0.255 ± 0.036	29.03 ± 0.38
	9/24/97	11:07:25	200	0.290 ± 0.038	29.16 ± 0.38
	9/25/97	18:42:14	200	0.205 ± 0.032	30.39 ± 0.39
	9/29/97	13:00:28	200	0.205 ± 0.032	30.44 ± 0.39
	9/30/97	17:45:03	200	0.275 ± 0.037	29.45 ± 0.38
	10/7/97	12:14:50	200	0.255 ± 0.036	28.56 ± 0.38
	10/9/97	12:08:36	200	0.255 ± 0.036	28.50 ± 0.38
	10/10/97	16:57:44	200	0.200 ± 0.032	27.36 ± 0.37
	10/11/97	18:10:45	200	0.205 ± 0.032	28.69 ± 0.38
	10/21/97	13:43:14	200	0.315 ± 0.040	28.97 ± 0.38
	10/30/97	21:31:53	200	0.255 ± 0.036	29.25 ± 0.38
	11/3/97	12:50:06	200	0.270 ± 0.037	30.30 ± 0.39
	11/4/97	13:06:53	200	0.205 ± 0.032	29.28 ± 0.38
	11/5/97	19:58:38	200	0.335 ± 0.041	28.45 ± 0.38
	11/6/97	16:56:07	200	0.240 ± 0.035	28.65 ± 0.38
	11/8/97	11:45:18	200	0.230 ± 0.034	28.58 ± 0.38
	11/11/97	15:03:59	200	0.220 ± 0.033	29.75 ± 0.39
	11/15/97	11:21:34	200	0.240 ± 0.035	29.11 ± 0.38
	11/22/97	11:31:36	200	0.270 ± 0.037	29.46 ± 0.38
Minimum				0.200 ± 0.032	27.36 ± 0.37
Maximum				0.335 ± 0.041	30.44 ± 0.39
Average				0.249 ± 0.035	29.12 ± 0.38
Standard Deviation				0.037 ± 0.003	0.74 ± 0.00
Count				19	19

APPENDIX C:

FACILITY PHOTOGRAPHS

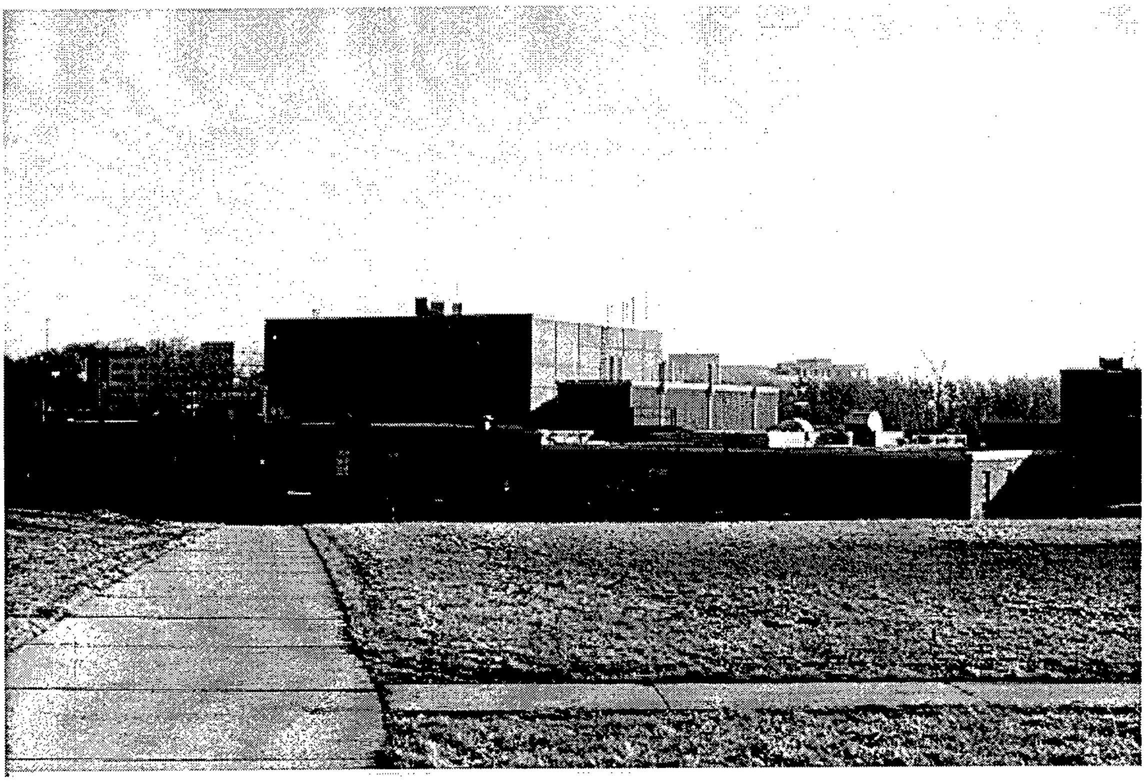
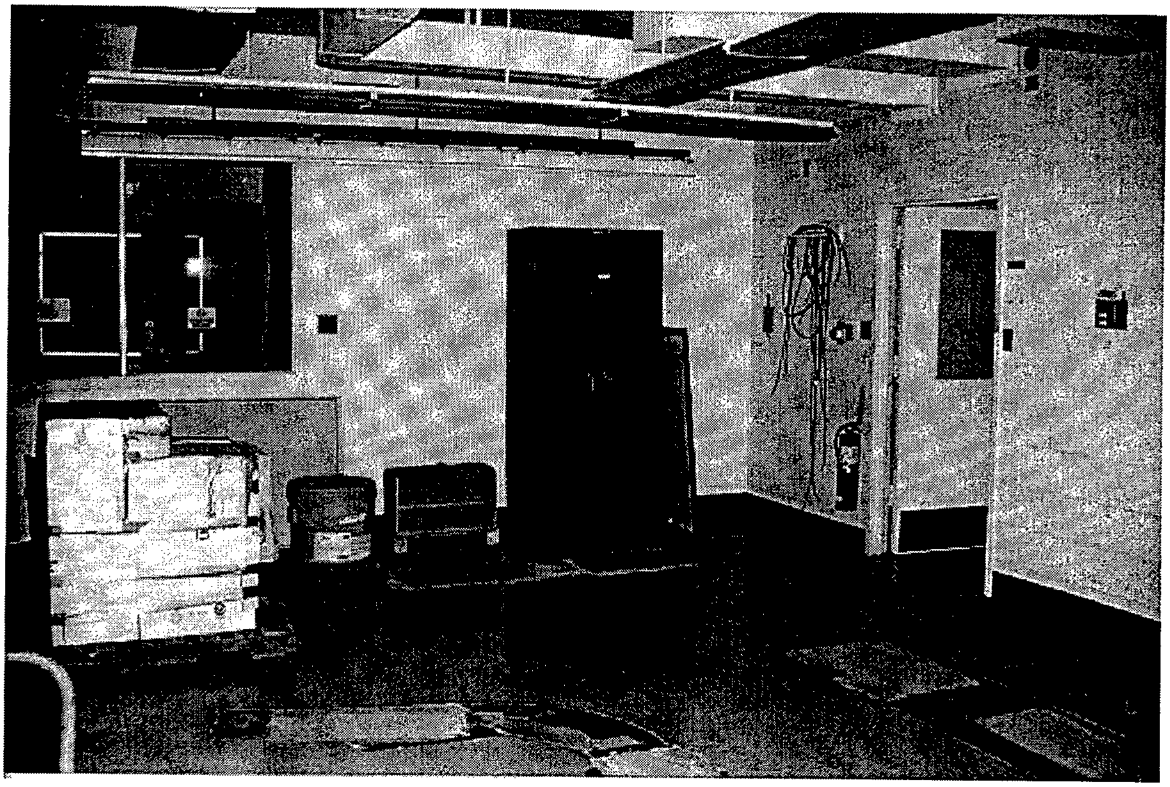


FIGURE 25 Building 211 Cyclotron Facility



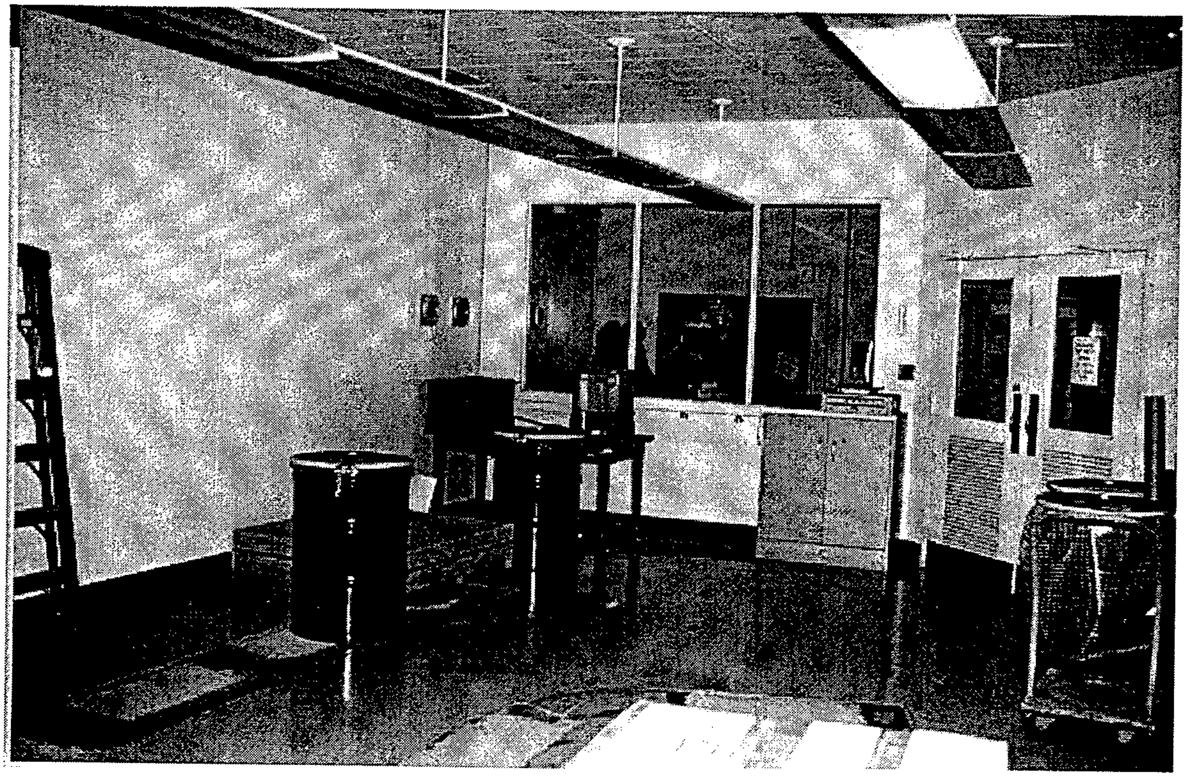


FIGURE 26 Two Views of the Former Control Room of the Cyclotron, B102

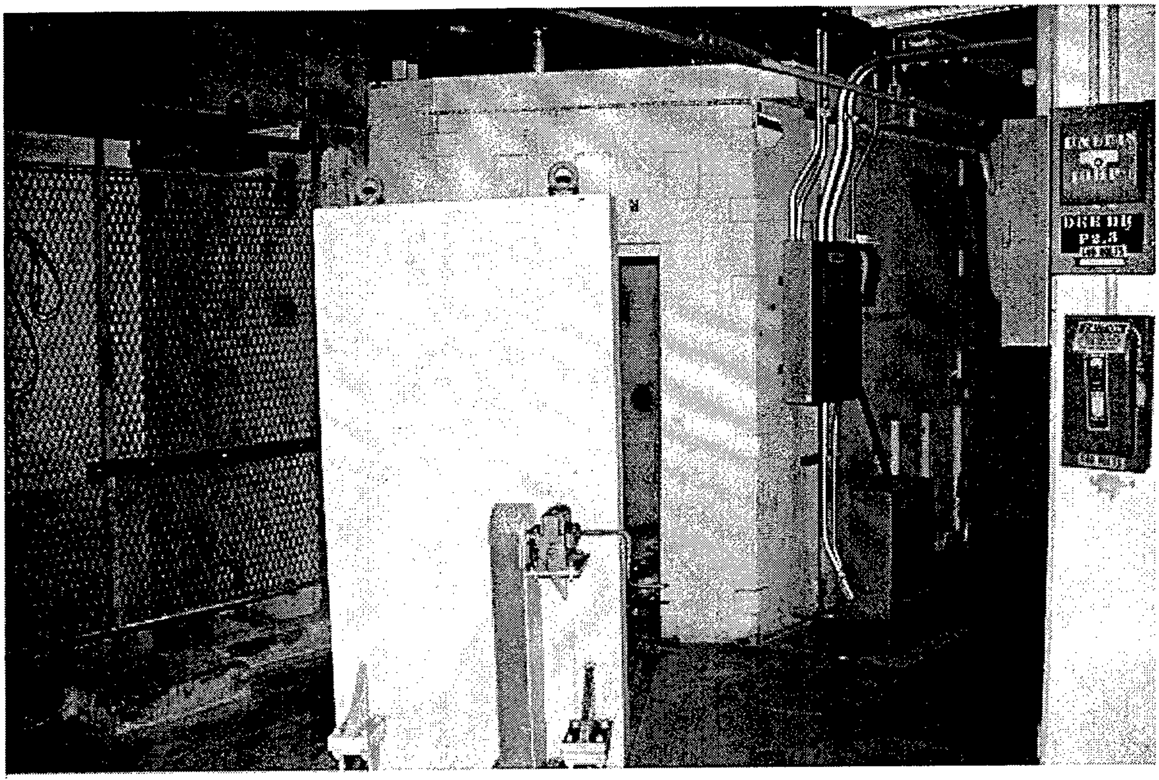


FIGURE 27 Steel/Paraffin-Lined Vault, A051

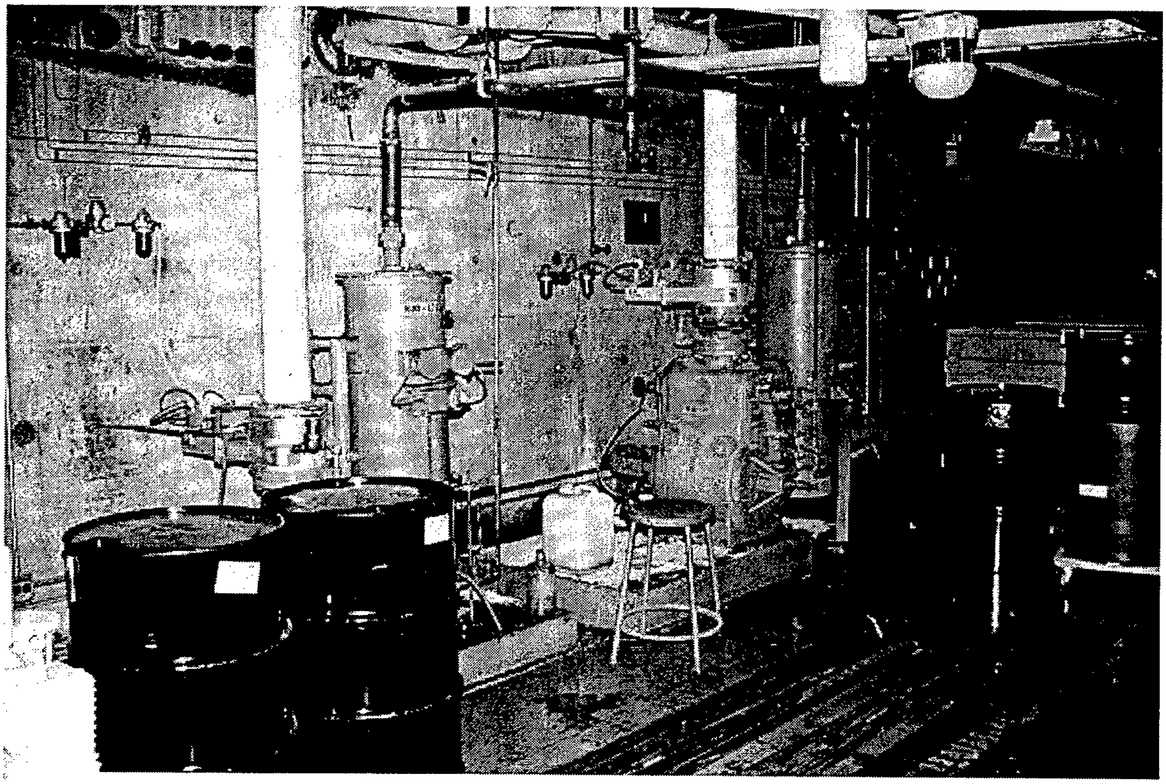


FIGURE 28 Various Mechanical Equipment and Pumps in A-004

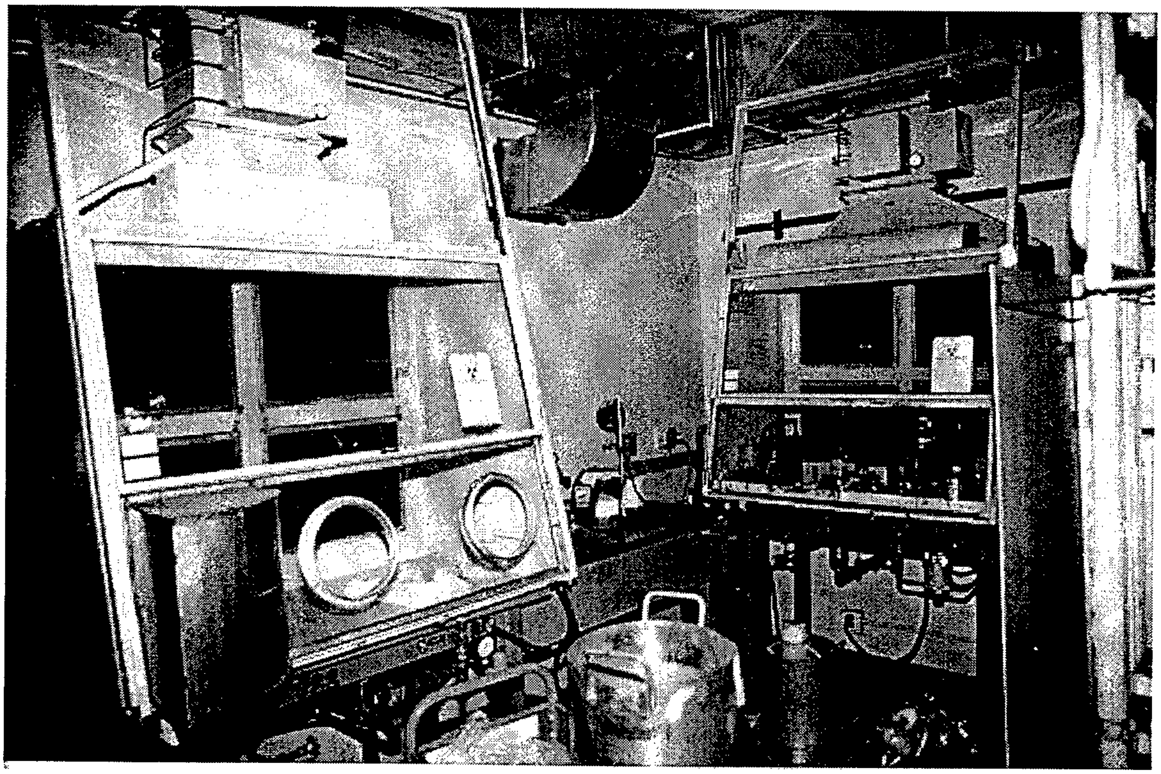


FIGURE 29 Contaminated Fume Hoods in B-126 Cave Work Area (southwest corner)

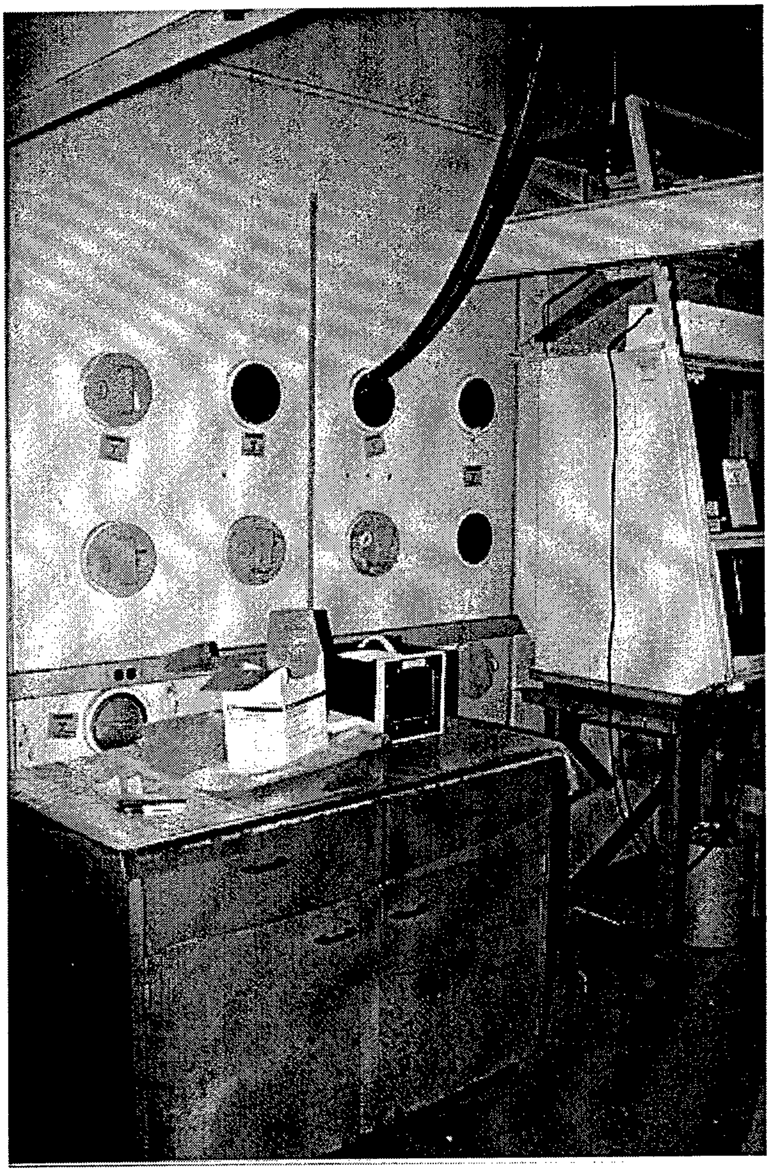


FIGURE 30 View of Radioactive Material Storage Holes Along the East Wall in B126

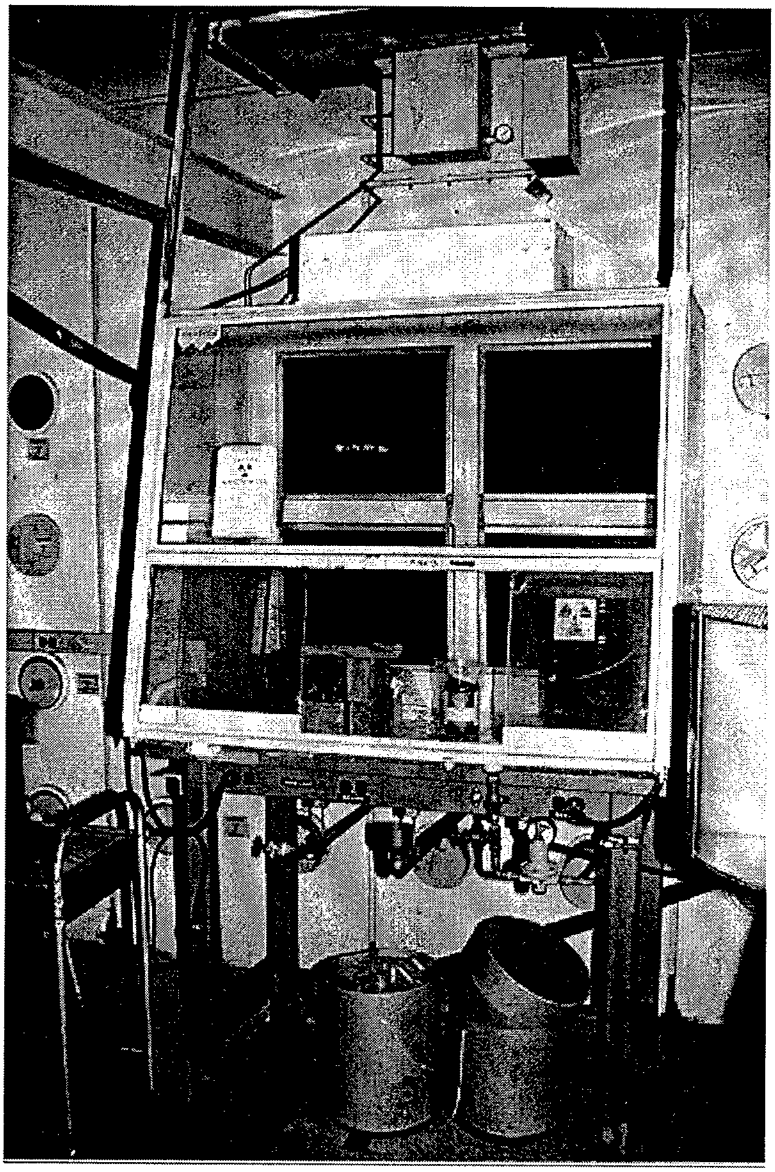


FIGURE 31 Contaminated Fume Hood in the Cave Work Area, East Wall in B126

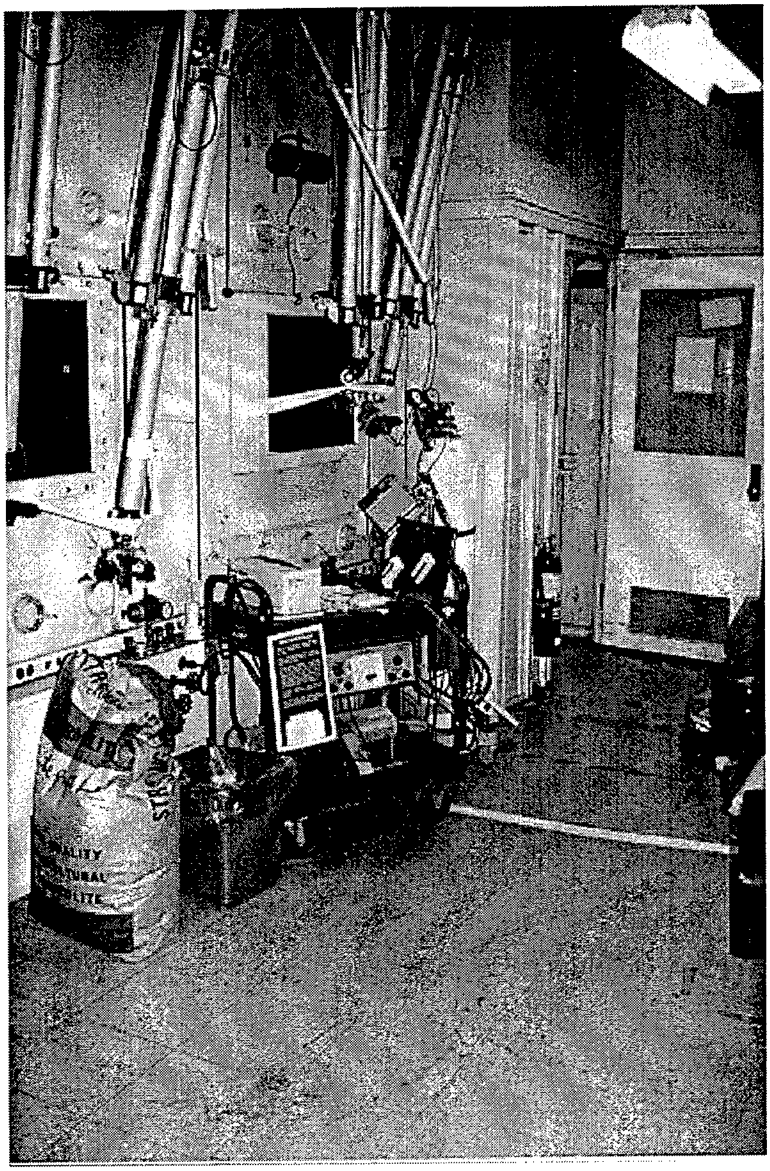


FIGURE 32 B-Wing Remote Handling Area Adjacent to the Cave Complex, B118

FIGURE 33 View of 2R Containers Under Benchtop, Senior Cave

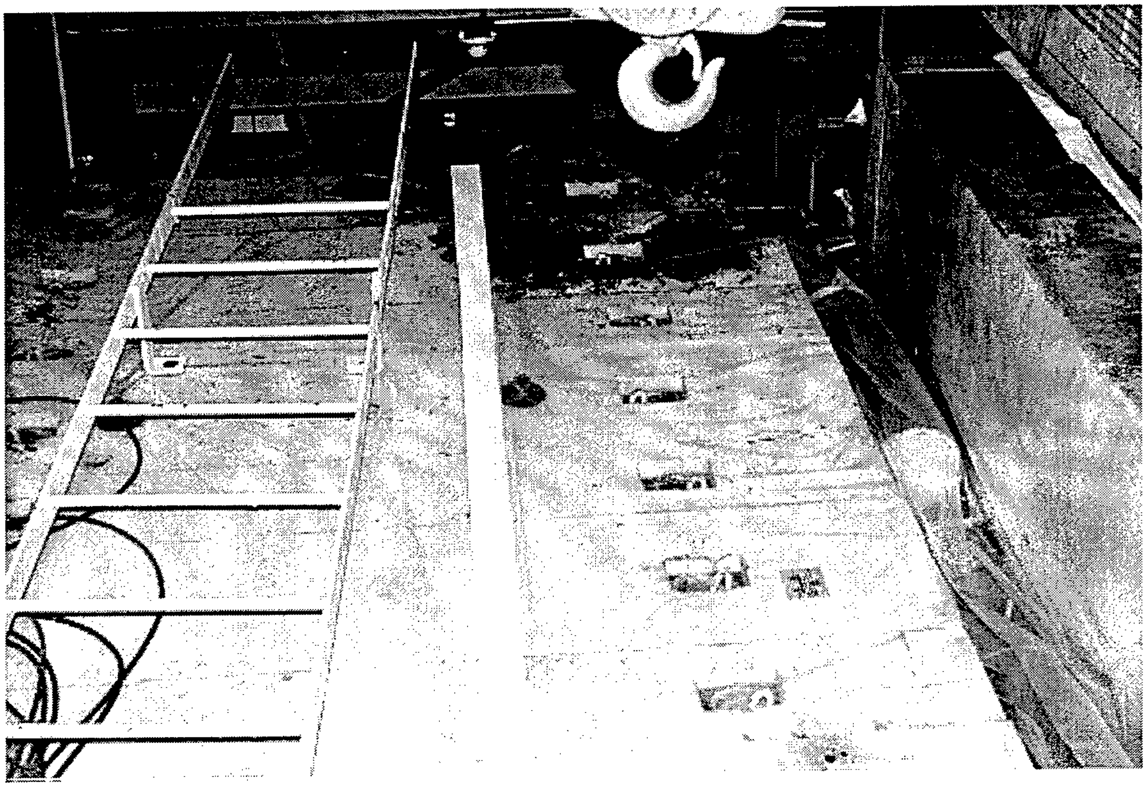
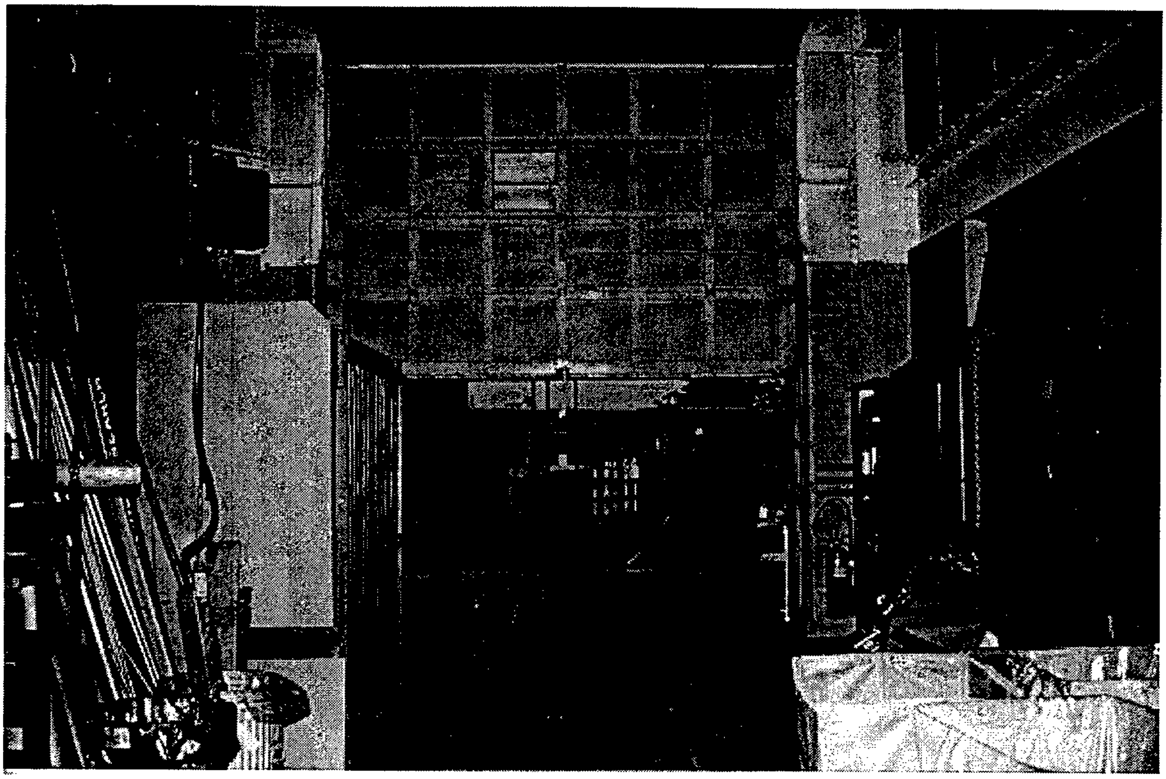


FIGURE 34 Top View of the Senior Cave, B126



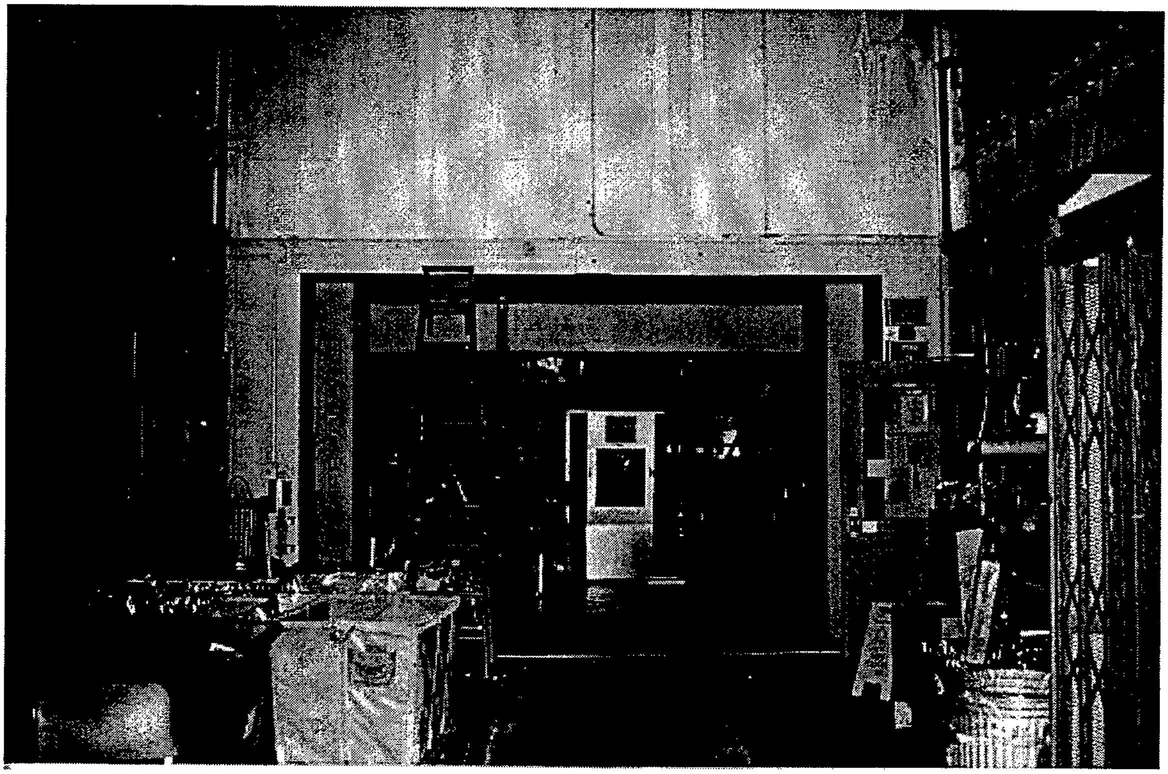


FIGURE 35 Dock Area (A-167) Adjacent to the Cyclotron Hall

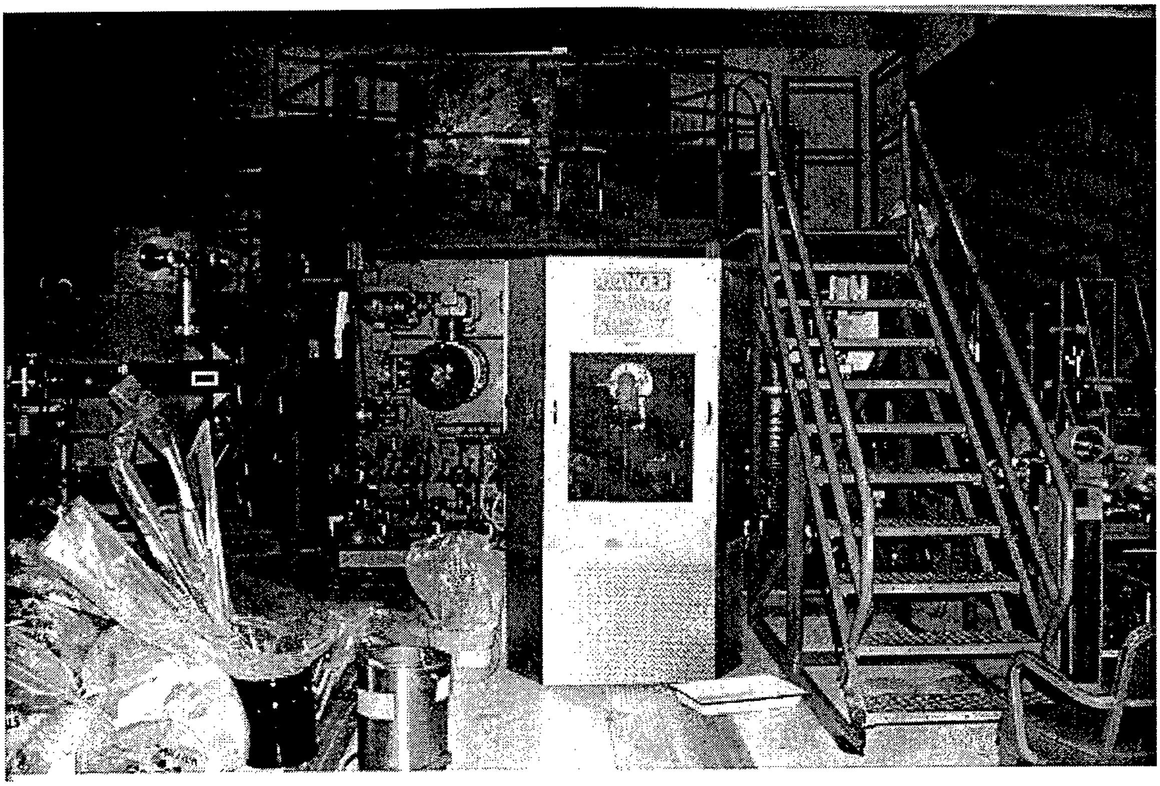
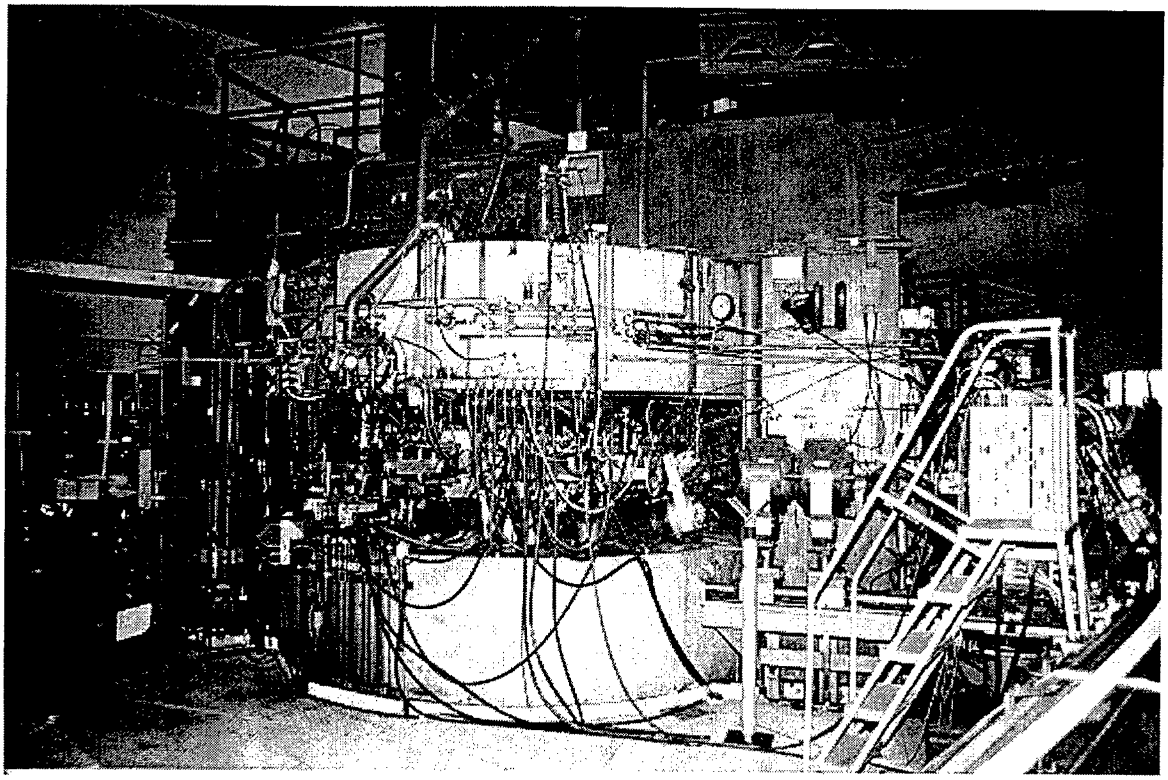


FIGURE 36 Cyclotron Hall, C-101. Stairs Leading to Platform Above Cyclotron.



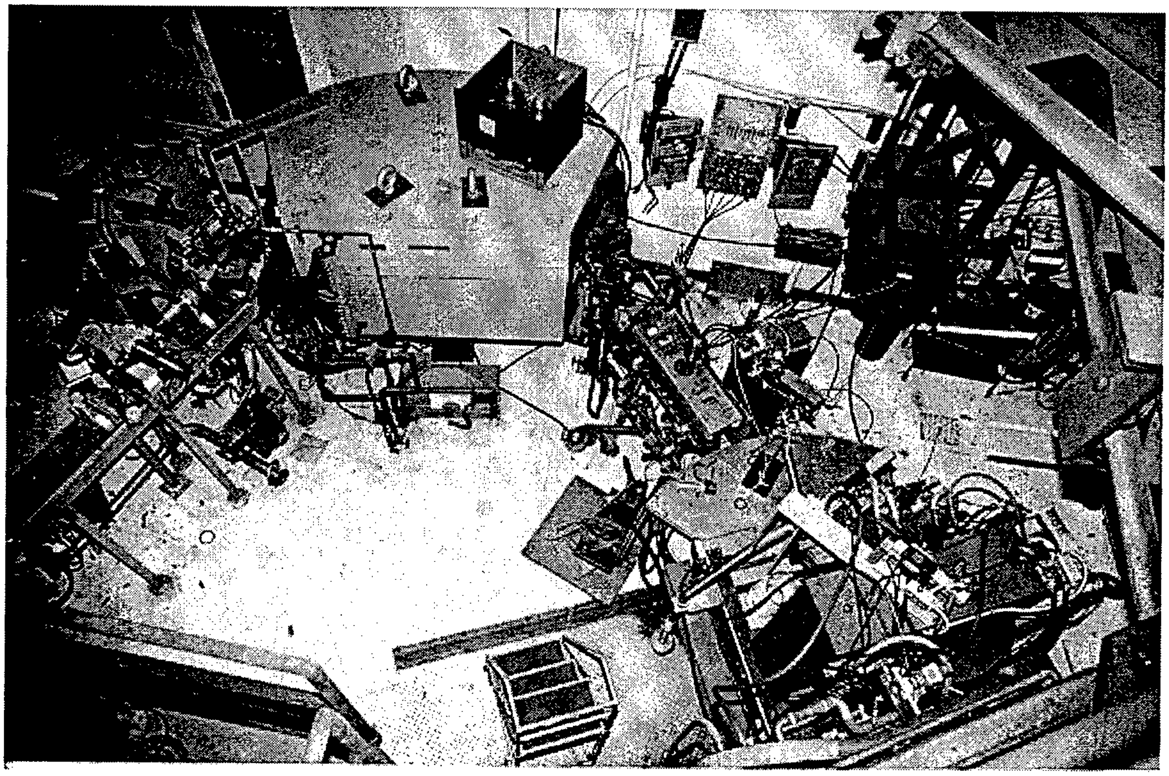


FIGURE 37 Two Views of the Cyclotron Hall, C-101

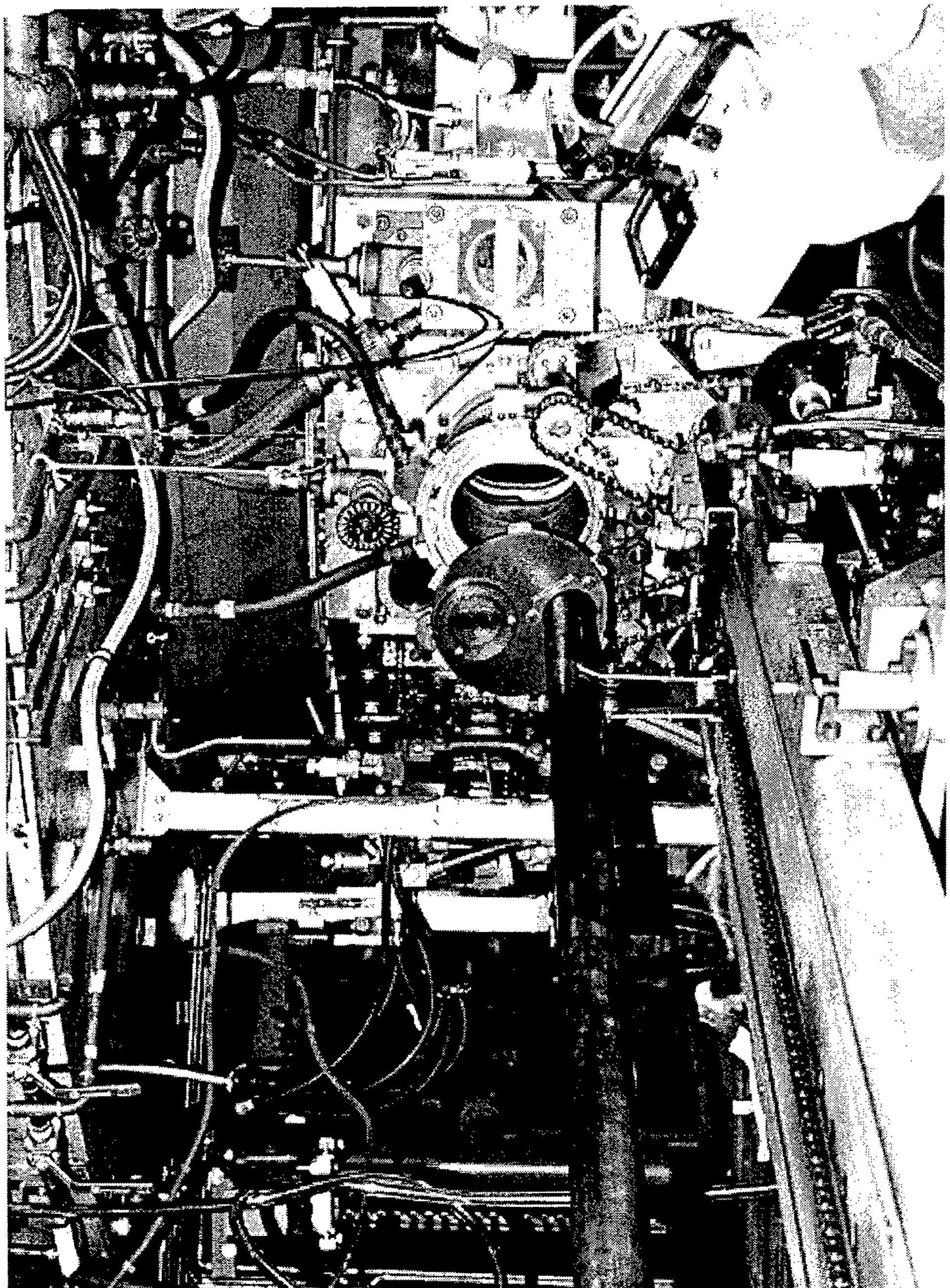


FIGURE 38 Close-Up View of Sample Parts on West Side of the Cyclotron, C101

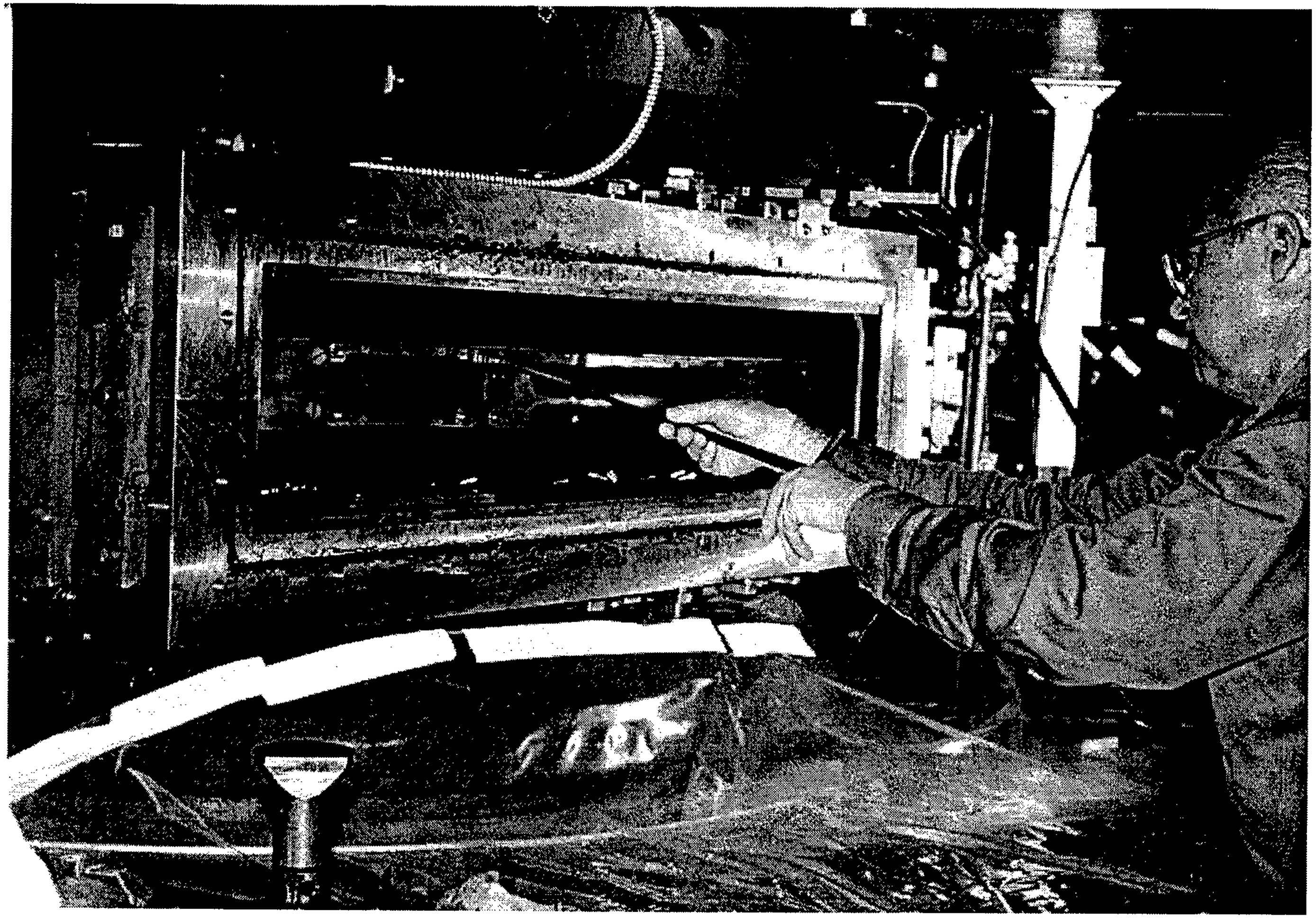


FIGURE 39 Close-Up View of Particle Accelerator Region of the Cyclotron, C101

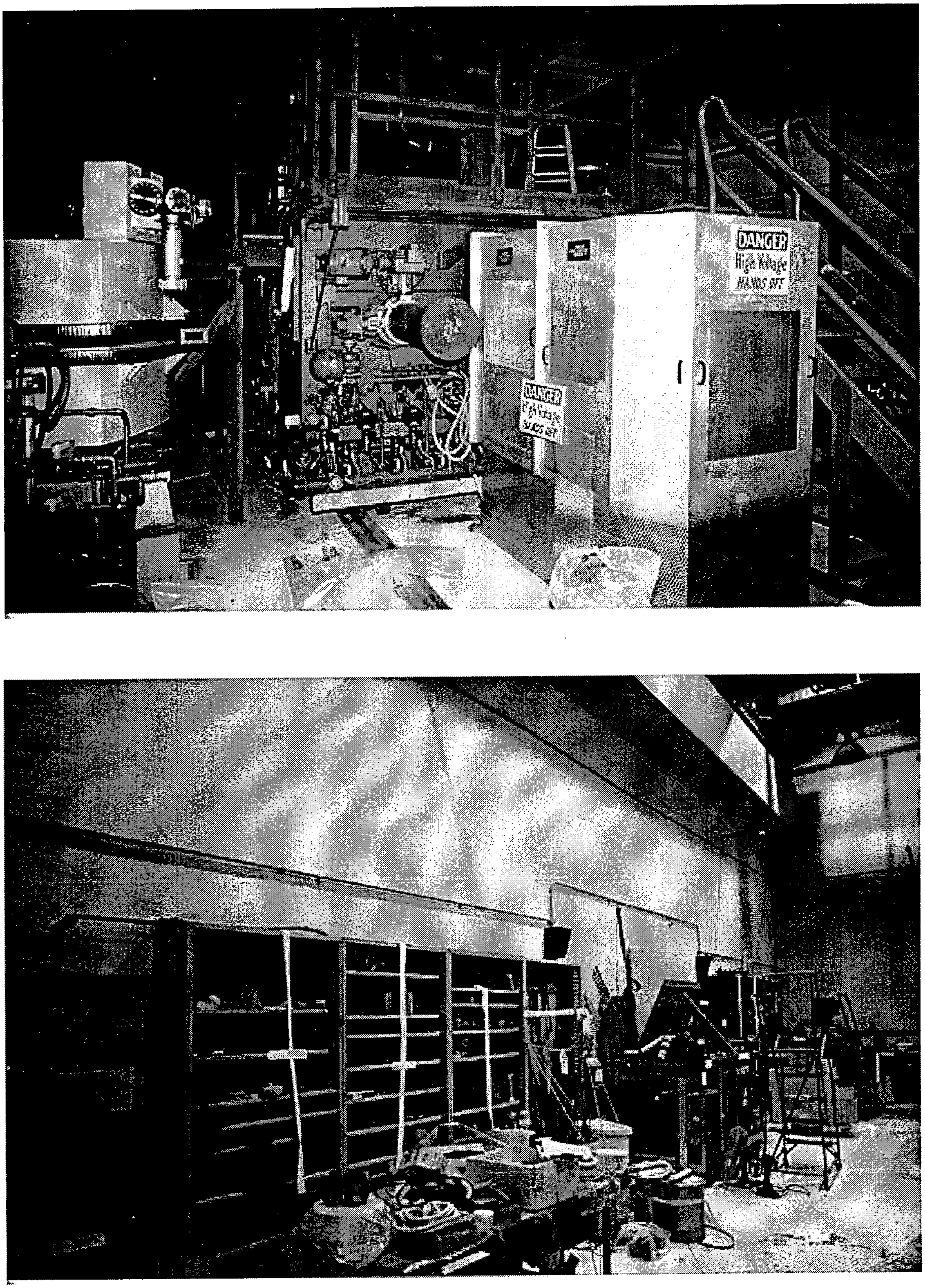


FIGURE 40 Two Views of the Cyclotron Hall, C101. Top Photo Shows the Cyclotron and the Service Platform. The Bottom Photo Shows Miscellaneous Equipment Along the North Wall of C101.

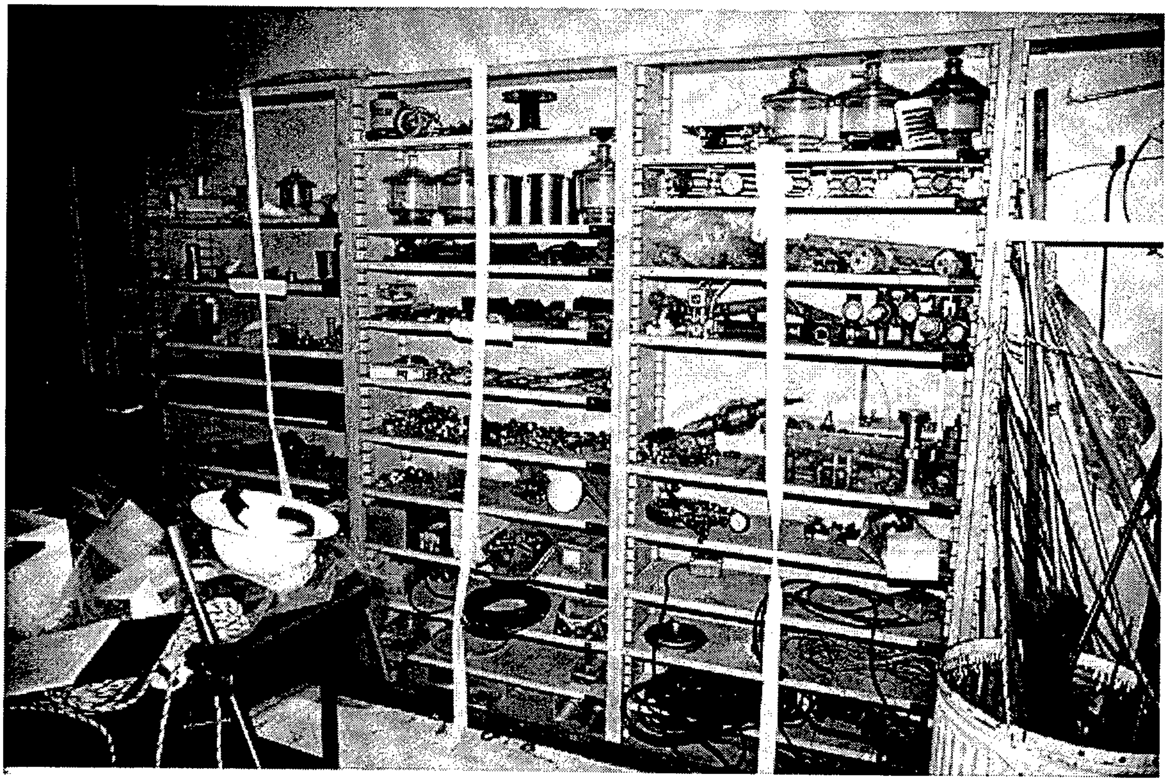
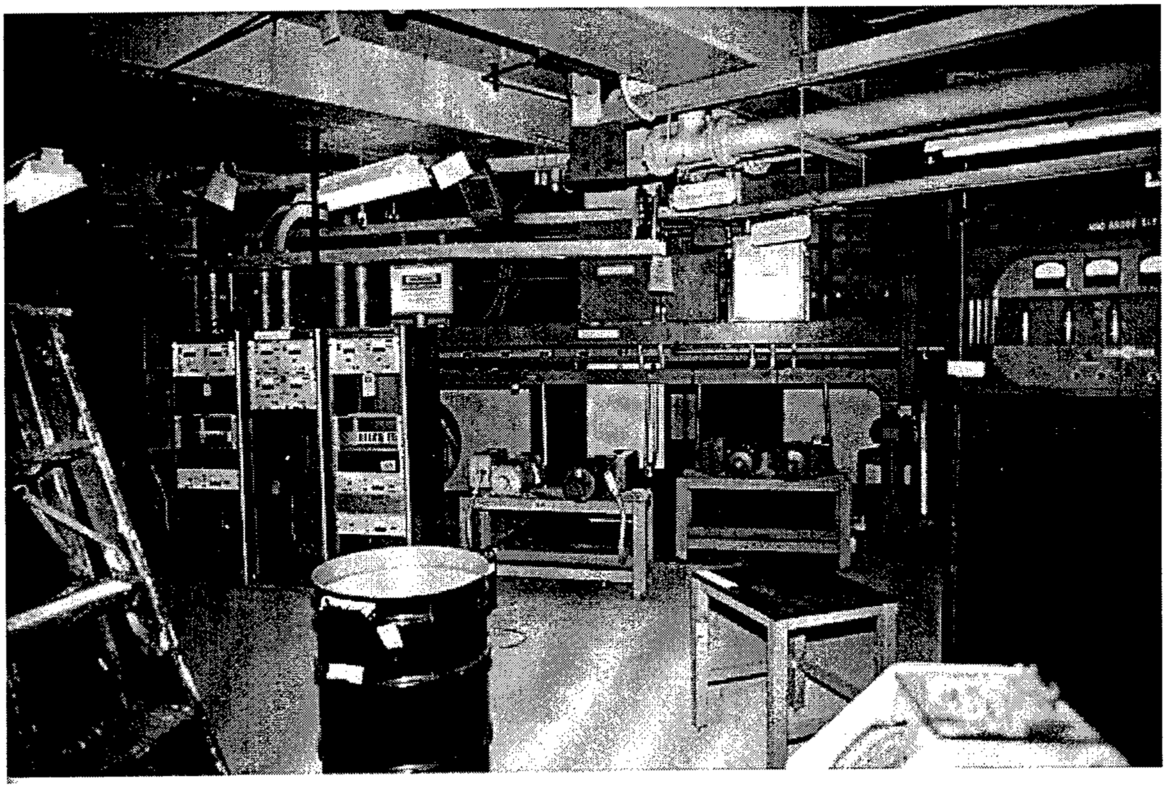


FIGURE 41 Two Views of the Miscellaneous Equipment Along the North Wall of the Cyclotron Hall, C-101



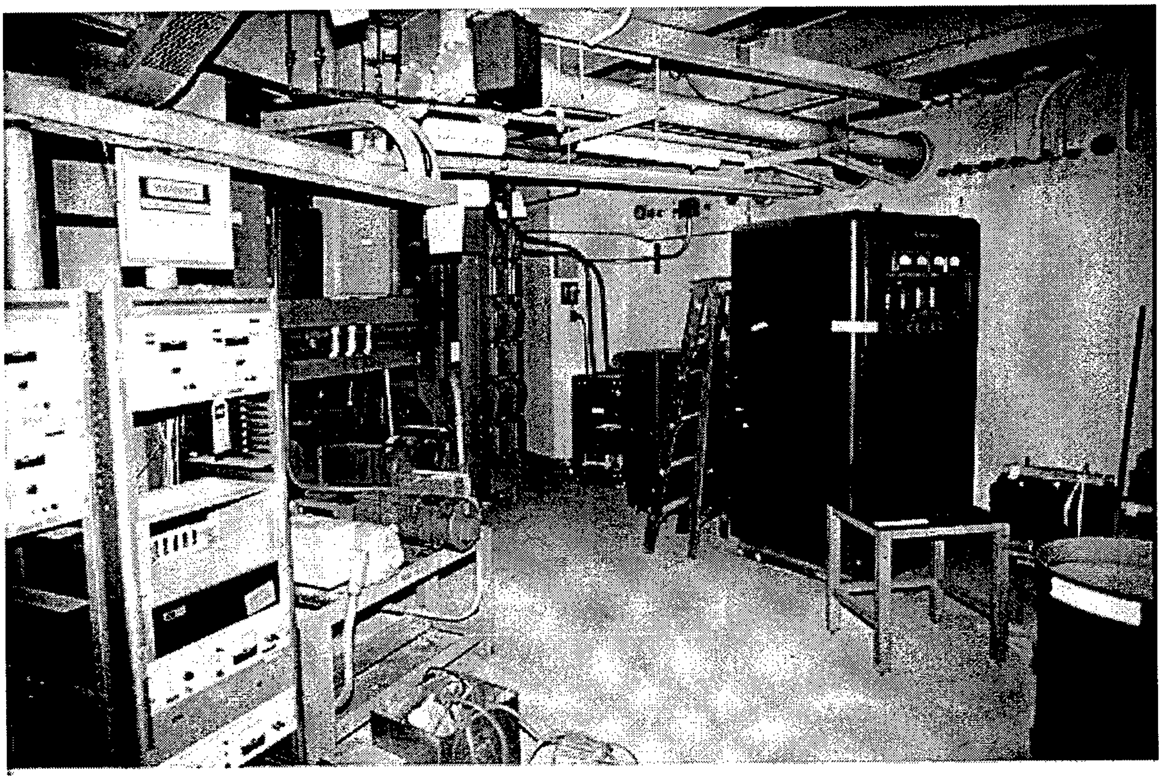
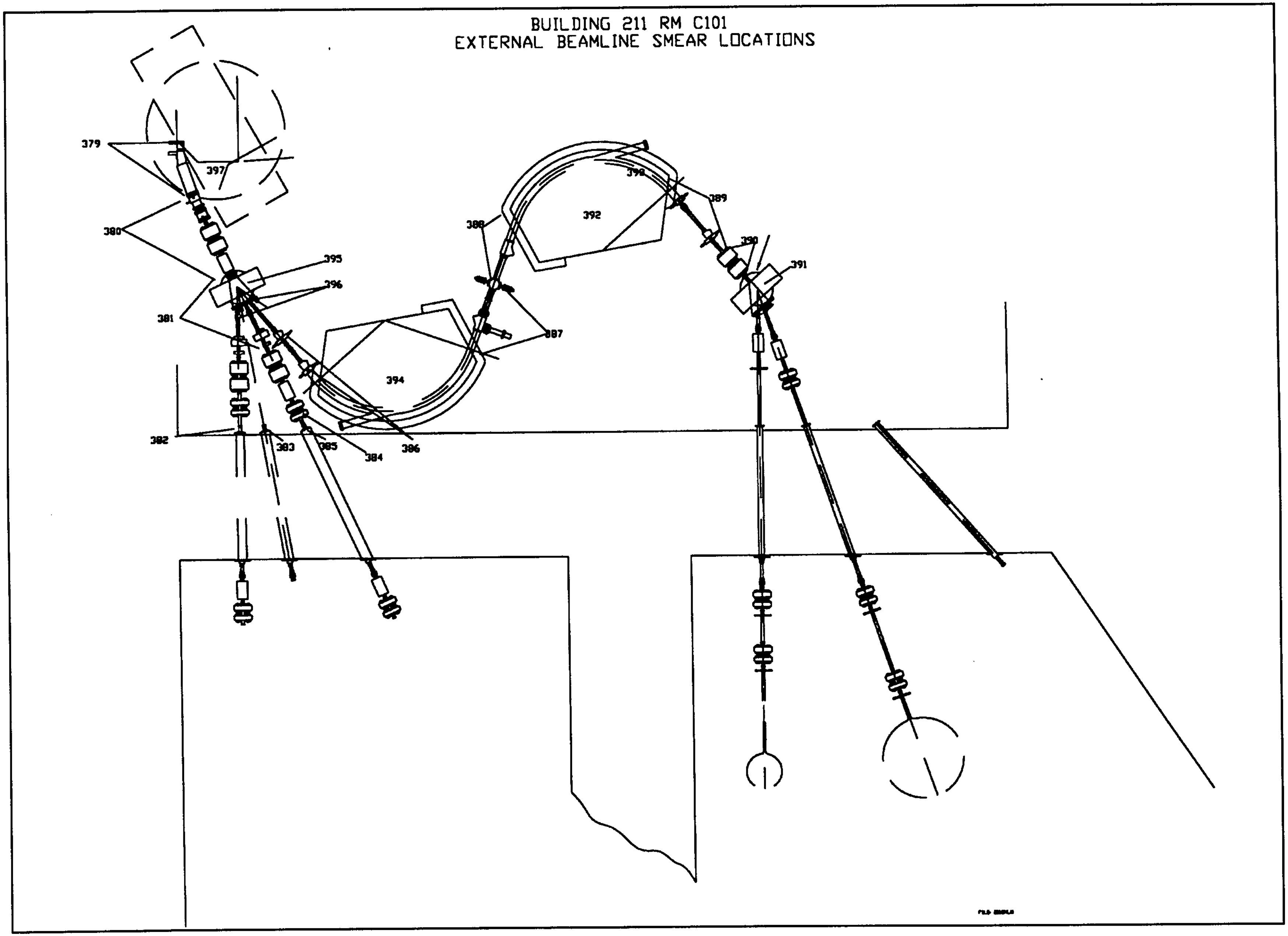


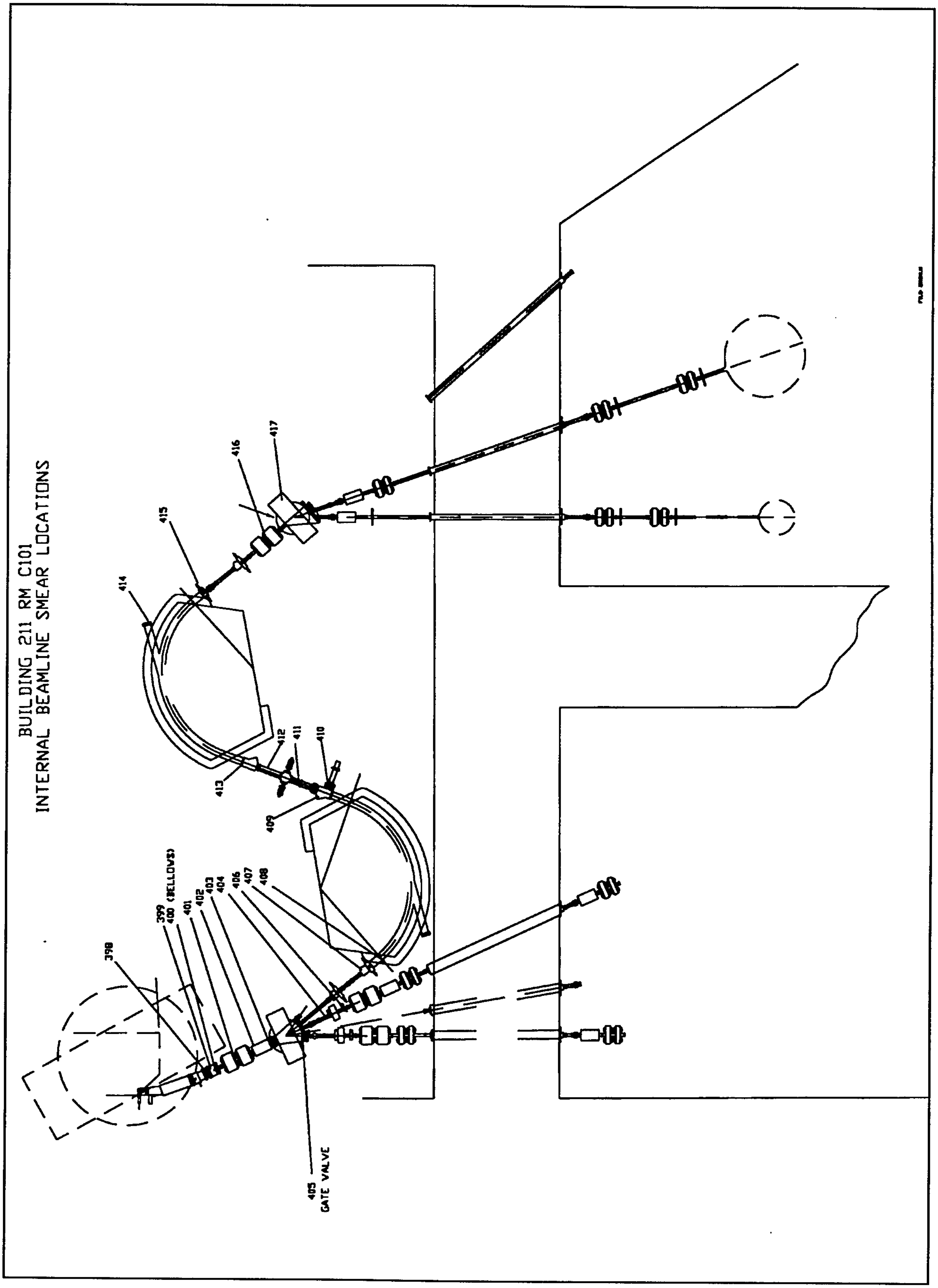
FIGURE 42 Two Views of the Cyclotron Facility Basement Area, C-001

APPENDIX D:

CYCLOTRON FACILITY RADIOLOGICAL SURVEY MAPS



BUILDING 211 RM C101
EXTERNAL BEAMLINE SMEAR LOCATIONS

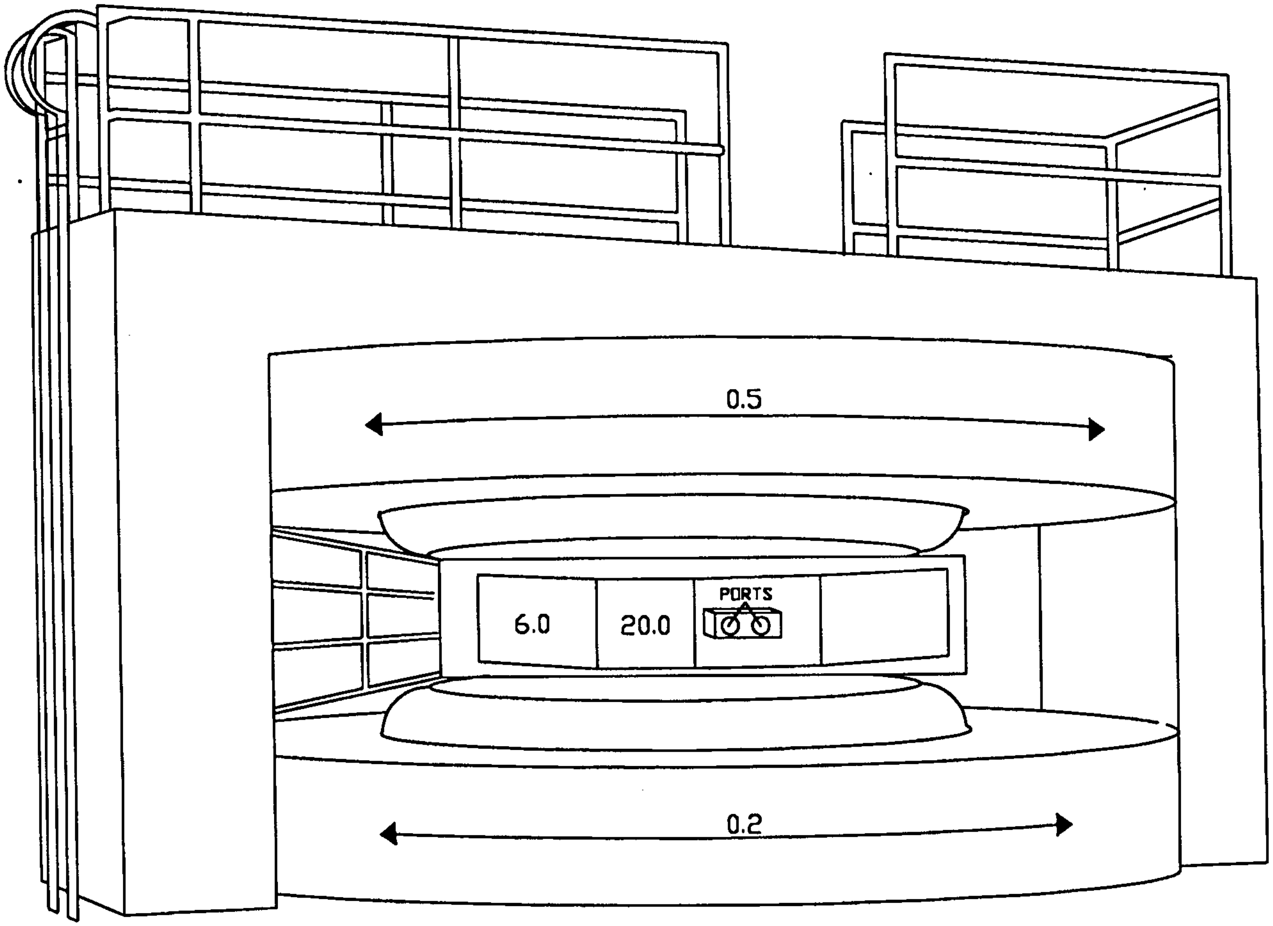


BUILDING 211 RM C101
INTERNAL BEAMLINE SMEAR LOCATIONS

BUILDING 211 RM. C101

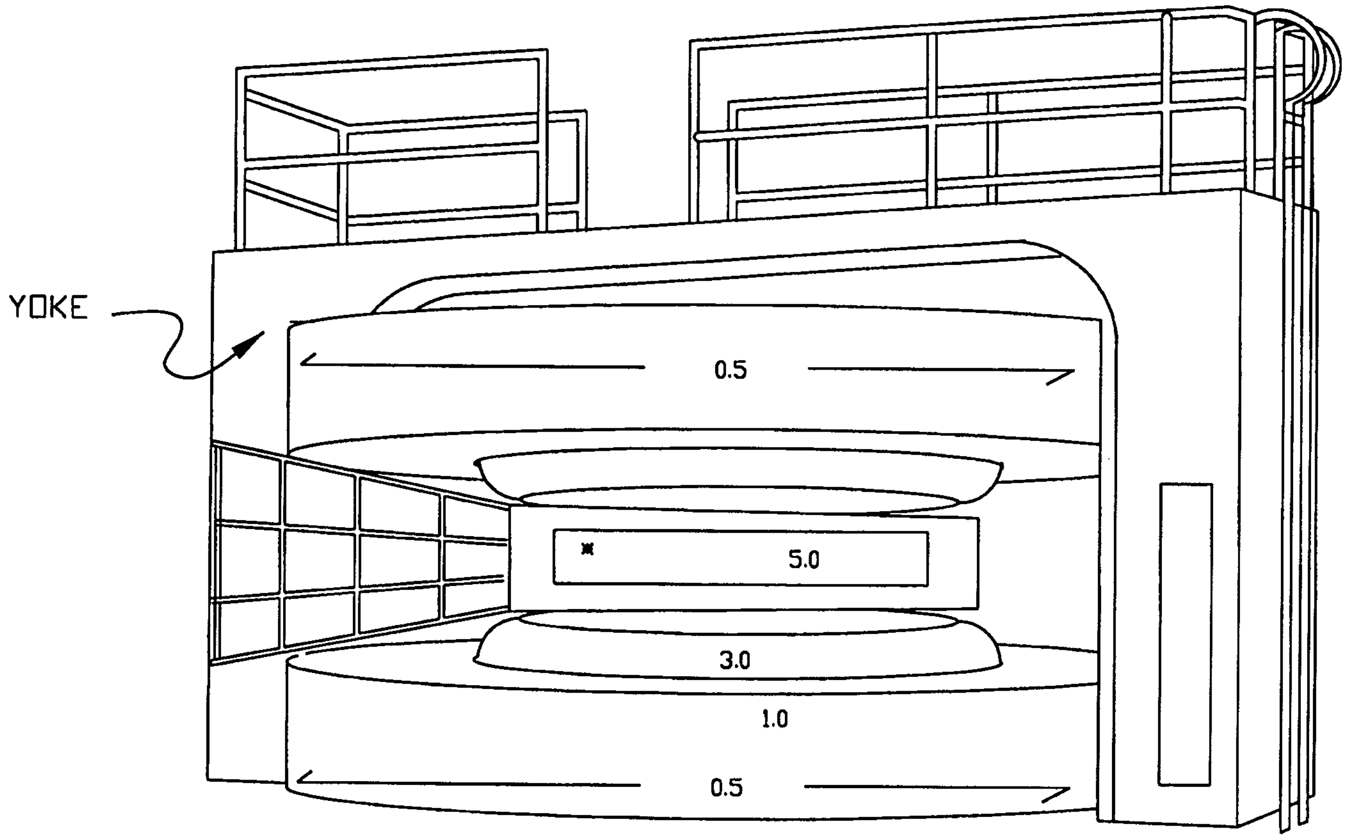
NORTHWEST CORNER-CYCLOTRON

RO-20 ION CHAMBER, mR/h γ



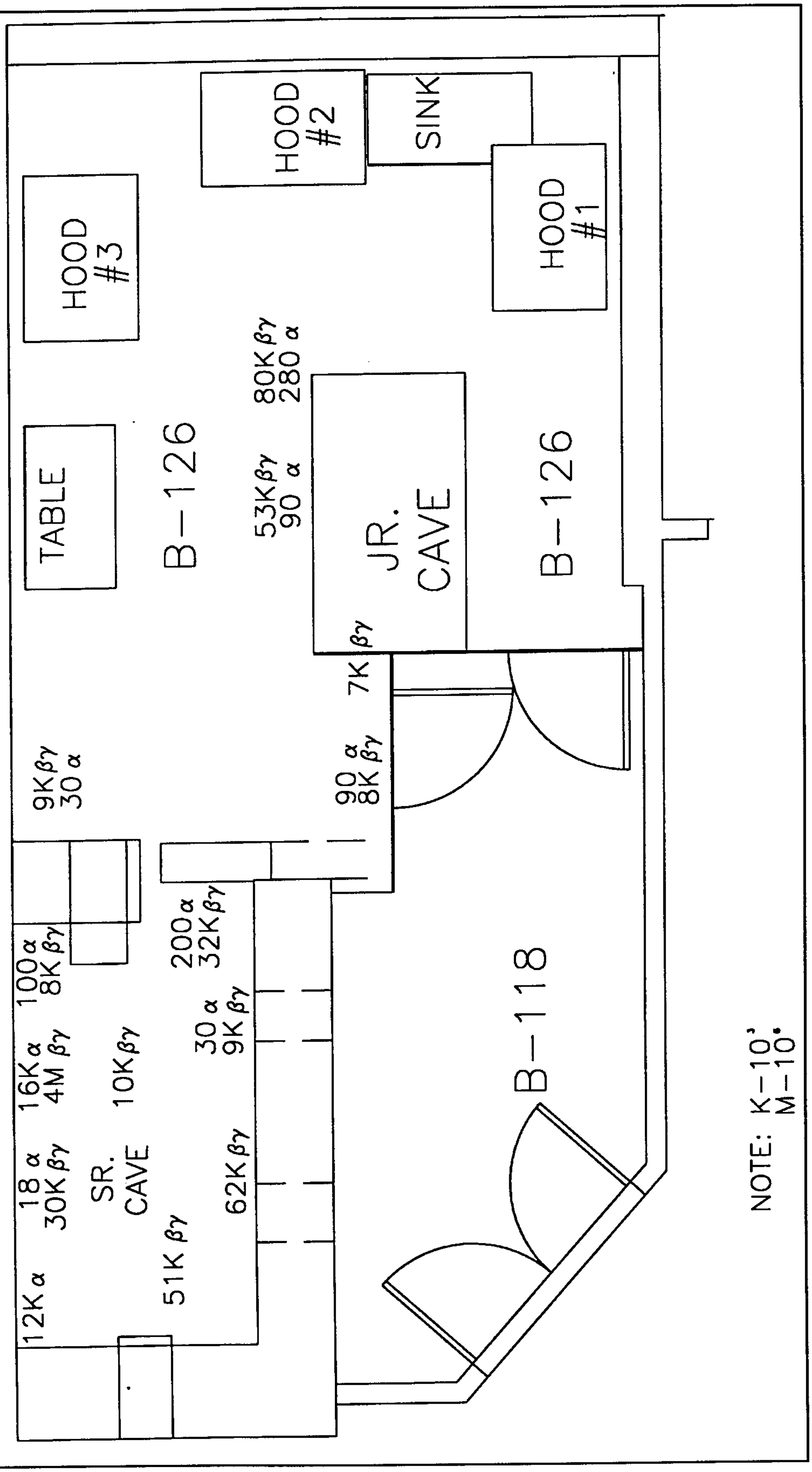
- PORTS UP TO 60mR/h
- MEASUREMENT 1ft FROM PORT FACE, 2mR/h

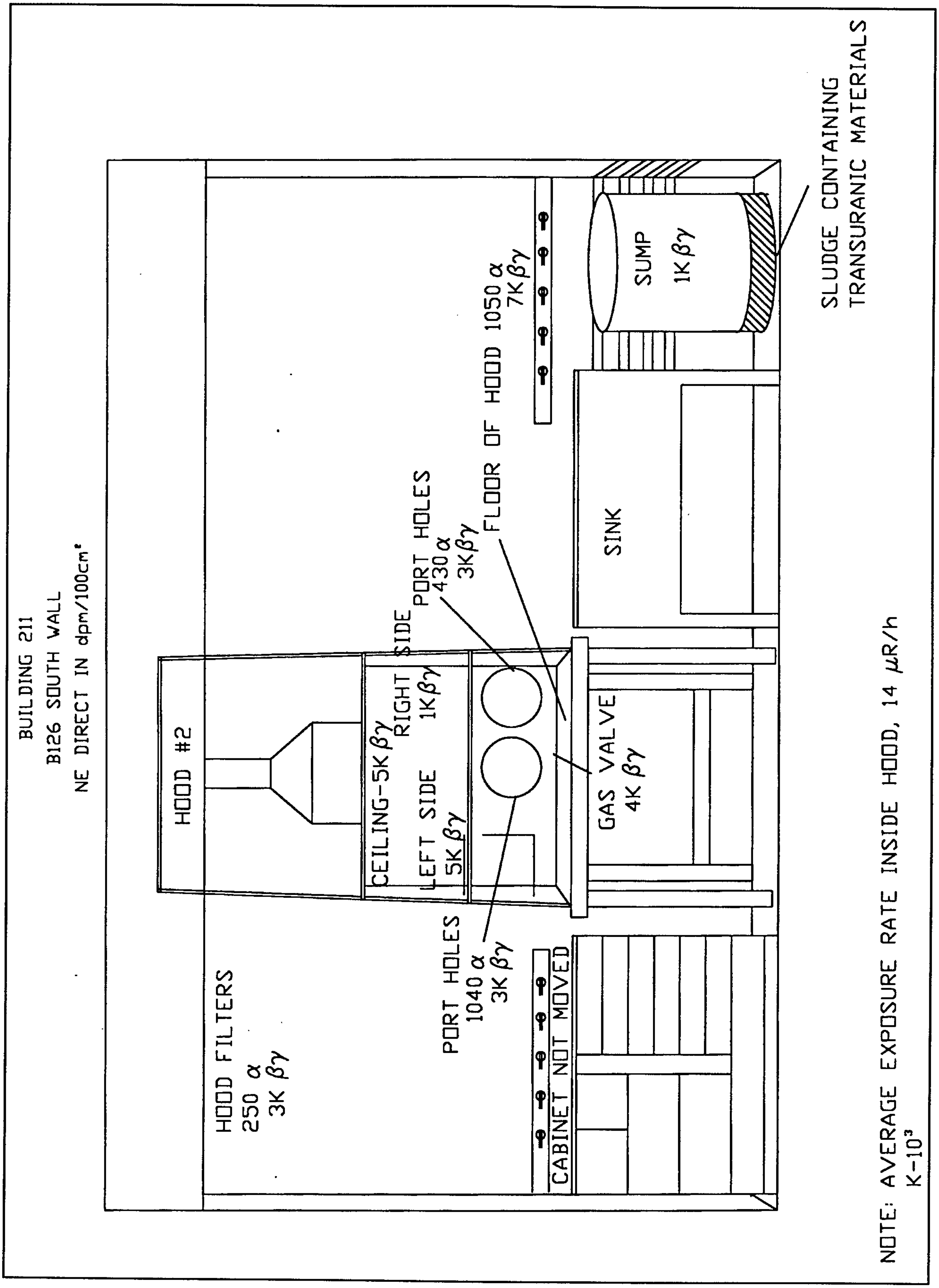
BUILDING 211 C101
EAST FACE-CYCLOTRON
RO-20 ION CHAMBER, mR/h γ



NOTE: * REMOVABLE COVER PLATE, $\beta\gamma$ DOSE RATE W/COVER REMOVED 1.5 Rad/h, 300mR/h γ

BUILDING 211 CAVE COMPLEX
FLOOR CONTAMINATION RESULTS
NE DIRECT IN dpm/100





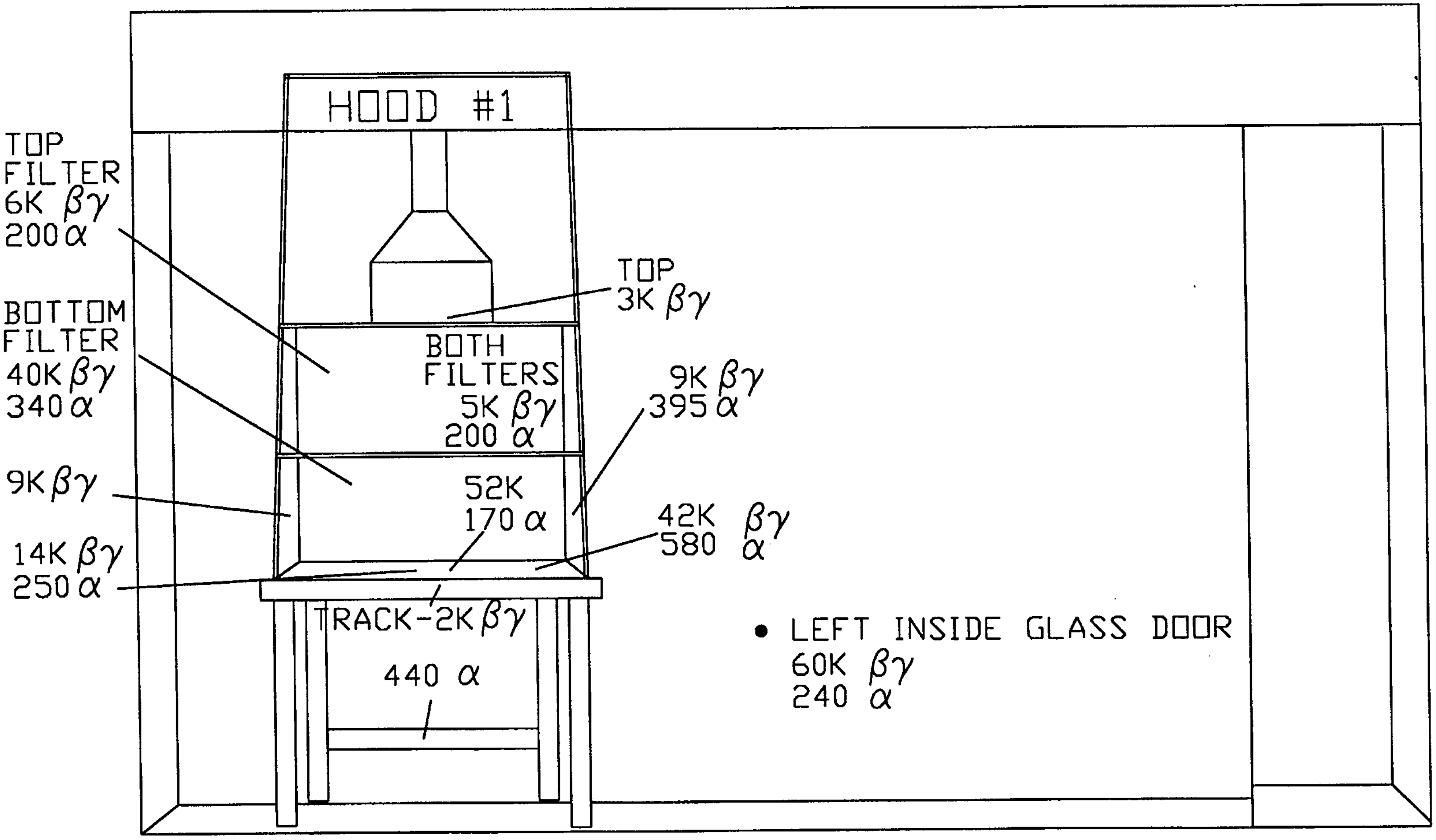
BUILDING 211
B126 SOUTH WALL
NE DIRECT IN dpm/100cm²

NOTE: AVERAGE EXPOSURE RATE INSIDE HOOD, 14 μR/h
K-10³

BUILDING 211 B126

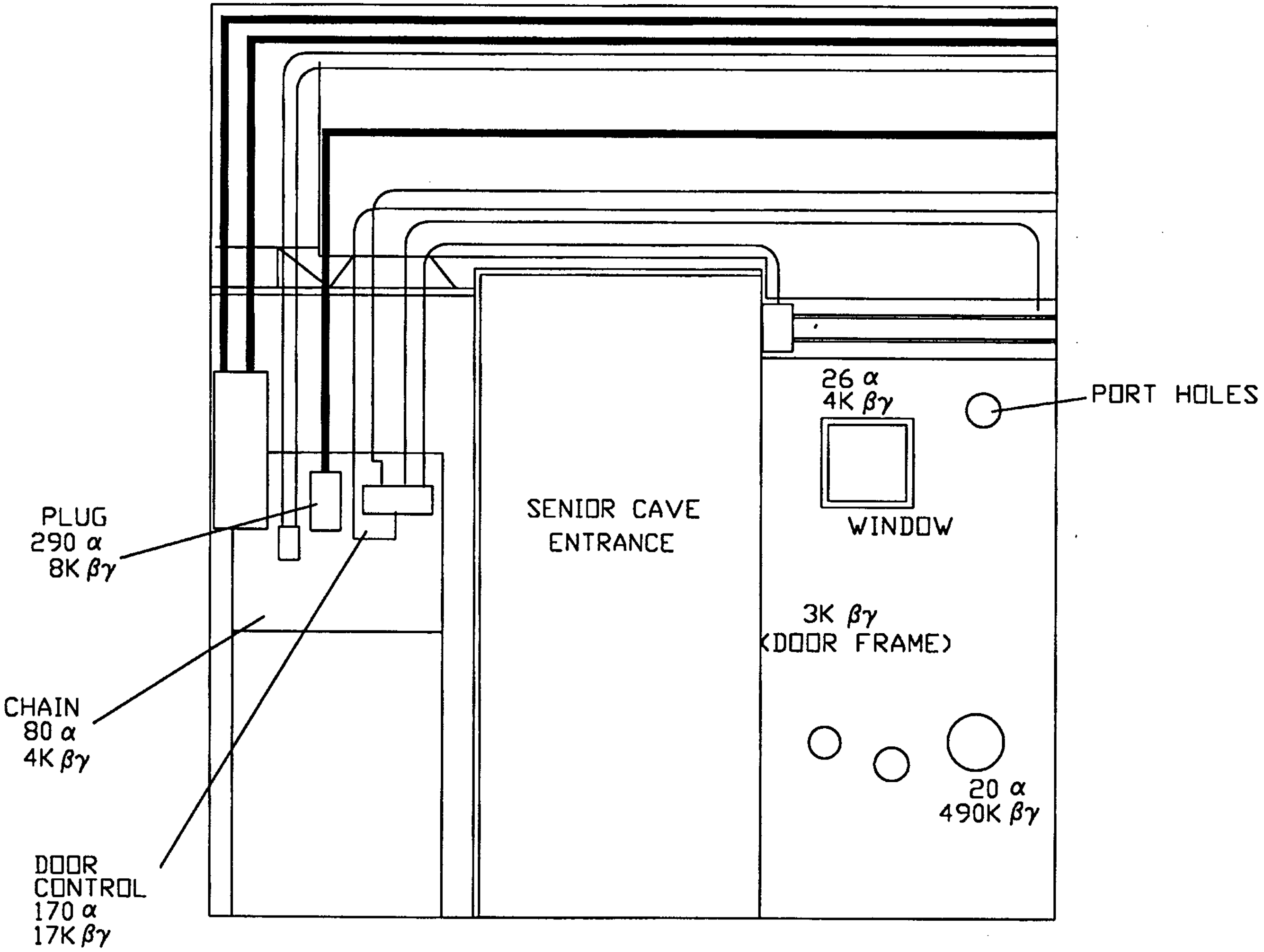
WEST WALL

NE DIRECT IN dpm/100cm²



NOTE: AVERAGE EXPOSURE RATE INSIDE HOOD, 20 μR/h
K-10^3

BUILDING 211 B126
NORTH WALL
NE DIRECT IN dpm/100cm²

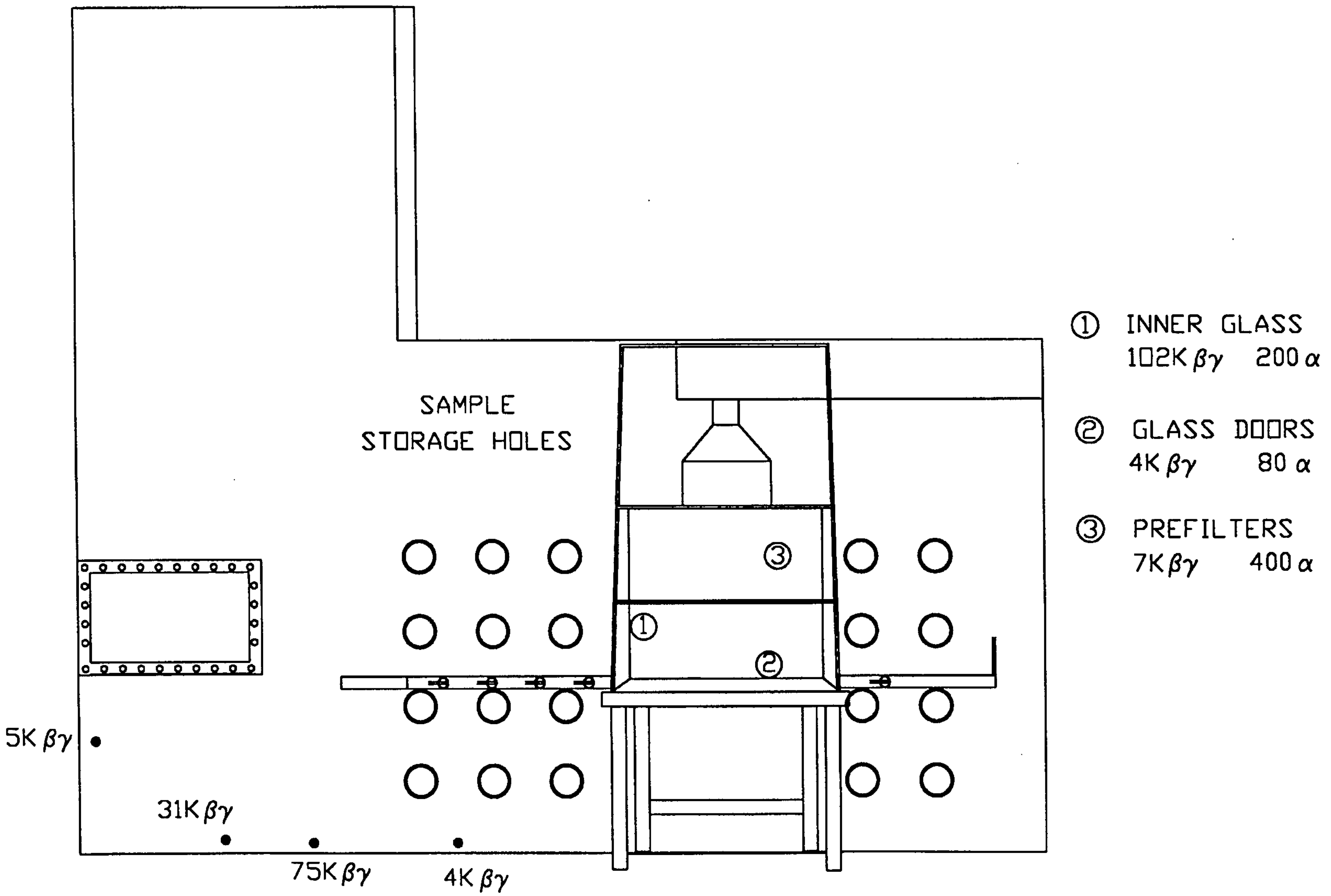


NOTE: $K-10^3$

BUILDING 211 B126

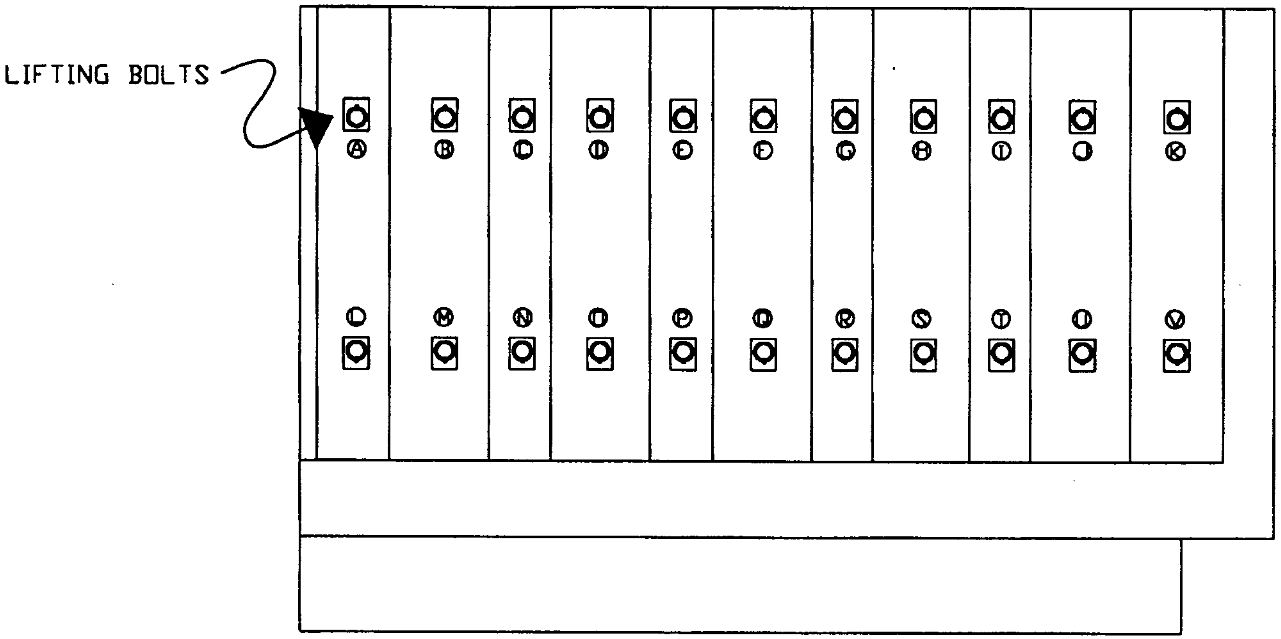
EAST WALL

NE DIRECT IN dpm/100cm²



BUILDING 211 SENIOR CAVE

CABLE — SIGNIFICANT AMOUNTS OF LOOSE CONTAMINATION FOUND ON CABLE TAPE (SEE TEXT)



DIRECT MEASUREMENTS W/NE:

Ⓐ	2500	βγ
Ⓑ	2400	βγ
Ⓒ	3600 60	βγ α
Ⓓ	7500 1200	βγ α
Ⓔ	14000 260	βγ α
Ⓕ	6500 360	βγ α
Ⓖ	12000 200	βγ α
Ⓗ	6000 160	βγ α
Ⓘ	4000	βγ
Ⓙ	3500	α
Ⓚ	1800	α
Ⓛ	1700	βγ
Ⓜ	2000	βγ
Ⓝ	2200	βγ
Ⓞ	2000	βγ
Ⓟ	3300	βγ
Ⓠ	4600 70	βγ α
Ⓡ	115000 1800	βγ
Ⓢ	10000 700	βγ α
Ⓣ	4000 70	βγ α
Ⓢ	2200 90	βγ α
Ⓣ	1700	α

NOTE: RADIOACTIVE CONTAMINATION IN
RESIDUE AROUND LIFTING BOLTS

ALL RESULTS IN dpm/100cm²

APPENDIX E:

SUMMARY OF SMEAR SURVEY RESULTS FOR REMOVABLE SURFACE CONTAMINATION

[All smears were taken over an area of approximately 100 cm^2]

TABLE E.1 Elevated Smear Sample Data

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	A-020	West wall	47S	4,4		-1.04 ± 4.09	245.2 ± 37.9
LA Smear	B-118	East Wall	619S	1,10	Hot spot	209.58 ± 41.04	35.9 ± 22.3
LA Smear	B-126	Crane	452S	4,13	Control	9.58 ± 9.13	241.2 ± 37.7
LA Smear	B-126	Door	564S	3,3	Frame	853.33 ± 82.68	2,079.3 ± 99.1
LA Smear	B-126	Door	565S	3,3	knob	555.42 ± 66.72	280.5 ± 40.0
LA Smear	B-126	East Wall	483S	Left glass door		5.42 ± 7.08	351.5 ± 43.7
LA Smear	B-126	East Wall	500S	Cabinet top		30.42 ± 15.82	84.9 ± 26.2
LA Smear	B-126	East Wall	502S	1,5	Hot spot	1.25 ± 4.09	49.2 ± 22.9
LA Smear	B-126	East Wall	503S	1,5	Hot spot	-0.83 ± 4.09	198.0 ± 34.7
LA Smear	B-126	East Wall	748S	2,1	Hole #3	3.13 ± 5.78	113.1 ± 28.8
LA Smear	B-126	East Wall	749S	1,1	Hole #4	3.13 ± 5.78	46.4 ± 22.9
LA Smear	B-126	East Wall	750S	4,2	Hole #5	-1.04 ± 4.09	71.4 ± 25.3
LA Smear	B-126	East Wall	752S	2,2	Hole #7	67.71 ± 23.46	1,738.1 ± 90.9
LA Smear	B-126	East Wall	753S	1,2	Hole #8	3.13 ± 5.78	102.4 ± 28.0
LA Smear	B-126	East Wall	757S	1,3	Hole #12	13.54 ± 10.81	2,845.2 ± 115.4
LA Smear	B-126	East Wall	760S	2,4	Hole #15	5.21 ± 7.08	50.0 ± 23.3
LA Smear	B-126	East Wall	771S	3,7	Hole #26	11.46 ± 10.01	69.0 ± 25.1
LA Smear	B-126	Floor	156S	1,1		44.63 ± 19.16	125.6 ± 29.9
LA Smear	B-126	Floor	157S	7,9		32.13 ± 16.34	37.5 ± 22.2
LA Smear	B-126	Floor	158S	7,16		27.96 ± 15.28	29.2 ± 21.3
LA Smear	B-126	Hood #1	213S	Floor	Interior	63.54 ± 22.74	1,547.6 ± 86.0
SA Smear	B-126	Hood #1	223S	Floor	Interior	15.46 ± 11.55	176.8 ± 33.6
LA Smear	B-126	Hood #1	472S	Filters	Interior	11.67 ± 10.01	132.5 ± 30.1
LA Smear	B-126	Hood #1	487S	Bottom cross brace	Exterior	30.42 ± 15.82	76.5 ± 25.5

TABLE E.1 Elevated Smear Sample Data (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	B-126	Hood #1	496S	South wall	Interior	3.33 ± 5.78	1,012.3 ± 70.2
LA Smear	B-126	Hood #1	497S	North wall	Interior	76.25 ± 24.84	242.0 ± 37.5
SA Smear	B-126	Hood #2	228S	Floor	Interior	1,063.38 ± 92.31	7,172.0 ± 182.0
LA Smear	B-126	Hood #2	476S	Floor	Interior	36.67 ± 17.33	76.5 ± 25.5
SA Smear	B-126	Hood #3	229S	Drain	Exterior	73.79 ± 24.50	231.5 ± 37.2
SA Smear	B-126	Hood #3	230S	Right wall	Interior	655.04 ± 72.47	1,887.5 ± 94.6
SA Smear	B-126	Hood #3	231S	Left wall	Interior	173.79 ± 37.43	243.5 ± 37.9
SA Smear	B-126	Hood #3	233S	Floor	Interior	138.38 ± 33.43	478.0 ± 50.1
LA Smear	B-126	Hood #3	488S	Floor	Interior	34.58 ± 16.84	34.9 ± 21.5
LA Smear	B-126	I beam top	617S	Cntr beam north	Hot spot	20.00 ± 12.92	60.9 ± 24.8
LA Smear	B-126	North Wall	161S	2,2		5.04 ± 7.08	45.8 ± 23.1
LA Smear	B-126	North Wall	165S	4,8		25.88 ± 14.73	2,578.0 ± 110.1
LA Smear	B-126	North Wall	480S	3,9	Hot spot	1.25 ± 4.09	3,275.4 ± 123.6
LA Smear	B-126	North Wall	485S	6,9	Hot spot	-0.83 ± 4.09	111.1 ± 28.4
LA Smear	B-126	Overhead	166S	North girder		21.71 ± 13.55	30.4 ± 21.5
LA Smear	Back dock	2 shelves, misc	783	-		3.33 ± 5.78	140.0 ± 30.9
LA Smear	Back dock	3- I beams	785	-		-0.83 ± 4.09	56.7 ± 24.0
LA Smear	C-101	6' inside ion	745S	Source chamber		1.04 ± 4.09	1,082.1 ± 72.5
LA Smear	C-101	Items East	653S	Cabinets	#101	-1.13 ± 4.09	86.3 ± 26.8
LA Smear	C-101	Items East	656S	Top of cabinets	#103	-1.13 ± 4.09	45.8 ± 23.1
LA Smear	C-101	Items East	657S	Target assembly	#104	80.13 ± 25.50	86.3 ± 26.8
LA Smear	C-101	Items East	717S	Bucket of parts	#109	117.63 ± 30.83	54.2 ± 23.9
LA Smear	C-101	Items East	666S	Bucket of parts	#114	3.04 ± 5.78	2,118.5 ± 100.1
LA Smear	C-101	Items East	690S	Pail of parts	#115	186.38 ± 38.74	266.1 ± 39.2

TABLE E.1 Elevated Smear Sample Data (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-101	Items East	691S	Plastic trim box	#116	548.88 ± 66.35	943.5 ± 68.1
LA Smear	C-101	Items West	377S	Pail of targets	#119	9.58 ± 9.13	59.9 ± 24.0
LA Smear	C-101	Items North	697S	Man lift	#126	-1.13 ± 4.09	1,337.5 ± 80.2
LA Smear	C-101	Items North	700S	SRW can	#129	-1.13 ± 4.09	43.5 ± 22.8
LA Smear	C-101	Items North	701S	Cabinet	#130	7.21 ± 8.17	73.2 ± 25.6
SA Smear	C-101	Items South	346S	Leak checker	#142	7.50 ± 8.17	52.7 ± 24.0
LA Smear	C-101	Items West	372S	Paraffin, table	#155	9.58 ± 9.13	286.1 ± 40.1
LA Smear	C-101	Items West	375S	Beam stand	#158	7.50 ± 8.17	151.5 ± 31.5
LA Smear	C-101	Items West	376S	Beam line heat	#161	63.75 ± 22.74	61.1 ± 24.1
LA Smear	C-101	North Wall	723S	Pb glass window		55.21 ± 21.22	96.4 ± 27.5
LA Smear	Cyclotron	Beam Line	379S	On map	External	17.92 ± 12.25	127.7 ± 30.3
LA Smear	Cyclotron	Beam Line	380S	On map	External	7.50 ± 8.17	44.3 ± 23.2
LA Smear	Cyclotron	Beam Line	381S	On map	External	28.33 ± 15.28	151.5 ± 32.0
LA Smear	Cyclotron	Beam Line	396S	On map	External	326.25 ± 51.16	922.9 ± 67.5
LA Smear	Cyclotron	Beam Line	397S	On map	External	1.25 ± 4.09	439.6 ± 48.4
LA Smear	Cyclotron	Beam Line	398S	On map	Internal	7,567.92 ± 246.12	18,444.3 ± 291.0
LA Smear	Cyclotron	Beam Line	399S	On map	Internal	6,705.42 ± 231.67	40,228.9 ± 429.3
LA Smear	Cyclotron	Beam Line	400S	On map	Internal	8,474.17 ± 111.83	11,642.0 ± 231.5
LA Smear	Cyclotron	Beam Line	401S	On map	Internal	1,561.67 ± 111.83	5,627.7 ± 161.5
LA Smear	Cyclotron	Beam Line	402S	On map	Internal	449.17 ± 60.01	825.3 ± 64.1
LA Smear	Cyclotron	Beam Line	403S	On map	Internal	2,522.08 ± 142.10	6,701.5 ± 176.0
LA Smear	Cyclotron	Beam Line	404S	On map	Internal	11.67 ± 10.01	897.9 ± 66.6
LA Smear	Cyclotron	Beam Line	405S	On map	Internal	2,430.42 ± 139.49	3,607.4 ± 129.7
LA Smear	Cyclotron	Beam Line	406S	On map	Internal	11.67 ± 10.01	49.1 ± 23.6

TABLE E.1 Elevated Smear Sample Data (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Cyclotron	Beam Line	407S	On map	Internal	40.83 ± 18.26	106.2 ± 28.6
LA Smear	Cyclotron	Beam Line	408S	On map	Internal	84.58 ± 26.15	43.1 ± 23.1
LA Smear	Cyclotron	Beam Line	409S	On map	Internal	297.08 ± 48.83	187.2 ± 34.5
LA Smear	Cyclotron	Beam Line	410S	On map	Internal	138.75 ± 33.42	90.8 ± 27.4
LA Smear	Cyclotron	Beam Line	411S	On map	Internal	78.33 ± 25.17	37.2 ± 22.5
LA Smear	Cyclotron	Beam Line	412S	On map	Internal	67.92 ± 23.46	18.1 ± 20.4
LA Smear	Cyclotron	Beam Line	413S	On map	Internal	47.08 ± 19.58	43.1 ± 23.1
LA Smear	Cyclotron	Beam Line	414S	On map	Internal	92.92 ± 27.39	71.7 ± 25.7
LA Smear	Cyclotron	Beam Line	415S	On map	Internal	182.50 ± 38.31	172.9 ± 33.5
LA Smear	Cyclotron	Beam Line	416S	On map	internal	20.00 ± 12.92	31.2 ± 21.8
LA Smear	Cyclotron	Beam Line	417S	On map	internal	242.92 ± 44.17	192.0 ± 34.8
LA Smear	Cyclotron	Beam parts	418S	Open beam	#165	267.92 ± 46.38	1,059.9 ± 71.7
LA Smear	Cyclotron	Elect Equip	430S	15,14,3	Exterior	5.42 ± 7.08	317.0 ± 42.2
LA Smear	Cyclotron	Elect Equip	438S	21,35,6	Exterior	7.50 ± 8.17	101.5 ± 28.3
LA Smear	Cyclotron	Elect Equip	444S	33,21,9	Exterior	17.92 ± 12.25	67.0 ± 25.3
LA Smear	Cyclotron	Diffusion pump	422S	28,26,5	Bellows	13.75 ± 10.81	57.5 ± 23.7
SA Smear	Cyclotron	Splitter	459S	-		11.67 ± 10.01	15,413.4 ± 266.1
SA Smear	Cyclotron	Target 2	462S	17,14,5		3.33 ± 5.78	3,317.0 ± 124.5
SA Smear	Cyclotron	Target port 1	463S	17,14,5		11.67 ± 10.01	2,763.4 ± 113.9
SA Smear	Cyclotron	Target port 2	464S	17,14,5		11.67 ± 10.01	8,782.4 ± 201.2
LA Smear	Fanloft	A-exh-B4	736S	Upstream	Interior	32.29 ± 16.34	20.2 ± 20.1
LA Smear	Fanloft	A-exh-B5-1	734S	Upstream	Interior	71.88 ± 24.16	35.7 ± 21.8
LA Smear	Jr. Cave	Floor (entire)	490S	-	Interior	7.50 ± 8.17	111.1 ± 28.4
LA Smear	Jr. Cave	West Wall (entire)	505S	-	Interior	3.33 ± 5.78	64.6 ± 24.4

TABLE E.1 Elevated Smear Sample Data (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Sr. Cave	HEPA filter	722S	Bottom	Exterior	48.96 ± 20.01	21.4 ± 20.3
LA Smear	Sr. Cave	Roof	277S	Smear of tape	Exterior	126.25 ± 31.89	105.1 ± 28.0
LA Smear	Sr. Cave	Roof	278S	Lift residue	Exterior	74.17 ± 24.50	109.9 ± 28.3
LA Smear	Sr. Cave	Roof	537S	5,2	Exterior	22.08 ± 13.55	-4.60 ± 17.7
LA Smear	Sr. Cave	Ceiling	559S	Lights	Interior	563.75 ± 67.22	1,023.4 ± 70.7
LA Smear	Sr. Cave	Crane	589S	Hook & Cable	Interior	38.75 ± 17.80	742.4 ± 60.9
LA Smear	Sr. Cave	Crane	590S	Trolly	Interior	28.33 ± 15.28	56.7 ± 24.0
LA Smear	Sr. Cave	Duct work	563S	North wall	Interior	4,084.58 ± 180.82	4,173.4 ± 139.3
LA Smear	Sr. Cave	Floor	545S	7,6	Interior	15.83 ± 11.55	8,127.7 ± 193.6
LA Smear	Sr. Cave	Floor	546S	7,2	Interior	1.25 ± 4.09	92.0 ± 26.9
LA Smear	Sr. Cave	Floor	569S	10,6	Interior	834.58 ± 81.77	1,481.7 ± 84.2
LA Smear	Sr. Cave	Floor	570S	9,6	Interior	3,384.58 ± 164.60	7,040.0 ± 180.3
LA Smear	Sr. Cave	Floor	571S	3,5	Interior	3.33 ± 5.78	106.7 ± 28.3
LA Smear	Sr. Cave	Floor	572S	2,2	Interior	9.58 ± 9.13	166.2 ± 32.8
LA Smear	Sr. Cave	Floor	573S	9,0	Interior	3.33 ± 5.78	374.6 ± 45.0
LA Smear	Sr. Cave	Items	554S	In cave	Interior	13.75 ± 10.81	100.4 ± 27.6
LA Smear	Sr. Cave	Manip arms, #3, #4	562S	-	Interior	92.92 ± 27.39	49.6 ± 23.3
LA Smear	Sr. Cave	North wall	553S	Grill	Interior	157.50 ± 35.60	296.8 ± 40.7
LA Smear	Sr. Cave	South Wall	579S	Inside door	Interior	63.75 ± 22.74	17.4 ± 19.9
LA Smear	Sr. Cave	South Wall	581S	51	Interior	22.08 ± 13.55	511.5 ± 51.5
LA Smear	Steel Vault	Floor (entire)	596S	-	Interior	1.25 ± 4.09	134.7 ± 30.8

TABLE E.1 Elevated Smear Sample Data (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
Minimum						-1.13 ± 4.09	-4.6 ± 17.7
Maximum						8,474.17 ± 260.44	40,228.9 ± 429.3
Average						400.71 ± 31.17	1,562.3 ± 58.4
Standard Deviation						1,316.85 ± 47.37	4,598.0 ± 63.7
Count						117	117

Notes:
- Coordinate data are either two dimensional X,Y or three dimensional X,Y,Z.
- For walls, X is the horizontal coordinate and Y is the vertical coordinate.
- For floors, X is the east-west coordinate and Y is the north-south coordinate.
- All data are listed in feet.
- [Refer to Section VI, Survey and Sampling Design for complete description of coordinate system].

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	A-004	Floor	1S	2,2		1.02 ± 4.09	9.5 ± 19.0
LA Smear	A-004	Floor	2S	2,4		-1.06 ± 4.09	-9.6 ± 16.6
LA Smear	A-004	Floor	3S	4,4		-1.06 ± 4.09	-16.7 ± 15.6
LA Smear	A-004	Floor	4S	4,2		-1.06 ± 4.09	16.6 ± 19.9
LA Smear	A-004	Tank	7S	6,2		15.60 ± 11.55	-6.0 ± 17.1
LA Smear	A-004	Tank	8S	6,4		3.10 ± 5.78	-9.6 ± 16.6
LA Smear	A-004	Tank	9S	6,2		1.02 ± 4.09	-16.7 ± 15.6
LA Smear	A-004	Tank	10S	6,4		5.19 ± 7.08	1.1 ± 18.0
					Minimum	-1.06 ± 4.09	-16.7 ± 15.6
					Maximum	15.60 ± 11.55	16.6 ± 19.9
					Average	2.84 ± 5.61	-3.9 ± 17.3
					Standard Deviation	5.25 ± 2.47	11.3 ± 1.5
					Count	8	8
LA Smear	A-011	Pump 1	11S	1,1	External	-1.06 ± 4.09	1.1 ± 18.0
LA Smear	A-011	Pump 1	12S	2,1	External	-1.06 ± 4.09	-9.6 ± 16.6
LA Smear	A-011	Pump 1	13S	4,3	External	1.02 ± 4.09	-16.7 ± 15.6
LA Smear	A-011	Pump 1	14S	4,3	External	-1.06 ± 4.09	-13.2 ± 16.1
LA Smear	A-011	Pump 1	15S	6,3	External	5.19 ± 7.08	-0.1 ± 17.9
SA Smear	A-011	Pump 1	21S	3,1	Internal	1.04 ± 4.09	-10.8 ± 16.4
SA Smear	A-011	Pump 1	22S	3,4	Internal	-1.04 ± 4.09	-12.0 ± 16.3
SA Smear	A-011	Pump 1	23S	1,1	Internal	-1.04 ± 4.09	5.9 ± 18.6
SA Smear	A-011	Pump 1	24S	1,3	Internal	3.13 ± 5.78	8.3 ± 18.9
SA Smear	A-011	Pump 1	25S	1,3	Internal	1.04 ± 4.09	9.5 ± 19.0

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	A-011	Pump 2	16S	1,1	External	1.04 ± 4.09	2.3 ± 18.2
LA Smear	A-011	Pump 2	17S	3,1	External	1.04 ± 4.09	-1.2 ± 17.7
LA Smear	A-011	Pump 2	18S	2,2	External	-1.04 ± 4.09	-1.2 ± 17.7
LA Smear	A-011	Pump 2	19S	4,3	External	-1.04 ± 4.09	3.5 ± 18.3
LA Smear	A-011	Pump 2	20S	6,4	External	-1.04 ± 4.09	-20.3 ± 15.0
SA Smear	A-011	Pump 2	26S	1,1	Internal	-1.04 ± 4.09	10.7 ± 19.2
SA Smear	A-011	Pump 2	27S	1,2	Internal	-1.04 ± 4.09	0.0 ± 17.9
SA Smear	A-011	Pump 2	28S	2,4	Internal	-1.04 ± 4.09	-7.2 ± 16.9
SA Smear	A-011	Pump 2	29S	3,2	Internal	-1.04 ± 4.09	-10.8 ± 16.4
SA Smear	A-011	Pump 2	30S	4,4	Internal	1.04 ± 4.09	-7.2 ± 16.9
					Minimum	-1.06 ± 4.09	-20.3 ± 15.0
					Maximum	5.19 ± 7.08	10.7 ± 19.2
					Average	0.10 ± 4.33	-3.4 ± 17.4
					Standard Deviation	1.67 ± 0.73	8.7 ± 1.2
					Count	20	20
LA Smear	A-020	East wall	31S	3,4		-1.04 ± 4.09	-7.1 ± 16.8
LA Smear	A-020	East wall	32S	6,14		3.13 ± 5.78	-13.1 ± 15.9
LA Smear	A-020	Floor	33S	1,2		-1.04 ± 4.09	-7.1 ± 16.8
LA Smear	A-020	Floor	34S	1,9		-1.04 ± 4.09	-26.2 ± 13.9
LA Smear	A-020	Floor	35S	9,9		1.04 ± 4.09	-14.3 ± 15.8
LA Smear	A-020	Floor	36S	15,6		-1.04 ± 4.09	2.4 ± 18.0
LA Smear	A-020	Hydraulics	37S	8,7		-1.04 ± 4.09	-6.0 ± 16.9
LA Smear	A-020	Hydraulics	38S	6,12		-1.04 ± 4.09	-2.4 ± 17.4
LA Smear	A-020	Hydraulics	39S	5,6		-1.04 ± 4.09	-15.5 ± 15.6

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	A-020	Hydraulics	40S	12,5		1.04 ± 4.09	-21.4 ± 14.7
LA Smear	A-020	Hydraulics	41S	-		-1.04 ± 4.09	7.1 ± 18.6
LA Smear	A-020	North wall	42S	5,11		-1.04 ± 4.09	-2.4 ± 17.4
LA Smear	A-020	North wall	43S	6,6		3.13 ± 5.78	-1.2 ± 17.6
LA Smear	A-020	South wall	44S	5,5		1.04 ± 4.09	4.8 ± 18.3
LA Smear	A-020	South wall	45S	2,12		-1.04 ± 4.09	-1.2 ± 17.6
LA Smear	A-020	Sump pit	46S	5,2		1.04 ± 4.09	31.0 ± 21.3
LA Smear	A-020	West wall	47S	4,4		-1.04 ± 4.09	245.2 ± 37.9
LA Smear	A-020	West wall	48S	4,13		-1.04 ± 4.09	6.0 ± 18.5
					Minimum	-1.04 ± 4.09	-26.2 ± 13.9
					Maximum	3.13 ± 5.78	245.2 ± 37.9
					Average	-0.12 ± 4.28	9.9 ± 18.3
					Standard Deviation	1.43 ± 0.53	58.4 ± 5.0
					Count	18	18
LA Smear	A-111 & A-119	East Wall	49S	1,1		-1.04 ± 4.09	-10.8 ± 16.4
LA Smear	A-111 & A-119	East Wall	50S	5,2		-1.04 ± 4.09	-8.4 ± 16.8
LA Smear	A-111 & A-119	East Wall	51S	7,6		-1.04 ± 4.09	1.1 ± 18.0
LA Smear	A-111 & A-119	East Wall	52S	7,10		-1.04 ± 4.09	2.3 ± 18.2
LA Smear	A-111 & A-119	East Wall	53S	4,11		1.04 ± 4.09	21.4 ± 20.4
LA Smear	A-111 & A-119	Floor	54S	5,3		-1.04 ± 4.09	-21.5 ± 14.9
LA Smear	A-111 & A-119	Floor	55S	15,10		-1.04 ± 4.09	5.9 ± 18.6
LA Smear	A-111 & A-119	Floor	56S	25,3		1.04 ± 4.09	10.7 ± 19.2
LA Smear	A-111 & A-119	Floor	57S	30,15		7.29 ± 8.17	-4.8 ± 17.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min) Alpha	Smear Activity (dis/min) Beta
LA Smear	A-111 & A-119	Floor	58S	4,5		-1.04 ± 4.09	4.7 ± 18.5
LA Smear	A-111 & A-119	North Wall	59S	5,5		3.13 ± 5.78	7.1 ± 18.8
LA Smear	A-111 & A-119	North Wall	60S	5,25		-1.04 ± 4.09	11.9 ± 19.3
LA Smear	A-111 & A-119	North Wall	61S	6,30		-1.04 ± 4.09	-13.1 ± 16.1
LA Smear	A-111 & A-119	North Wall	62S	3,35		-1.04 ± 4.09	3.5 ± 18.3
LA Smear	A-111 & A-119	North Wall	63S	4,50		-1.04 ± 4.09	-1.2 ± 17.7
LA Smear	A-111 & A-119	South Wall	64S	6,10		-1.04 ± 4.09	-9.6 ± 16.6
LA Smear	A-111 & A-119	South Wall	65S	6,20		1.04 ± 4.09	-1.2 ± 17.7
LA Smear	A-111 & A-119	South Wall	66S	8,26		-1.04 ± 4.09	-1.2 ± 17.7
LA Smear	A-111 & A-119	South Wall	67S	4,35		-1.04 ± 4.09	-17.9 ± 15.4
LA Smear	A-111 & A-119	South Wall	68S	4,40		-1.04 ± 4.09	5.9 ± 18.6
LA Smear	A-111 & A-119	West Wall	69S	6,3		1.04 ± 4.09	-12.0 ± 16.3
LA Smear	A-111 & A-119	West Wall	70S	6,6		-1.04 ± 4.09	-8.4 ± 16.8
LA Smear	A-111 & A-119	West Wall	71S	5,10		-1.04 ± 4.09	0.0 ± 17.9
LA Smear	A-111 & A-119	West Wall	72S	8,13		1.04 ± 4.09	-21.5 ± 14.9
LA Smear	A-111 & A-119	West Wall	73S	8,14		-1.04 ± 4.09	-16.7 ± 15.6
					Minimum	-1.04 ± 4.09	-21.5 ± 14.9
					Maximum	7.29 ± 8.17	21.4 ± 20.4
					Average	-0.13 ± 4.32	-3.0 ± 17.4
					Standard Deviation	1.87 ± 0.85	10.7 ± 1.4
					Count	25	25

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	B-012	East wall	74S	4,1		1.04 ± 4.09	-9.5 ± 16.4
LA Smear	B-012	East wall	75S	6,8		1.04 ± 4.09	32.1 ± 21.5
LA Smear	B-012	Floor	76S	1,2		1.04 ± 4.09	-1.2 ± 17.6
LA Smear	B-012	Floor	77S	1,5		3.13 ± 5.78	0.0 ± 17.7
LA Smear	B-012	Floor	78S	6,1		-1.04 ± 4.09	-8.3 ± 16.6
LA Smear	B-012	Floor	79S	-		1.04 ± 4.09	2.4 ± 18.0
LA Smear	B-012	Hydraulics	80S	-	East pillar	-1.04 ± 4.09	-3.6 ± 17.2
LA Smear	B-012	Hydraulics	81S	-	West pillar	3.13 ± 5.78	-3.6 ± 17.2
LA Smear	B-012	Hydraulics	82S	-	Pipes	-1.04 ± 4.09	-15.5 ± 15.6
LA Smear	B-012	Hydraulics	83S	-	Piston	-1.04 ± 4.09	-8.3 ± 16.6
LA Smear	B-012	Hydraulics	84S	-	Platform	7.29 ± 8.17	-1.2 ± 17.6
LA Smear	B-012	North wall	85S	6,6		-1.04 ± 4.09	-6.0 ± 16.9
LA Smear	B-012	North wall	86S	8,9		1.04 ± 4.09	2.4 ± 18.0
LA Smear	B-012	South wall	87S	5,2		1.04 ± 4.09	-9.5 ± 16.4
LA Smear	B-012	South wall	88S	4,12		-1.04 ± 4.09	0.0 ± 17.7
LA Smear	B-012	Sump pit	89S	8,12		1.04 ± 4.09	-9.5 ± 16.4
LA Smear	B-012	West wall	90S	6,2		-1.04 ± 4.09	-2.4 ± 17.4
LA Smear	B-012	West wall	91S	3,8		1.04 ± 4.09	-3.6 ± 17.2
					Minimum	-1.04 ± 4.09	-15.5 ± 15.6
					Maximum	7.29 ± 8.17	32.1 ± 21.5
					Average	0.81 ± 4.51	-2.5 ± 17.3
					Standard Deviation	2.07 ± 1.03	9.6 ± 1.2
					Count	18	18

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	B-102	Air Ducts	92S	9,12	External	-1.04 ± 4.09	-10.8 ± 16.4
LA Smear	B-102	Air Ducts	93S	9,9	External	3.13 ± 5.78	-3.6 ± 17.4
LA Smear	B-102	Air Ducts	94S	9,7	External	-1.04 ± 4.09	-9.6 ± 16.6
LA Smear	B-102	Ceiling	95S	3,5		-1.04 ± 4.09	-6.0 ± 17.1
LA Smear	B-102	Ceiling	96S	15,9		-1.04 ± 4.09	13.0 ± 19.5
LA Smear	B-102	Ceiling	97S	27,4		3.13 ± 5.78	2.3 ± 18.2
LA Smear	B-102	East Wall	98S	3,3		-1.04 ± 4.09	-14.3 ± 15.9
LA Smear	B-102	East Wall	99S	8,16		-1.04 ± 4.09	-3.6 ± 17.4
LA Smear	B-102	East Wall	100S	5,30		-1.04 ± 4.09	-4.8 ± 17.2
LA Smear	B-102	Floor	101S	8,8		3.13 ± 5.78	4.7 ± 18.5
LA Smear	B-102	Floor	102S	12,15		-1.04 ± 4.09	-4.8 ± 17.2
LA Smear	B-102	Floor	103S	12,25		1.04 ± 4.09	-10.8 ± 16.4
LA Smear	B-102	North Wall	104S	6,15		-1.04 ± 4.09	-1.2 ± 17.7
LA Smear	B-102	North Wall	105S	3,9		-1.04 ± 4.09	-15.5 ± 15.8
LA Smear	B-102	North Wall	106S	6,3		-1.04 ± 4.09	22.6 ± 20.6
LA Smear	B-102	South Wall	107S	3,3		3.13 ± 5.78	-4.8 ± 17.2
LA Smear	B-102	South Wall	108S	9,6		1.04 ± 4.09	-7.2 ± 16.9
LA Smear	B-102	South Wall	109S	5,14		5.21 ± 7.08	-13.1 ± 16.1
LA Smear	B-102	West Wall	110S	3,6		-1.04 ± 4.09	0.0 ± 17.9
LA Smear	B-102	West Wall	111S	9,11		1.04 ± 4.09	-6.0 ± 17.1
LA Smear	B-102	West Wall	112S	6,19		1.04 ± 4.09	-10.8 ± 16.4
					Minimum	-1.04 ± 4.09	-15.5 ± 15.8
					Maximum	5.21 ± 7.08	22.6 ± 20.6
					Average	0.45 ± 4.56	-4.0 ± 17.3
					Standard Deviation	1.94 ± 0.87	8.9 ± 1.1
					Count	21	21

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	B-118	Ceiling	113S	5,2		-1.04 ± 4.09	-17.9 ± 15.4
LA Smear	B-118	Ceiling	114S	10,2		-1.04 ± 4.09	-9.6 ± 16.6
LA Smear	B-118	Ceiling	115S	10,5		-1.04 ± 4.09	0.0 ± 17.9
LA Smear	B-118	Ceiling	116S	12,4		1.04 ± 4.09	-1.2 ± 17.7
LA Smear	B-118	Ceiling	117S	5,5		3.13 ± 5.78	-2.4 ± 17.6
SA Smear	B-118	Drop Ceiling	140S	7,1		-1.21 ± 4.10	-7.7 ± 16.9
SA Smear	B-118	Drop Ceiling	141S	10,1		5.04 ± 7.08	-13.7 ± 16.1
SA Smear	B-118	Drop Ceiling	142S	7,4		0.88 ± 4.10	-11.3 ± 16.4
SA Smear	B-118	Drop Ceiling	143S	10,4		0.88 ± 4.10	13.7 ± 19.6
SA Smear	B-118	Drop Ceiling	144S	12,4		-1.21 ± 4.10	-12.5 ± 16.3
SA Smear	B-118	Duct Work	145S	2,7		0.88 ± 4.10	11.3 ± 19.3
LA Smear	B-118	East Wall	118S	10,8		3.13 ± 5.78	-9.6 ± 16.6
LA Smear	B-118	East Wall	119S	10,15		9.38 ± 9.14	-2.4 ± 17.6
LA Smear	B-118	East Wall	120S	6,15		-1.04 ± 4.09	-3.6 ± 17.4
LA Smear	B-118	East Wall	121S	6,8		3.13 ± 5.78	-4.8 ± 17.2
LA Smear	B-118	East Wall	619S	1,10	Hot Spot	209.58 ± 41.04	35.9 ± 22.3
LA Smear	B-118	Floor	122S	3,0		-1.04 ± 4.09	13.0 ± 19.5
LA Smear	B-118	Floor	123S	7,2		1.04 ± 4.09	0.0 ± 17.9
LA Smear	B-118	Floor	124S	7,6		3.13 ± 5.78	8.3 ± 18.9
LA Smear	B-118	Floor	125S	10,3		3.13 ± 5.78	21.4 ± 20.4
LA Smear	B-118	Floor	126S	10,6		-1.04 ± 4.09	9.5 ± 19.0
SA Smear	B-118	Lifted Tile	146S	10,4		11.29 ± 10.01	5.4 ± 18.6
SA Smear	B-118	Lifted Tile	147S	5,4		2.96 ± 5.78	13.7 ± 19.6
LA Smear	B-118	North Wall	127S	7,3		1.04 ± 4.09	2.3 ± 18.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	B-118	North Wall	128S	7,10		-1.04 ± 4.09	8.3 ± 18.9
LA Smear	B-118	North Wall	129S	3,3		-1.04 ± 4.09	0.0 ± 17.9
LA Smear	B-118	North Wall	130S	3,10		1.04 ± 4.09	-3.6 ± 17.4
LA Smear	B-118	South Wall	131S	7,3		1.04 ± 4.09	-3.6 ± 17.4
LA Smear	B-118	South Wall	132S	3,3		3.13 ± 5.78	-6.0 ± 17.1
LA Smear	B-118	South Wall	133S	7,5		1.04 ± 4.09	8.3 ± 18.9
LA Smear	B-118	South Wall	134S	5,3		1.04 ± 4.09	8.3 ± 18.9
LA Smear	B-118	West Wall	136S	7,3		-1.21 ± 4.10	-8.9 ± 16.8
LA Smear	B-118	West Wall	137S	7,10		-1.21 ± 4.10	5.4 ± 18.6
LA Smear	B-118	West Wall	138S	3,3		0.88 ± 4.10	0.6 ± 18.0
LA Smear	B-118	West Wall	139S	3,10		0.88 ± 4.10	14.9 ± 19.7
					Minimum	-1.21 ± 4.09	-17.9 ± 15.4
					Maximum	209.58 ± 41.04	35.9 ± 22.3
					Average	7.30 ± 5.89	1.7 ± 18.1
					Standard Deviation	34.80 ± 6.19	10.9 ± 1.4
					Count	35	35
LA Smear	B-126	Cave door	567	4,2	Control	-0.83 ± 4.09	-13.5 ± 15.9
LA Smear	B-126	Cave door	568	5,2	Level	1.25 ± 4.09	-5.2 ± 17.1
SA Smear	B-126	Ceiling	214S	2,2	Tile 1	0.88 ± 4.10	-0.6 ± 17.9
SA Smear	B-126	Ceiling	215S	3,8	Tile 2	0.88 ± 4.10	-4.2 ± 17.4
SA Smear	B-126	Ceiling	216S	6,9	Tile 3	-1.21 ± 4.10	12.5 ± 19.5
SA Smear	B-126	Ceiling	217S	12,7	Tile 4	0.88 ± 4.10	-6.5 ± 17.1
SA Smear	B-126	Ceiling	218S	8,0	Tile 5	2.96 ± 5.78	0.6 ± 18.0
LA Smear	B-126	Crane	452	4,3	Control	9.58 ± 9.13	241.2 ± 37.7

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	B-126	Door	564	3,3	Frame	853.33 ± 82.68	2079.3 ± 99.1
LA Smear	B-126	Door	565	3,3	Knob	555.42 ± 66.72	280.5 ± 40.0
LA Smear	B-126	Door	566	1,1	Bottoms	-0.83 ± 4.09	-2.8 ± 17.4
LA Smear	B-126	East Wall	151S	3,4		0.88 ± 4.10	-5.4 ± 17.2
LA Smear	B-126	East Wall	152S	6,9		0.88 ± 4.10	-3.0 ± 17.6
LA Smear	B-126	East Wall	153S	4,16		0.88 ± 4.10	-0.6 ± 17.9
LA Smear	B-126	East Wall	154S	6,3		-1.21 ± 4.10	7.7 ± 18.9
LA Smear	B-126	East Wall	155S	2,16		0.88 ± 4.10	-0.6 ± 17.9
LA Smear	B-126	East Wall	482S	Lower trap		7.50 ± 8.17	23.0 ± 20.1
LA Smear	B-126	East Wall	483S	Left glass door		5.42 ± 7.08	351.5 ± 43.7
LA Smear	B-126	East Wall	500S	Cabinet top		30.42 ± 15.82	84.9 ± 26.2
LA Smear	B-126	East Wall	502S	1,5	Hot spot	1.25 ± 4.09	49.2 ± 22.9
LA Smear	B-126	East Wall	503S	1,5	Hot spot	-0.83 ± 4.09	198.0 ± 34.7
LA Smear	B-126	East Wall	504S	9,0	Hot spot	3.33 ± 5.78	-5.6 ± 16.6
LA Smear	B-126	East Wall	746S	4,1	Hole #1	-1.04 ± 4.09	-4.8 ± 17.1
LA Smear	B-126	East Wall	747S	3,1	Hole #2	1.04 ± 4.09	-3.6 ± 17.2
LA Smear	B-126	East Wall	748S	2,1	Hole #3	3.13 ± 5.78	113.1 ± 28.8
LA Smear	B-126	East Wall	749S	1,1	Hole #4	3.13 ± 5.78	46.4 ± 22.9
LA Smear	B-126	East Wall	750S	4,2	Hole #5	-1.04 ± 4.09	71.4 ± 25.3
LA Smear	B-126	East Wall	751S	3,2	Hole #6	5.21 ± 7.08	0.0 ± 17.7
LA Smear	B-126	East Wall	752S	2,2	Hole #7	67.71 ± 23.46	1738.1 ± 90.9
LA Smear	B-126	East Wall	753S	1,2	Hole #8	3.13 ± 5.78	102.4 ± 28.0
LA Smear	B-126	East Wall	754S	4,3	Hole #9	-1.04 ± 4.09	20.2 ± 20.1
LA Smear	B-126	East Wall	755S	3,3	Hole #10	1.04 ± 4.09	-3.6 ± 17.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	B-126	East Wall	756S	2,3	Hole #11	1.04 ± 4.09	33.3 ± 21.6
LA Smear	B-126	East Wall	757S	1,3	Hole #12	13.54 ± 10.81	2845.2 ± 115.4
LA Smear	B-126	East Wall	758S	4,4	Hole #13	-1.04 ± 4.09	-9.5 ± 16.4
LA Smear	B-126	East Wall	759S	3,4	Hole #14	3.13 ± 5.78	11.9 ± 19.2
LA Smear	B-126	East Wall	760S	2,4	Hole #15	5.21 ± 7.08	50.0 ± 23.3
LA Smear	B-126	East Wall	761S	1,4	Hole #16	5.21 ± 7.08	6.0 ± 18.5
LA Smear	B-126	East Wall	762S	4,5	Hole #17	1.04 ± 4.09	9.5 ± 18.9
LA Smear	B-126	East Wall	763S	3,5	Hole #18	-1.04 ± 4.09	-9.5 ± 16.4
LA Smear	B-126	East Wall	764S	2,5	Hole #19	-1.04 ± 4.09	6.0 ± 18.5
LA Smear	B-126	East Wall	765S	1,5	Hole #20	7.29 ± 8.17	-1.2 ± 17.6
LA Smear	B-126	East Wall	766S	4,6	Hole #21	-1.04 ± 4.09	21.4 ± 20.3
LA Smear	B-126	East Wall	767S	3,6	Hole #22	-1.04 ± 4.09	-15.5 ± 15.6
LA Smear	B-126	East Wall	768S	2,6	Hole #23	-1.04 ± 4.09	10.7 ± 19.0
LA Smear	B-126	East Wall	769S	1,6	Hole #24	5.21 ± 7.08	0.0 ± 17.7
LA Smear	B-126	East Wall	770S	4,7	Hole #25	5.21 ± 7.08	25.0 ± 20.7
LA Smear	B-126	East Wall	771S	3,7	Hole #26	11.46 ± 10.01	69.0 ± 25.1
LA Smear	B-126	East Wall	772S	2,7	Hole #27	1.04 ± 4.09	3.6 ± 18.2
LA Smear	B-126	East Wall	773S	1,7	Hole #28	5.21 ± 7.08	29.8 ± 21.2
LA Smear	B-126	East Wall	774S	4,8	Hole #29	1.04 ± 4.09	8.3 ± 18.8
LA Smear	B-126	East Wall	775S	3,8	Hole #30	5.21 ± 7.08	-2.4 ± 17.4
LA Smear	B-126	East Wall	776S	2,8	Hole #31	-1.04 ± 4.09	19.0 ± 20.0
LA Smear	B-126	East Wall	777S	1,8	Hole #32	-1.04 ± 4.09	-11.9 ± 16.1
LA Smear	B-126	East Wall	778S	10,5	Hot spot	1.25 ± 4.09	8.7 ± 18.5
LA Smear	B-126	Floor	156S	1,1		44.63 ± 19.16	125.6 ± 29.9

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	B-126	Floor	157S	7,9		32.13 ± 16.34	37.5 ± 22.2
LA Smear	B-126	Floor	158S	7,16		27.96 ± 15.28	29.2 ± 21.3
LA Smear	B-126	Floor	159S	4,16		0.88 ± 4.10	8.9 ± 19.0
LA Smear	B-126	Floor	160S	1,0		15.46 ± 11.55	24.4 ± 20.8
LA Smear	B-126	Hood #1	213S	Floor	Interior	63.54 ± 22.74	1547.6 ± 86.0
SA Smear	B-126	Hood #1	219S	Drain	Exterior	-1.21 ± 4.10	11.3 ± 19.3
SA Smear	B-126	Hood #1	220S	Right wall	Interior	5.04 ± 7.08	-8.9 ± 16.8
SA Smear	B-126	Hood #1	221S	Left wall	Interior	-1.21 ± 4.10	-14.9 ± 15.9
SA Smear	B-126	Hood #1	222S	Back wall	Interior	0.88 ± 4.10	6.5 ± 18.8
SA Smear	B-126	Hood #1	223S	Floor	Interior	15.46 ± 11.55	176.8 ± 33.6
LA Smear	B-126	Hood #1	472S	Filters	Interior	11.67 ± 10.01	132.5 ± 30.1
LA Smear	B-126	Hood #1	474S	Top	Exterior	-0.83 ± 4.09	7.5 ± 18.3
LA Smear	B-126	Hood #1	487S	Bottom cross brace	Exterior	30.42 ± 15.82	76.5 ± 25.5
LA Smear	B-126	Hood #1	496S	South wall	Interior	3.33 ± 5.78	1012.3 ± 70.2
LA Smear	B-126	Hood #1	497S	North wall	Interior	76.25 ± 24.84	242.0 ± 37.5
LA Smear	B-126	Hood #1	729S	Drain	Exterior	13.54 ± 10.81	36.9 ± 22.0
SA Smear	B-126	Hood #2	224S	Drain	Exterior	-1.21 ± 4.10	11.3 ± 19.3
SA Smear	B-126	Hood #2	225S	Duct work	Exterior	5.04 ± 7.08	11.3 ± 19.3
SA Smear	B-126	Hood #2	226S	Left wall	Interior	-1.21 ± 4.10	22.0 ± 20.6
SA Smear	B-126	Hood #2	227S	Back wall	Interior	-1.21 ± 4.10	11.3 ± 19.3
SA Smear	B-126	Hood #2	228S	Floor	Interior	1063.38 ± 92.31	7172.0 ± 182.0
LA Smear	B-126	Hood #2	475S	West side	Exterior	-0.83 ± 4.09	-10.4 ± 15.9
LA Smear	B-126	Hood #2	476S	Floor	Interior	36.67 ± 17.33	76.5 ± 25.5
LA Smear	B-126	Hood #2	479S	Top	Exterior	-0.83 ± 4.09	-10.4 ± 15.9

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min) Alpha	Smear Activity (dis/min) Beta
LA Smear	B-126	Hood #2	498S	East side	Exterior	1.25 ± 4.09	-3.2 ± 16.9
LA Smear	B-126	Hood #2	501S	Filters	Exterior	1.25 ± 4.09	8.7 ± 18.5
LA Smear	B-126	Hood #2	730S	Drain	Exterior	3.13 ± 5.78	-4.8 ± 17.1
SA Smear	B-126	Hood #3	229S	Drain	Exterior	73.79 ± 24.50	231.5 ± 37.2
SA Smear	B-126	Hood #3	230S	Right wall	Interior	655.04 ± 72.47	1887.5 ± 94.6
SA Smear	B-126	Hood #3	231S	Left wall	Interior	173.79 ± 37.43	243.5 ± 37.9
SA Smear	B-126	Hood #3	232S	Back wall	Interior	13.38 ± 10.81	36.3 ± 22.1
SA Smear	B-126	Hood #3	233S	Floor	Interior	138.38 ± 33.43	478.0 ± 50.1
LA Smear	B-126	Hood #3	486S	Filters on back	Interior	7.50 ± 8.17	24.2 ± 20.3
LA Smear	B-126	Hood #3	488S	Floor	Interior	34.58 ± 16.84	34.9 ± 21.5
LA Smear	B-126	Hood #3	489S	Ceiling	Interior	-0.83 ± 4.09	2.7 ± 17.7
LA Smear	B-126	Hood #3	731S	Drain	Exterior	3.13 ± 5.78	2.4 ± 18.0
LA Smear	B-126	I beam top	617S	Cntr beam n.	Hot spot	20.00 ± 12.92	60.9 ± 24.8
LA Smear	B-126	Lifted tile	234S	6th,2nd row		1.04 ± 4.09	-3.6 ± 17.2
LA Smear	B-126	Lifted tile	235S	11th, 6th row		-1.04 ± 4.09	7.1 ± 18.6
LA Smear	B-126	North Wall	161S	2,2		5.04 ± 7.08	45.8 ± 23.1
LA Smear	B-126	North Wall	162S	3,6		0.88 ± 4.10	19.6 ± 20.3
LA Smear	B-126	North Wall	163S	7,4		2.96 ± 5.78	5.4 ± 18.6
LA Smear	B-126	North Wall	164S	6,8		7.13 ± 8.17	41.1 ± 22.6
LA Smear	B-126	North Wall	165S	4,8		25.88 ± 14.73	2578.0 ± 110.1
LA Smear	B-126	North Wall	477S	4,6	Hot spot	1.25 ± 4.09	1.5 ± 17.5
LA Smear	B-126	North Wall	480S	3,9	Hot spot	1.25 ± 4.09	3275.4 ± 123.6
LA Smear	B-126	North Wall	481S	6,7	Hot spot	-0.83 ± 4.09	23.0 ± 20.1
LA Smear	B-126	North Wall	485S	6,9	Hot spot	-0.83 ± 4.09	111.1 ± 28.4

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	B-126	Overhead	166S	North girder		21.71 ± 13.55	30.4 ± 21.5
LA Smear	B-126	Overhead	167S	Ductwork and piping		0.88 ± 4.10	8.9 ± 19.0
LA Smear	B-126	Overhead	168S	South girder		7.13 ± 8.17	-1.8 ± 17.7
LA Smear	B-126	Overhead	169S	Ductwork along walls		-1.21 ± 4.10	-3.0 ± 17.6
LA Smear	B-126	South Wall	203S	4,2		2.96 ± 5.78	5.4 ± 18.6
LA Smear	B-126	South Wall	204S	8,6		-1.21 ± 4.10	-11.3 ± 16.4
LA Smear	B-126	South Wall	205S	6,9		-1.21 ± 4.10	-3.0 ± 17.6
LA Smear	B-126	South Wall	206S	3,12		0.88 ± 4.10	-16.1 ± 15.8
LA Smear	B-126	South Wall	207S	6,15		-1.21 ± 4.10	11.3 ± 19.3
LA Smear	B-126	West Wall	208S	6,2		2.96 ± 5.78	8.9 ± 19.0
LA Smear	B-126	West Wall	209S	3,6		5.04 ± 7.08	-14.9 ± 15.9
LA Smear	B-126	West Wall	210S	9,11		-1.21 ± 4.10	-8.9 ± 16.8
LA Smear	B-126	West Wall	211S	5,14		2.96 ± 5.78	0.6 ± 18.0
LA Smear	B-126	West Wall	212S	4,3		0.88 ± 4.10	-0.6 ± 17.9
					Minimum	-1.21 ± 4.09	-16.1 ± 15.6
					Maximum	1,063.38 ± 92.31	7,172.0 ± 182.0
					Average	36.11 ± 9.91	240.0 ± 27.8
					Standard Deviation	146.25 ± 14.28	850.2 ± 25.3
					Count	118	118
LA Smear	Back dock	2 shelves,misc	783	-		3.33 ± 5.78	140.0 ± 30.9
LA Smear	Back dock	2 steel racks	781	-		1.25 ± 4.09	21.0 ± 20.3
LA Smear	Back dock	3- I beams	785	-		-0.83 ± 4.09	56.7 ± 24.0
LA Smear	Back dock	Elevator	786	-		7.50 ± 8.17	6.7 ± 18.6

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Back dock	Floor	779	-		-0.83 ± 4.09	13.9 ± 19.5
LA Smear	Back dock	Ladder	784	-		-0.83 ± 4.09	24.6 ± 20.7
LA Smear	Back dock	Pipe stor rack	782	-		7.50 ± 8.17	38.9 ± 22.2
LA Smear	Back dock	Walls 6' up	780	-		5.42 ± 7.08	32.9 ± 21.6
					Minimum	-0.83 ± 4.09	6.7 ± 18.6
					Maximum	7.50 ± 8.17	140.0 ± 30.9
					Average	2.81 ± 5.70	41.8 ± 22.2
				Standard Deviation		3.42 ± 1.75	39.9 ± 3.6
					Count	8	8
LA Smear	C-001	East Wall	259S	7,2		-1.21 ± 4.10	-23.2 ± 14.7
LA Smear	C-001	East Wall	260S	5,10		2.96 ± 5.78	-10.1 ± 16.6
LA Smear	C-001	East Wall	261S	5,17		-1.21 ± 4.10	-6.5 ± 17.1
LA Smear	C-001	East Wall	262S	3,22		-1.21 ± 4.10	-7.7 ± 16.9
LA Smear	C-001	East Wall	263S	5,3		-1.21 ± 4.10	-12.5 ± 16.3
LA Smear	C-001	East Wall	313S	1,31	Hole in wall	-0.83 ± 4.09	11.1 ± 18.7
LA Smear	C-001	East Wall	710S	8,10	Speaker	0.96 ± 4.09	4.2 ± 18.5
LA Smear	C-001	Floor	264S	8,9		-1.21 ± 4.10	12.5 ± 19.5
LA Smear	C-001	Floor	265S	6,40		-1.21 ± 4.10	13.7 ± 19.6
LA Smear	C-001	Floor	266S	32,35		9.21 ± 9.14	14.9 ± 19.7
LA Smear	C-001	Floor	267S	33,12		0.88 ± 4.10	-6.5 ± 17.1
LA Smear	C-001	Floor	268S	19,21		-1.21 ± 4.10	12.5 ± 19.5
LA Smear	C-001	Helium line	456S	HEPA filter housing		1.25 ± 4.09	2.7 ± 17.7

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-001	Items North	621S	Table	# 1	-0.83 ± 4.09	-7.0 ± 17.4
LA Smear	C-001	Items North	622S	Table	# 2	-0.83 ± 4.09	10.9 ± 19.6
LA Smear	C-001	Items North	623S	Tubes	# 3	1.25 ± 4.09	-10.5 ± 16.9
LA Smear	C-001	Items North	624S	Coil	# 4	0.96 ± 4.09	-3.0 ± 17.6
LA Smear	C-001	Items North	625S	Wheel cart	# 5	3.04 ± 5.78	6.5 ± 18.8
LA Smear	C-001	Items North	626S	Box with coil	# 6	-1.13 ± 4.09	-11.3 ± 16.4
LA Smear	C-001	Items North	627S	Quadropole	# 7	0.96 ± 4.09	3.0 ± 18.3
LA Smear	C-001	Items North	628S	Quadropole	# 8	-1.13 ± 4.09	-3.0 ± 17.6
LA Smear	C-001	Items North	629S	Quadropole	# 9	0.96 ± 4.09	0.6 ± 18.0
LA Smear	C-001	Items North	630S	Quadropole	# 10	0.96 ± 4.09	-0.6 ± 17.9
LA Smear	C-001	Items North	643S	Quadropole	# 11	3.04 ± 5.78	-3.0 ± 17.6
LA Smear	C-001	Items North	644S	Quadropole	# 12	0.96 ± 4.09	-3.0 ± 17.6
LA Smear	C-001	Items North	649S	Quadropole	# 13	5.13 ± 7.08	3.0 ± 18.3
LA Smear	C-001	Items North	650S	Quadropole	# 14	0.96 ± 4.09	1.8 ± 18.2
LA Smear	C-001	Items North	658S	Table	# 15	-1.13 ± 4.09	-7.7 ± 16.9
LA Smear	C-001	Items North	659S	Anode power	# 16	0.96 ± 4.09	10.1 ± 19.2
LA Smear	C-001	Items East	660S	Empty drum	# 17	0.96 ± 4.09	-8.9 ± 16.8
LA Smear	C-001	Items East	677S	Empty box	# 18	-1.13 ± 4.09	-11.3 ± 16.4
LA Smear	C-001	Items North	678S	Filters	# 19	-1.13 ± 4.09	-13.7 ± 16.1
LA Smear	C-001	Items East	679S	Misc junk	# 20	-1.13 ± 4.09	-18.5 ± 15.4
LA Smear	C-001	Items East	680S	Empty box	# 21	-1.13 ± 4.09	-0.6 ± 17.9
LA Smear	C-001	Items East	681S	Metal roller	# 22	0.96 ± 4.09	-7.7 ± 16.9
LA Smear	C-001	Items East	682S	Periscope	# 23	-1.13 ± 4.09	13.7 ± 19.6
LA Smear	C-001	mid room	683S	Metal box	# 24	0.96 ± 4.09	-8.9 ± 16.8

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-001	Items East	684S	Metal plate	# 25	-1.13 ± 4.09	-6.5 ± 17.1
LA Smear	C-001	Items East	685S	Stainless tube	# 26	-1.13 ± 4.09	4.2 ± 18.5
LA Smear	C-001	Items East	686S	Metal plate	# 27	0.96 ± 4.09	0.6 ± 18.0
LA Smear	C-001	Items East	687S	Transformer	# 28	-1.13 ± 4.09	13.7 ± 19.6
LA Smear	C-001	Items East	688S	Transformer	# 29	0.96 ± 4.09	-6.5 ± 17.1
LA Smear	C-001	Items East	243S	Rad pail	# 30	0.88 ± 4.10	1.8 ± 18.2
LA Smear	C-001	Items East	241S	Rad 5 gal pail	# 31	2.96 ± 5.78	11.3 ± 19.3
LA Smear	C-001	Items East	242S	Rad pail	# 32	-1.21 ± 4.10	-6.5 ± 17.1
LA Smear	C-001	Items East	239S	Rad 5 gal pail	# 33	-1.21 ± 4.10	-7.7 ± 16.9
LA Smear	C-001	Items East	240S	Rad 5 gal pail	# 34	2.96 ± 5.78	-19.6 ± 15.2
LA Smear	C-001	Items East	244S	Rad pail	# 35	5.04 ± 7.08	-4.2 ± 17.4
LA Smear	C-001	Items East	245S	Empty pail	# 36	0.88 ± 4.10	4.2 ± 18.5
LA Smear	C-001	Items East	246S	Pump	# 37	0.88 ± 4.10	28.0 ± 21.2
LA Smear	C-001	Items East	247S	Coil	# 38	2.96 ± 5.78	-13.7 ± 16.1
LA Smear	C-001	Items East	248S	Coil	# 39	-1.21 ± 4.10	-1.8 ± 17.7
LA Smear	C-001	Items East	253S	Crate	# 40	5.04 ± 7.08	3.0 ± 18.3
LA Smear	C-001	Items East	250S	Crate	# 41	-1.21 ± 4.10	-3.0 ± 17.6
LA Smear	C-001	Items East	255S	Alum valve	# 42	-1.21 ± 4.10	0.6 ± 18.0
LA Smear	C-001	Items East	256S	Box with coil	# 43	-1.21 ± 4.10	-4.2 ± 17.4
LA Smear	C-001	Items North	270S	Box with coils	# 44	-1.21 ± 4.10	8.9 ± 19.0
LA Smear	C-001	Items North	269S	Wood ladder	# 45	0.88 ± 4.10	0.6 ± 18.0
LA Smear	C-001	Items North	271S	Garbage can	# 47	-1.21 ± 4.10	-0.6 ± 17.9
LA Smear	C-001	Items under cycl	631S	Motor	# 49	5.13 ± 7.08	-11.3 ± 16.4
LA Smear	C-001	Items under cycl	634S	Motor	# 50	-1.13 ± 4.09	-17.3 ± 15.6

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-001	Items under cycl	635S	Wire case	# 51	-1.13 ± 4.09	0.6 ± 18.0
LA Smear	C-001	Items East	637S	Motor	# 52	-1.13 ± 4.09	-6.5 ± 17.1
LA Smear	C-001	Items East	639S	Motor	# 53	-1.13 ± 4.09	-10.1 ± 16.6
LA Smear	C-001	Items East	249S	Metal stand	# 54	7.13 ± 8.17	0.6 ± 18.0
LA Smear	C-001	Items East	636S	Control panel	# 55	-1.13 ± 4.09	1.8 ± 18.2
LA Smear	C-001	Items East	251S	3 elect cabinet	# 56	-1.21 ± 4.10	-6.5 ± 17.1
LA Smear	C-001	Items East	252S	2 motors-stan	# 57	0.88 ± 4.10	8.9 ± 19.0
LA Smear	C-001	Items East	254S	Current supply	# 58	-1.21 ± 4.10	-14.9 ± 15.9
LA Smear	C-001	Items East	638S	Metal stand	# 59	-1.13 ± 4.09	-10.1 ± 16.6
LA Smear	C-001	Items East	258S	Equip-shelves	# 66	0.88 ± 4.10	-10.1 ± 16.6
LA Smear	C-001	Items East	285S	Control panel	# 67	15.46 ± 11.55	4.2 ± 18.5
LA Smear	C-001	Items South	286S	Connector box	# 68	-1.21 ± 4.10	-5.4 ± 17.2
LA Smear	C-001	Items East	287S	Ventilation intk	# 69	-1.21 ± 4.10	-16.1 ± 15.8
LA Smear	C-001	Items West	288S	2 control panel	# 70	-1.21 ± 4.10	5.4 ± 18.6
LA Smear	C-001	Items West	289S	Air intake	# 71	2.96 ± 5.78	-8.9 ± 16.8
LA Smear	C-001	Items East	290S	Rad. equipmnt	# 72	0.88 ± 4.10	1.8 ± 18.2
LA Smear	C-001	Items South	291S	Rad. equipmnt	# 73	-1.21 ± 4.10	10.1 ± 19.2
LA Smear	C-001	Items South	292S	Rad. equipmnt	# 74	2.96 ± 5.78	17.3 ± 20.0
LA Smear	C-001	Items South	293S	Rad. equipmnt	# 75	-1.21 ± 4.10	-13.7 ± 16.1
LA Smear	C-001	Items South	640S	Ion source holder	# 76	0.96 ± 4.09	-1.8 ± 17.7
LA Smear	C-001	Items South	661S	Source assembly	# 77	-1.13 ± 4.09	-0.6 ± 17.9
LA Smear	C-001	Items South	662S	Source assembly	# 78	-1.13 ± 4.09	1.8 ± 18.2
LA Smear	C-001	Items South	663S	Source assembly	# 79	5.13 ± 7.08	-22.0 ± 14.9
LA Smear	C-001	Items South	664S	Source assembly	# 80	-1.13 ± 4.09	11.3 ± 19.3

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	C-001	Items South	665S	Source assembly	# 81	-1.13 ± 4.09	-8.9 ± 16.8
LA Smear	C-001	Items South	667S	Tripod	# 82	0.96 ± 4.09	-3.0 ± 17.6
LA Smear	C-001	Items South	668S	Source assembly	# 83	-1.13 ± 4.09	-5.4 ± 17.2
LA Smear	C-001	Items South	669S	Source assembly	# 84	0.96 ± 4.09	8.9 ± 19.0
LA Smear	C-001	Items South	670S	Source assembly	# 85	0.96 ± 4.09	-8.9 ± 16.8
LA Smear	C-001	Items West	299S	Current regulator	# 86	0.88 ± 4.10	6.5 ± 18.8
LA Smear	C-001	Items West	300S	DC generator	# 87	0.88 ± 4.10	-22.0 ± 14.9
LA Smear	C-001	Items West	301S	Current regulator	# 88	-1.21 ± 4.10	-12.5 ± 16.3
LA Smear	C-001	Items West	302S	DC generator	# 89	-1.21 ± 4.10	4.2 ± 18.5
LA Smear	C-001	Items West	303S	Ladder	# 90	0.88 ± 4.10	-14.9 ± 15.9
LA Smear	C-001	Items West	304S	Transformer	# 91	-1.21 ± 4.10	-8.9 ± 16.8
LA Smear	C-001	Items West	305S	3 powerstats	# 92	-1.21 ± 4.10	1.8 ± 18.2
LA Smear	C-001	Items West	306S	Rectifier	# 93	0.88 ± 4.10	11.3 ± 19.3
LA Smear	C-001	Items West	307S	Westnghs panels	# 94	5.04 ± 7.08	-0.6 ± 17.9
LA Smear	C-001	Items West	308S	Gener. on cart	# 95	0.88 ± 4.10	-8.9 ± 16.8
LA Smear	C-001	Items West	632S	Mop, bucket	# 96	-1.13 ± 4.09	-13.7 ± 16.1
LA Smear	C-001	Item	725S	Pump	#120	3.13 ± 5.78	-8.3 ± 16.6
LA Smear	C-001	Item	726S	Filter housing	#160	1.04 ± 4.09	22.6 ± 20.4
LA Smear	C-001	North Wall	279S	22,53		-1.21 ± 4.10	-4.2 ± 17.4
LA Smear	C-001	North Wall	280S	5,6		0.88 ± 4.10	-12.5 ± 16.3
LA Smear	C-001	North Wall	281S	29,3		0.88 ± 4.10	4.2 ± 18.5
LA Smear	C-001	North Wall	282S	35,6		-1.21 ± 4.10	1.8 ± 18.2
LA Smear	C-001	North Wall	283S	5,0		-1.21 ± 4.10	-14.9 ± 15.9
LA Smear	C-001	North Wall	709S	8,40	Speaker	0.96 ± 4.09	0.6 ± 18.0

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-001	South Wall	294S	3,45		-1.21 ± 4.10	10.1 ± 19.2
LA Smear	C-001	South Wall	295S	4,41		-1.21 ± 4.10	-11.3 ± 16.4
LA Smear	C-001	South Wall	296S	6,28		-1.21 ± 4.10	-13.7 ± 16.1
LA Smear	C-001	South Wall	297S	5,13		-1.21 ± 4.10	-13.7 ± 16.1
LA Smear	C-001	South Wall	298S	5,6		0.88 ± 4.10	-6.5 ± 17.1
LA Smear	C-001	South Wall	493S	Inside duct work		1.25 ± 4.09	-6.8 ± 16.4
LA Smear	C-001	South Wall	711S	8,27	Speaker	3.04 ± 5.78	-5.4 ± 17.2
LA Smear	C-001	Tunnel	311S	Large pipe		1.25 ± 4.09	-9.2 ± 16.1
LA Smear	C-001	West Wall	309S	3,22		-1.21 ± 4.10	3.0 ± 18.3
LA Smear	C-001	West Wall	310S	6,14		-1.21 ± 4.10	-12.5 ± 16.3
LA Smear	C-001	West Wall	712S	7,14	Speaker	-1.13 ± 4.09	-5.4 ± 17.2
LA Smear	C-001	West Wall	719S	7,42	Speaker	0.96 ± 4.09	-5.4 ± 17.2
					Minimum	-1.21 ± 4.09	-23.2 ± 14.7
					Maximum	15.46 ± 11.55	28.0 ± 21.2
					Average	0.49 ± 4.52	-2.6 ± 17.5
					Standard Deviation	2.43 ± 1.14	9.6 ± 1.2
					Count	121	121.0
LA Smear	C-101	3 tygon lines	732S	Inside blacktube	B-126	3.13 ± 5.78	-6.0 ± 16.9
LA Smear	C-101	6' inside ion	745S	Source chamber		1.04 ± 4.09	1082.1 ± 72.5
LA Smear	C-101	Black tube	733S	C-101\B-126		7.29 ± 8.17	-17.9 ± 15.2
LA Smear	C-101	Ceiling	351S	20,25		1.25 ± 4.09	8.7 ± 18.5
LA Smear	C-101	Ceiling	352S	-		1.25 ± 4.09	12.3 ± 18.9
LA Smear	C-101	Ceiling	353S	38,7		1.25 ± 4.09	12.3 ± 18.9

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min) Alpha	Smear Activity (dis/min) Beta
LA Smear	C-101	Ceiling	354S	4,8		-0.83 ± 4.09	1.5 ± 17.5
LA Smear	C-101	Ceiling N.E.	350S	38,44		1.25 ± 4.09	1.5 ± 17.5
LA Smear	C-101	Ceiling S.E.	349S	44,6		-0.83 ± 4.09	-4.4 ± 16.8
LA Smear	C-101	Crane	367S	Trolley		1.25 ± 4.09	12.3 ± 18.9
LA Smear	C-101	East Wall	363S	3,5		5.42 ± 7.08	5.1 ± 18.0
LA Smear	C-101	East Wall	364S	3,7		3.33 ± 5.78	26.5 ± 20.5
LA Smear	C-101	East Wall	419S	13,13	Speaker	1.25 ± 4.09	1.5 ± 17.5
LA Smear	C-101	East Wall	738S	13,13	Speaker	-1.04 ± 4.09	6.0 ± 18.5
LA Smear	C-101	Helium cart	272S	Charcoal	Cannisters	-1.04 ± 4.09	-8.3 ± 16.6
LA Smear	C-101	Helium cart	273S	Pumps 2x3		-0.83 ± 4.09	-4.4 ± 16.8
LA Smear	C-101	Helium cart	274S	Vacuum pump dials		-0.83 ± 4.09	9.9 ± 18.6
LA Smear	C-101	Helium cart	275S	SS cylinders		3.33 ± 5.78	-2.0 ± 17.1
LA Smear	C-101	under cycl	673S	Pipe drain	# 46	-1.13 ± 4.09	8.9 ± 19.0
LA Smear	C-101	under cycl	675S	Motor	# 48	3.04 ± 5.78	-5.4 ± 17.2
LA Smear	C-101	under cycl	671S	Motor	# 60	0.96 ± 4.09	-0.6 ± 17.9
LA Smear	C-101	under cycl	672S	Cable spool	# 61	0.96 ± 4.09	4.2 ± 18.5
LA Smear	C-101	under cycl	674S	Cable spool	# 62	0.96 ± 4.09	14.9 ± 19.7
LA Smear	C-101	top cyclotron	676S	Pump	# 64	-1.13 ± 4.09	-5.4 ± 17.2
LA Smear	C-101	Items West	633S	Nuts and bolts	# 97	0.96 ± 4.09	1.8 ± 18.2
LA Smear	C-101	Items East	651S	Cabinets	# 98	5.13 ± 7.08	12.5 ± 19.5
LA Smear	C-101	Items East	652S	Cabinets	# 99	7.21 ± 8.17	33.9 ± 21.8

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	C-101	Items East	654S	Cabinets	#100	0.96 ± 4.09	-11.3 ± 16.4
LA Smear	C-101	Items East	653S	Cabinets	#101	-1.13 ± 4.09	86.3 ± 26.8
LA Smear	C-101	Items East	655S	Cabinets	#102	15.54 ± 11.55	37.5 ± 22.2
LA Smear	C-101	Items East	656S	Top of cabinets	#103	-1.13 ± 4.09	45.8 ± 23.1
LA Smear	C-101	Items East	657S	Target assembly	#104	80.13 ± 25.50	86.3 ± 26.8
LA Smear	C-101	Items East	713S	Bucket of parts	#105	-1.13 ± 4.09	16.1 ± 19.9
LA Smear	C-101	Items East	714S	Bucket of parts	#106	-1.13 ± 4.09	-4.2 ± 17.4
LA Smear	C-101	Items East	715S	Stainless fitting	#107	-1.13 ± 4.09	3.0 ± 18.3
LA Smear	C-101	Items East	716S	Stainless pipe	#108	-1.13 ± 4.09	16.1 ± 19.9
LA Smear	C-101	Items East	717S	Bucket of parts	#109	117.63 ± 30.83	54.2 ± 23.9
LA Smear	C-101	Items East	718S	Hood	#110	7.21 ± 8.17	8.9 ± 19.0
LA Smear	C-101	Items East	707S	Manifold	#112	-1.13 ± 4.09	-3.0 ± 17.6
LA Smear	C-101	Items East	708S	Wrench	#113	-1.13 ± 4.09	22.0 ± 20.6
LA Smear	C-101	Items East	666S	Bucket of parts	#114	3.04 ± 5.78	2118.5 ± 100.1
LA Smear	C-101	Items East	690S	Pail of parts	#115	186.38 ± 38.74	266.1 ± 39.2
LA Smear	C-101	Items East	691S	Plastic trim box	#116	548.88 ± 66.35	943.5 ± 68.1
LA Smear	C-101	Items East	720S	Valve	#118	0.96 ± 4.09	7.7 ± 18.9
LA Smear	C-101	Items West	377S	Pail of targets	#119	9.58 ± 9.13	59.9 ± 24.0
LA Smear	C-101	Items North	692S	Cabinets	#121	-1.13 ± 4.09	-7.7 ± 16.9
LA Smear	C-101	Items North	693S	Cabinets	#122	7.21 ± 8.17	12.5 ± 19.5
LA Smear	C-101	Items North	694S	Cabinets	#123	3.04 ± 5.78	3.0 ± 18.3
LA Smear	C-101	Items North	695S	Cabinets	#124	-1.13 ± 4.09	1.8 ± 18.2
LA Smear	C-101	Items North	696S	1 foot pipe	#125	5.13 ± 7.08	22.0 ± 20.6
LA Smear	C-101	Items North	697S	Man lift	#126	-1.13 ± 4.09	1337.5 ± 80.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	C-101	Items North	698S	Helium cart	#127	0.96 ± 4.09	11.3 ± 19.3
LA Smear	C-101	Items North	699S	Cabinet	#128	0.96 ± 4.09	23.2 ± 20.7
LA Smear	C-101	Items North	700S	SRW can	#129	-1.13 ± 4.09	43.5 ± 22.8
LA Smear	C-101	Items North	701S	Cabinet	#130	7.21 ± 8.17	73.2 ± 25.6
LA Smear	C-101	Items North	702S	Cabinet	#131	3.04 ± 5.78	33.9 ± 21.8
LA Smear	C-101	Items North	703S	Cabinet	#132	0.96 ± 4.09	7.7 ± 18.9
LA Smear	C-101	Items North	704S	Table	#133	5.13 ± 7.08	-13.7 ± 16.1
LA Smear	C-101	Items North	705S	Sink	#134	7.21 ± 8.17	7.7 ± 18.9
LA Smear	C-101	Items North	706S	Hood	#135	-1.13 ± 4.09	4.2 ± 18.5
SA Smear	C-101	Items North	340S	TV carton-stands	#136	3.33 ± 5.78	8.6 ± 19.3
SA Smear	C-101	Items West	341S	Corner table	#137	1.25 ± 4.09	-3.3 ± 17.9
SA Smear	C-101	Items North	342S	Diffusion pump	#138	1.25 ± 4.09	15.8 ± 20.2
SA Smear	C-101	Items South	343S	Cabinet	#139	1.25 ± 4.09	-14.0 ± 16.4
SA Smear	C-101	Items South	344S	Drawers	#140	1.25 ± 4.09	12.2 ± 19.7
SA Smear	C-101	Items East	345S	Meter on dolly	#141	9.58 ± 9.13	2.7 ± 18.6
SA Smear	C-101	Items South	346S	Leak checker	#142	7.50 ± 8.17	52.7 ± 24.0
SA Smear	C-101	Items South	347S	HEPA vacuum	#143	5.42 ± 7.08	33.6 ± 22.1
SA Smear	C-101	Items East	348S	Box of pipe	#144	3.33 ± 5.78	14.6 ± 20.0
LA Smear	C-101	Items East	689S	Leak checker	#145	0.96 ± 4.09	4.2 ± 18.5
LA Smear	C-101	Items East	314S	Pipe on floor	#146	5.04 ± 7.08	5.4 ± 18.6
LA Smear	C-101	Items East	315S	Meter on cart	#147	0.88 ± 4.10	-13.7 ± 16.1
LA Smear	C-101	Items East	316S	Flux meter	#148	0.88 ± 4.10	-8.9 ± 16.8
LA Smear	C-101	Items East	317S	Yellow motor	#149	0.88 ± 4.10	7.7 ± 18.9
LA Smear	C-101	Items East	318S	Stands	#150	7.13 ± 8.17	18.5 ± 20.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-101	Items East	329S	Vacuum pump	#151	-1.21 ± 4.10	5.4 ± 18.6
LA Smear	C-101	Items West	369S	Table, hoses	#152	-0.83 ± 4.09	13.5 ± 19.0
LA Smear	C-101	Items West	370S	Table	#153	9.58 ± 9.13	20.6 ± 19.9
LA Smear	C-101	Items West	371S	Aluminum table	#154	-0.83 ± 4.09	-9.2 ± 16.1
LA Smear	C-101	Items West	372S	Paraffin, table	#155	9.58 ± 9.13	286.1 ± 40.1
LA Smear	C-101	Items West	373S	Ion source cart	#156	5.42 ± 7.08	23.0 ± 20.1
LA Smear	C-101	Items West	374S	Closed H2O	#157	3.33 ± 5.78	1.5 ± 17.5
LA Smear	C-101	Items West	375S	Beam stand	#158	7.50 ± 8.17	151.5 ± 31.5
LA Smear	C-101	Items West	376S	Beam line heat	#161	63.75 ± 22.74	61.1 ± 24.1
LA Smear	C-101	Item Magnet	378S	Small magnets	#166	-0.83 ± 4.09	-2.0 ± 17.1
LA Smear	C-101	North Wall	328S	23,20		-0.83 ± 4.09	-2.0 ± 17.1
LA Smear	C-101	North Wall	355S	4,6		3.33 ± 5.78	9.9 ± 18.6
LA Smear	C-101	North Wall	356S	40,15		-0.83 ± 4.09	-12.7 ± 15.6
LA Smear	C-101	North Wall	357S	40,32		1.25 ± 4.09	-6.8 ± 16.4
LA Smear	C-101	North Wall	358S	40,42		1.25 ± 4.09	-10.4 ± 15.9
LA Smear	C-101	North Wall	723S	Pb glass window		55.21 ± 21.22	96.4 ± 27.5
LA Smear	C-101	North Wall	727S	7,3	Speaker	5.21 ± 7.08	9.5 ± 18.9
LA Smear	C-101	North Wall	728S	7,19	Speaker	13.54 ± 10.81	-25.0 ± 14.1
LA Smear	C-101	South Wall	321S	7,31	Speaker	-0.83 ± 4.09	-12.7 ± 15.6
LA Smear	C-101	South Wall	322S	7,6	Speaker	1.25 ± 4.09	0.4 ± 17.4
LA Smear	C-101	South Wall	325S	7,16	Speaker	1.25 ± 4.09	-5.6 ± 16.6
LA Smear	C-101	South Wall	359S	48,25		-0.83 ± 4.09	28.9 ± 20.8
LA Smear	C-101	South Wall	360S	34,22		-0.83 ± 4.09	8.7 ± 18.5
LA Smear	C-101	South Wall	361S	34,26		3.33 ± 5.78	13.5 ± 19.0

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	C-101	South Wall	362S	5,26		1.25 ± 4.09	37.3 ± 21.7
LA Smear	C-101	West Wall	334S	9,9	Speaker	-0.83 ± 4.09	0.4 ± 17.4
LA Smear	C-101	West Wall	335S	6,15	Pressure meter	-0.83 ± 4.09	-3.2 ± 16.9
LA Smear	C-101	West Wall	336S	9,21	Speaker	-0.83 ± 4.09	2.7 ± 17.7
LA Smear	C-101	West Wall	337S	7,33	Speaker	1.25 ± 4.09	2.7 ± 17.7
LA Smear	C-101	West Wall	338S	7,48	Speaker	1.25 ± 4.09	5.1 ± 18.0
LA Smear	C-101	West Wall	365S	30,25		1.25 ± 4.09	26.5 ± 20.5
LA Smear	C-101	West Wall	366S	30,24		-0.83 ± 4.09	3.9 ± 17.9
					Minimum	-1.21 ± 4.09	-25.0 ± 14.1
					Maximum	548.88 ± 66.35	2,118.5 ± 100.1
					Average	11.85 ± 6.86	68.9 ± 21.8
					Standard Deviation	57.20 ± 7.81	274.6 ± 12.4
					Count	107	107
LA Smear	Cooling Tower	East	600S	-		-0.83 ± 4.09	-9.4 ± 17.1
LA Smear	Cooling Tower	North	601S	-		-0.83 ± 4.09	-9.4 ± 17.1
LA Smear	Cooling Tower	N.E. Side	642S	Elevated direct activity		3.04 ± 5.78	-12.5 ± 16.3
LA Smear	Cooling Tower	South	602S	-		-0.83 ± 4.09	2.5 ± 18.6
					Minimum	-0.83 ± 4.09	-12.5 ± 16.3
					Maximum	3.04 ± 5.78	2.5 ± 18.6
					Average	0.14 ± 4.51	-7.2 ± 17.3
					Standard Deviation	1.68 ± 0.73	5.8 ± 0.8
					Count	4	4

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
SA Smear	Cyclotron	12" vac line	448S	-		-0.83 ± 4.09	8.6 ± 19.3
SA Smear	Cyclotron	12" vac line	449S	-		1.25 ± 4.09	24.1 ± 21.1
SA Smear	Cyclotron	12" vac line	450S	-		3.33 ± 5.78	9.8 ± 19.5
LA Smear	Cyclotron	Beam Line	379S	On map	External	17.92 ± 12.25	127.7 ± 30.3
LA Smear	Cyclotron	Beam Line	380S	On map	External	7.50 ± 8.17	44.3 ± 23.2
LA Smear	Cyclotron	Beam Line	381S	On map	External	28.33 ± 15.28	151.5 ± 32.0
LA Smear	Cyclotron	Beam Line	382S	On map	External	5.42 ± 7.08	-3.3 ± 17.9
LA Smear	Cyclotron	Beam Line	383S	On map	External	-0.83 ± 4.09	-8.0 ± 17.2
LA Smear	Cyclotron	Beam Line	384S	On map	External	1.25 ± 4.09	2.7 ± 18.6
LA Smear	Cyclotron	Beam Line	385S	On map	External	-0.83 ± 4.09	0.3 ± 18.3
LA Smear	Cyclotron	Beam Line	386S	On map	External	15.83 ± 11.55	27.7 ± 21.5
LA Smear	Cyclotron	Beam Line	387S	On map	External	-0.83 ± 4.09	20.5 ± 20.7
LA Smear	Cyclotron	Beam Line	388S	On map	External	5.42 ± 7.08	19.3 ± 20.6
LA Smear	Cyclotron	Beam Line	389S	On map	External	-0.83 ± 4.09	39.6 ± 22.7
LA Smear	Cyclotron	Beam Line	390S	On map	External	5.42 ± 7.08	13.4 ± 19.9
LA Smear	Cyclotron	Beam Line	391S	On map	External	5.42 ± 7.08	25.3 ± 21.2
LA Smear	Cyclotron	Beam Line	392S	On map	External	1.25 ± 4.09	5.0 ± 18.9
LA Smear	Cyclotron	Beam Line	393S	On map	External	1.25 ± 4.09	0.3 ± 18.3
LA Smear	Cyclotron	Beam Line	394S	On map	External	3.33 ± 5.78	22.9 ± 20.9
LA Smear	Cyclotron	Beam Line	395S	On map	External	7.50 ± 8.17	-3.3 ± 17.9
LA Smear	Cyclotron	Beam Line	396S	On map	External	326.25 ± 51.16	922.9 ± 67.5
LA Smear	Cyclotron	Beam Line	397S	On map	External	1.25 ± 4.09	439.6 ± 48.4
LA Smear	Cyclotron	Beam Line	398S	On map	Internal	7,567.92 ± 246.12	18,444.3 ± 291.0
LA Smear	Cyclotron	Beam Line	399S	On map	Internal	6,705.42 ± 231.67	40,228.9 ± 429.3

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinate	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Cyclotron	Beam Line	400S	On map	Internal	8,474.17 ± 260.44	11,642.0 ± 231.5
LA Smear	Cyclotron	Beam Line	401S	On map	Internal	1,561.67 ± 111.83	5,627.7 ± 161.5
LA Smear	Cyclotron	Beam Line	402S	On map	Internal	449.17 ± 60.01	825.3 ± 64.1
LA Smear	Cyclotron	Beam Line	403S	On map	Internal	2,522.08 ± 142.10	6,701.5 ± 176.0
LA Smear	Cyclotron	Beam Line	404S	On map	Internal	11.67 ± 10.01	897.9 ± 66.6
LA Smear	Cyclotron	Beam Line	405S	On map	Internal	2,430.42 ± 139.49	3,607.4 ± 129.7
LA Smear	Cyclotron	Beam Line	406S	On map	Internal	11.67 ± 10.01	49.1 ± 23.6
LA Smear	Cyclotron	Beam Line	407S	On map	Internal	40.83 ± 18.26	106.2 ± 28.6
LA Smear	Cyclotron	Beam Line	408S	On map	Internal	84.58 ± 26.15	43.1 ± 23.1
LA Smear	Cyclotron	Beam Line	409S	On map	Internal	297.08 ± 48.83	187.2 ± 34.5
LA Smear	Cyclotron	Beam Line	410S	On map	Internal	138.75 ± 33.42	90.8 ± 27.4
LA Smear	Cyclotron	Beam Line	411S	On map	Internal	78.33 ± 25.17	37.2 ± 22.5
LA Smear	Cyclotron	Beam Line	412S	On map	Internal	67.92 ± 23.46	18.1 ± 20.4
LA Smear	Cyclotron	Beam Line	413S	On map	Internal	47.08 ± 19.58	43.1 ± 23.1
LA Smear	Cyclotron	Beam Line	414S	On map	Internal	92.92 ± 27.39	71.7 ± 25.7
LA Smear	Cyclotron	Beam Line	415S	On map	Internal	182.50 ± 38.31	172.9 ± 33.5
LA Smear	Cyclotron	Beam Line	416S	On map	Internal	20.00 ± 12.92	31.2 ± 21.8
LA Smear	Cyclotron	Beam Line	417S	On map	Internal	242.92 ± 44.17	192.0 ± 34.8
LA Smear	Cyclotron	Beam parts	418S	Open beam	#165	267.92 ± 46.38	1,059.9 ± 71.7
LA Smear	Cyclotron	Elect Equip	428S	14,13,6	Exterior	-0.83 ± 4.09	-8.0 ± 17.2
LA Smear	Cyclotron	Elect Equip	429S	16,20,3	Exterior	-0.83 ± 4.09	7.4 ± 19.2
LA Smear	Cyclotron	Elect Equip	430S	15,14,3	Exterior	5.42 ± 7.08	317.0 ± 42.2
LA Smear	Cyclotron	Elect Equip	431S	21,11,7	Exterior	5.42 ± 7.08	7.4 ± 19.2
LA Smear	Cyclotron	Elect Equip	432S	24133	Exterior	-0.83 ± 4.09	-0.9 ± 18.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Cyclotron	Cyc and Elect	433S	21,13,5	Exterior	-0.83 ± 4.09	-15.2 ± 16.3
LA Smear	Cyclotron	Cyc and Elect	434S	25,10,5	Exterior	1.25 ± 4.09	2.7 ± 18.6
LA Smear	Cyclotron	Cyc and Elect	435S	22,11,2	Exterior	-0.83 ± 4.09	12.2 ± 19.7
LA Smear	Cyclotron	Cyc and Elect	436S	26,20,6	Exterior	-0.83 ± 4.09	-8.0 ± 17.2
LA Smear	Cyclotron	Cyc and Elect	437S	26,30,5	Exterior	3.33 ± 5.78	26.5 ± 21.3
LA Smear	Cyclotron	Cyc and Elect	438S	21,35,6	Exterior	7.50 ± 8.17	101.5 ± 28.3
LA Smear	Cyclotron	Cyc and Elect	439S	16,33,6	Exterior	-0.83 ± 4.09	33.6 ± 22.1
LA Smear	Cyclotron	Cyc and Elect	440S	16,20,5	Exterior	-0.83 ± 4.09	-15.2 ± 16.3
LA Smear	Cyclotron	Cyc and Elect	441S	16,27,4	Exterior	-0.83 ± 4.09	-8.0 ± 17.2
LA Smear	Cyclotron	Cyc and Elect	442S	14,23,8	Exterior	-0.83 ± 4.09	-4.5 ± 17.7
LA Smear	Cyclotron	Cyc and Elect	443S	15,15,11	Exterior	1.25 ± 4.09	15.8 ± 20.2
LA Smear	Cyclotron	Cyc and Elect	444S	33,21,9	Exterior	17.92 ± 12.25	67.0 ± 25.3
LA Smear	Cyclotron	Cyc and Elect	445S	21,27,14	Exterior	9.58 ± 9.13	7.4 ± 19.2
LA Smear	Cyclotron	Cyc and Elect	446S	22,25,10	Exterior	3.33 ± 5.78	7.4 ± 19.2
LA Smear	Cyclotron	Cyc and Elect	447S	23,31,15	Exterior	7.50 ± 8.17	40.8 ± 22.8
LA Smear	Cyclotron	Diffusion pump	422S	28,26,5	Bellows	13.75 ± 10.81	57.5 ± 23.7
LA Smear	Cyclotron	Diffusion pump	423S	28,31,5	Control pnl	-0.83 ± 4.09	-10.4 ± 15.9
LA Smear	Cyclotron	Diffusion pump	424S	29,31,6	Top pipe	9.58 ± 9.13	14.6 ± 19.2
LA Smear	Cyclotron	Diffusion pump	425S	Inside top vent		-0.83 ± 4.09	44.4 ± 22.4
LA Smear	Cyclotron	Diffusion pump	426S	Inside top vent		1.25 ± 4.09	1.5 ± 17.5
SA Smear	Cyclotron	Splitter	459S	-		11.67 ± 10.01	15,413.4 ± 266.1
SA Smear	Cyclotron	Target 2	462S	17,14,5		3.33 ± 5.78	3,317.0 ± 124.5
SA Smear	Cyclotron	Target port 1	463S	17,14,5		11.67 ± 10.01	2,763.4 ± 113.9
SA Smear	Cyclotron	Target port 2	464S	17,14,5		11.67 ± 10.01	8,782.4 ± 201.2

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Cyclotron	Telephone	427S	28,34,4		-0.83 ± 4.09	-3.2 ± 16.9
					Minimum	-0.83 ± 4.09	-15.2 ± 15.9
					Maximum	8,474.17 ± 260.44	40,228.9 ± 429.3
					Average	436.21 ± 26.68	1,684.1 ± 50.9
					Standard Deviation	1,550.42 ± 52.82	5,630.1 ± 73.8
					Count	73	73
LA Smear	Fanloft	A-exh-B4	736S	Upstream	Interior	32.29 ± 16.34	20.2 ± 20.1
LA Smear	Fanloft	A-exh-B4	739S	Downstream	Interior	-1.04 ± 4.09	-2.4 ± 17.4
LA Smear	Fanloft	A-exh-B5-1	724S	Down	Interior	1.04 ± 4.09	1.2 ± 17.9
LA Smear	Fanloft	A-exh-B5-1	734S	Upstream	Interior	71.88 ± 24.16	35.7 ± 21.8
LA Smear	Fanloft	A-exh-b5-2	740S	Downstream	Interior	3.13 ± 5.78	-2.4 ± 17.4
LA Smear	Fanloft	A-exh-B5-2	735S	Upstream	Interior	1.04 ± 4.09	0.0 ± 17.7
LA Smear	Fanloft	A-exh-B5-3a	741S	Upstream	Interior	5.21 ± 7.08	10.7 ± 19.0
LA Smear	Fanloft	A-exh-B5-3a	742S	Downstream	Interior	-1.04 ± 4.09	-14.3 ± 15.8
LA Smear	Fanloft	A-exh-B5-3b	743S	Upstream	Interior	5.21 ± 7.08	-14.3 ± 15.8
LA Smear	Fanloft	A-exh-B5-3b	744S	Downstream	Interior	1.04 ± 4.09	0.0 ± 17.7
LA Smear	Fanloft	Sr. cave ducts	737S	-	Exterior	1.04 ± 4.09	2.4 ± 18.0
					Minimum	-1.04 ± 4.09	-14.3 ± 15.8
					Maximum	71.88 ± 24.16	35.7 ± 21.8
					Average	10.89 ± 7.73	3.4 ± 18.1
					Standard Deviation	21.27 ± 6.24	13.8 ± 1.7
					Count	11	11

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Jr. Cave	East Wall	465S	-	Exterior	3.33 ± 5.78	2.7 ± 18.6
LA Smear	Jr. Cave	East Wall	466S	-	Exterior	7.50 ± 8.17	11.0 ± 19.6
LA Smear	Jr. Cave	North Wall	467S	-	Exterior	-0.83 ± 4.09	-6.9 ± 17.4
LA Smear	Jr. Cave	North Wall	468S	-	Exterior	1.25 ± 4.09	6.2 ± 19.0
LA Smear	Jr. Cave	Overhead	170S	Top of cave	Exterior	7.13 ± 8.17	-3.0 ± 17.6
LA Smear	Jr. Cave	Roof	469S	-	Exterior	5.42 ± 7.08	-8.0 ± 17.2
LA Smear	Jr. Cave	Roof	470S	-	Exterior	-0.83 ± 4.09	-0.9 ± 18.2
LA Smear	Jr. Cave	South Wall	471S	-	Exterior	-0.83 ± 4.09	-10.4 ± 15.9
LA Smear	Jr. Cave	West Wall	473S	-	Exterior	5.42 ± 7.08	6.3 ± 18.2
LA Smear	Jr. Cave	Ceiling	478S	-	Interior	-0.83 ± 4.09	7.5 ± 18.3
LA Smear	Jr. Cave	East Wall	484S	-	Interior	-0.83 ± 4.09	-6.8 ± 16.4
LA Smear	Jr. Cave	Floor	490S	-	Interior	7.50 ± 8.17	111.1 ± 28.4
LA Smear	Jr. Cave	North Wall	495S	-	Interior	1.25 ± 4.09	23.0 ± 20.1
LA Smear	Jr. Cave	South Wall	499S	-	Interior	1.25 ± 4.09	43.2 ± 22.3
LA Smear	Jr. Cave	West Wall	505S	-	Interior	3.33 ± 5.78	64.6 ± 24.4
					Minimum	-0.83 ± 4.09	-10.4 ± 15.9
					Maximum	7.50 ± 8.17	111.1 ± 28.4
					Average	2.61 ± 5.53	16.0 ± 19.5
					Standard Deviation	3.16 ± 1.68	32.3 ± 3.2
					Count	15	15

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	Repair Clerestory	Roof	506S	5,5		1.25 ± 4.09	-0.9 ± 18.2
LA Smear	Repair Clerestory	Roof	507S	5,15		-0.83 ± 4.09	-3.3 ± 17.9
LA Smear	Repair Clerestory	Roof	508S	10,15		9.58 ± 9.13	8.6 ± 19.3
LA Smear	Repair Clerestory	Roof	509S	5,10		-0.83 ± 4.09	8.6 ± 19.3
					Minimum	-0.83 ± 4.09	-3.3 ± 17.9
					Maximum	9.58 ± 9.13	8.6 ± 19.3
					Average	2.29 ± 5.35	3.3 ± 18.7
					Standard Deviation	4.29 ± 2.18	5.4 ± 0.7
					Count	4	4
LA Smear	Service platform	Electric box	510S	3,28		3.33 ± 5.78	-12.8 ± 16.6
LA Smear	Service platform	Electric box	511S	3,18		1.25 ± 4.09	-5.7 ± 17.6
LA Smear	Service platform	Electric box	512S	3,6		1.25 ± 4.09	-9.2 ± 17.1
LA Smear	Service platform	Electric box	513S	3,0		1.25 ± 4.09	1.5 ± 18.5
LA Smear	Service platform	Grate	514S	3,3		-0.83 ± 4.09	-0.9 ± 18.2
LA Smear	Service platform	Grate	515S	3,14		-0.83 ± 4.09	-2.1 ± 18.0
LA Smear	Service platform	Grate	516S	6,13		1.25 ± 4.09	-21.1 ± 15.4
LA Smear	Service platform	Grate	517S	Support pillars		-0.83 ± 4.09	-4.5 ± 17.7
LA Smear	Service platform	Grate	518S	16,22		-0.83 ± 4.09	0.3 ± 18.3
LA Smear	Service platform	H20 cab	519S	Right side		1.25 ± 4.09	0.3 ± 18.3
LA Smear	Service platform	H20 cab	520S	Middle side		-0.83 ± 4.09	-5.8 ± 17.6
SA Smear	Service platform	H20 manifold	528S	-		3.33 ± 5.78	-17.7 ± 15.9
SA Smear	Service platform	H20 manifold	529S	-		-0.83 ± 4.09	-11.7 ± 16.8
SA Smear	Service platform	H20 manifold	530S	-		3.33 ± 5.78	-2.2 ± 18.0

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
SA Smear	Service platform	H20 manifold	531S	-		-0.83 ± 4.09	-2.2 ± 18.0
SA Smear	Service platform	H20 manifold	532S	-		3.33 ± 5.78	-12.9 ± 16.6
LA Smear	Service platform	Mech Pump	521S	On platform		-0.83 ± 4.09	6.1 ± 19.0
LA Smear	Service platform	Overhead	522S	3,3		-0.83 ± 4.09	3.7 ± 18.8
LA Smear	Service platform	Overhead	523S	3,25		3.33 ± 5.78	12.1 ± 19.7
LA Smear	Service platform	Overhead	524S	6,12		-0.83 ± 4.09	-18.9 ± 15.8
LA Smear	Service platform	Overhead	525S	15,12		7.50 ± 8.17	-7.0 ± 17.4
LA Smear	Service platform	Overhead	526S	15,25		1.25 ± 4.09	13.3 ± 19.9
LA Smear	Service platform	South Items	284S	Vac pump-meter	#65	0.88 ± 4.10	-8.9 ± 16.8
LA Smear	Service platform	Turbo Pump	527S	-		20.00 ± 12.92	4.9 ± 18.9
					Minimum	-0.83 ± 4.09	-21.1 ± 15.4
					Maximum	20.00 ± 12.92	13.3 ± 19.9
					Average	1.84 ± 4.98	-4.2 ± 17.7
					Standard Deviation	4.32 ± 1.93	8.8 ± 1.2
					Count	24	24
LA Smear	Sr. Cave	East Wall	533S	4,6	Exterior	1.25 ± 4.09	8.5 ± 19.3
LA Smear	Sr. Cave	East Wall	534S	4,6	Exterior	1.25 ± 4.09	-3.4 ± 17.9
LA Smear	Sr. Cave	HEPA filter	721S	top	Exterior	7.29 ± 8.17	-4.8 ± 17.1
LA Smear	Sr. Cave	HEPA filter	722S	bottom	Exterior	48.96 ± 20.01	21.4 ± 20.3
LA Smear	Sr. Cave	North Wall	535S	3,3	Exterior	1.25 ± 4.09	-8.2 ± 17.2
LA Smear	Sr. Cave	North Wall	536S	3,3	Exterior	-0.83 ± 4.09	-12.9 ± 16.6
LA Smear	Sr. Cave	Roof	277S	Smear of tape	Exterior	126.25 ± 31.89	105.1 ± 28.0
LA Smear	Sr. Cave	Roof	278S	Lift residue	Exterior	74.17 ± 24.50	109.9 ± 28.3

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Sr. Cave	Roof	537S	5,2	Exterior	22.08 ± 13.55	-4.6 ± 17.7
LA Smear	Sr. Cave	Roof	538S	5,2	Exterior	1.25 ± 4.09	10.9 ± 19.6
LA Smear	Sr. Cave	South Wall	539S	2,4	Exterior	3.33 ± 5.78	-3.4 ± 17.9
LA Smear	Sr. Cave	South Wall	540S	2,4	Exterior	1.25 ± 4.09	6.1 ± 19.0
LA Smear	Sr. Cave	West Wall	541S	4,6	Exterior	3.33 ± 5.78	-10.5 ± 16.9
LA Smear	Sr. Cave	West Wall	542S	4,6	Exterior	-0.83 ± 4.09	1.4 ± 18.5
LA Smear	Sr. Cave	Ceiling	559S	lights	Interior	563.75 ± 67.22	1023.4 ± 70.7
LA Smear	Sr. Cave	Ceiling	560S	-	Interior	3.33 ± 5.78	-8.8 ± 16.6
LA Smear	Sr. Cave	Ceiling	561S	Center	Interior	13.75 ± 10.81	2.0 ± 18.0
LA Smear	Sr. Cave	Crane	589S	Hook & Cable	Interior	38.75 ± 17.80	742.4 ± 60.9
LA Smear	Sr. Cave	Crane	590S	Trolly	Interior	28.33 ± 15.28	56.7 ± 24.0
LA Smear	Sr. Cave	Duct work	563S	North wall	Interior	4084.58 ± 180.82	4173.4 ± 139.3
LA Smear	Sr. Cave	Floor	545S	7,6	Interior	15.83 ± 11.55	8127.7 ± 193.6
LA Smear	Sr. Cave	Floor	546S	7,2	Interior	1.25 ± 4.09	92.0 ± 26.9
LA Smear	Sr. Cave	Floor	569S	10,6	Interior	834.58 ± 81.77	1481.7 ± 84.2
LA Smear	Sr. Cave	Floor	570S	9,6	Interior	3384.58 ± 164.60	7040.0 ± 180.3
LA Smear	Sr. Cave	Floor	571S	3,5	Interior	3.33 ± 5.78	106.7 ± 28.3
LA Smear	Sr. Cave	Floor	572S	2,2	Interior	9.58 ± 9.13	166.2 ± 32.8
LA Smear	Sr. Cave	Floor	573S	9,0	Interior	3.33 ± 5.78	374.6 ± 45.0
LA Smear	Sr. Cave	Items	554S	In cave	Interior	13.75 ± 10.81	100.4 ± 27.6
LA Smear	Sr. Cave	Manip arms	562S	#3,#4	Interior	92.92 ± 27.39	49.6 ± 23.3
LA Smear	Sr. Cave	North wall	553S	Grill	Interior	157.50 ± 35.60	296.8 ± 40.7
LA Smear	Sr. Cave	North Wall	555S	6,0	Interior	9.58 ± 9.13	23.0 ± 20.1
LA Smear	Sr. Cave	North Wall	556S	5,4	Interior	-0.83 ± 4.09	7.9 ± 18.8

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	Sr. Cave	North Wall	557S	5,3	Interior	11.67 ± 10.01	12.7 ± 19.3
LA Smear	Sr. Cave	North Wall	558S	5,3	Interior	-0.83 ± 4.09	-1.6 ± 17.6
LA Smear	Sr. Cave	South Wall	549S	5,8	Interior	5.42 ± 7.08	38.5 ± 21.8
LA Smear	Sr. Cave	South Wall	550S	5,0	Interior	1.25 ± 4.09	11.1 ± 18.7
LA Smear	Sr. Cave	South Wall	579S	Inside door	Interior	63.75 ± 22.74	17.4 ± 19.9
LA Smear	Sr. Cave	South Wall	580S	0,0	Interior	3.33 ± 5.78	-2.8 ± 17.4
LA Smear	Sr. Cave	South Wall	581S	5,1	Interior	22.08 ± 13.55	511.5 ± 51.5
LA Smear	Sr. Cave	South Wall	582S	8,2	Interior	3.33 ± 5.78	-10.0 ± 16.4
LA Smear	Sr. Cave	South Wall	583S	7,4	Interior	7.50 ± 8.17	-5.2 ± 17.1
LA Smear	Sr. Cave	West Wall	551S	1,1	Interior	1.25 ± 4.09	-3.2 ± 16.9
LA Smear	Sr. Cave	West Wall	552S	6,0	Interior	9.58 ± 9.13	-15.1 ± 15.2
LA Smear	Sr. Cave	West Wall	584S	6,5	Interior	1.25 ± 4.09	-1.6 ± 17.6
LA Smear	Sr. Cave	West Wall	585S	5,3	Interior	-0.83 ± 4.09	6.7 ± 18.6
LA Smear	Sr. Cave	West Wall	586S	2,7	Interior	7.50 ± 8.17	28.1 ± 21.1
LA Smear	Sr. Cave	West Wall	587S	7,0	Interior	1.25 ± 4.09	18.6 ± 20.0
LA Smear	Sr. Cave	West Wall	588S	5,6	Interior	7.50 ± 8.17	13.9 ± 19.5
LA Smear	Sr. Cave	West Wall	641S	5,9	Interior	-1.13 ± 4.09	-14.9 ± 15.9
					Minimum	-1.13 ± 4.09	-15.1 ± 15.2
					Maximum	4,084.58 ± 180.82	8,127.7 ± 193.6
					Average	197.79 ± 19.04	503.6 ± 34.1
					Standard Deviation	746.46 ± 35.06	1,597.1 ± 38.2
					Count	49	49

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Type	Room	Location	No.	Coordinates	Item Number	Smear Activity (dis/min)	
						Alpha	Beta
LA Smear	Steel Vault	East Side	645S	-	Exterior	0.96 ± 4.09	-11.3 ± 16.4
LA Smear	Steel Vault	North Side	647S	-	Exterior	-1.13 ± 4.09	1.8 ± 18.2
LA Smear	Steel Vault	Roof	591S	-	Exterior	-0.83 ± 4.09	3.7 ± 18.8
LA Smear	Steel Vault	Roof	612S	Roof filter	Exterior	11.67 ± 10.01	-5.8 ± 17.6
LA Smear	Steel Vault	South Side	648S	-	Exterior	-1.13 ± 4.09	-5.4 ± 17.2
LA Smear	Steel Vault	South Wall	592S	-	Exterior	-0.83 ± 4.09	-16.5 ± 16.1
LA Smear	Steel Vault	West Side	646S	-	Exterior	-1.13 ± 4.09	-19.6 ± 15.2
LA Smear	Steel Vault	West Wall	593S	-	Exterior	1.25 ± 4.09	-5.8 ± 17.6
LA Smear	Steel Vault	Ceiling	594S	-	Interior	-0.83 ± 4.09	6.1 ± 19.0
LA Smear	Steel Vault	East Wall	595S	-	Interior	7.50 ± 8.17	29.9 ± 21.7
LA Smear	Steel Vault	Floor	596S	-	Interior	1.25 ± 4.09	134.7 ± 30.8
LA Smear	Steel Vault	North Wall	597S	-	Interior	7.50 ± 8.17	10.9 ± 19.6
LA Smear	Steel Vault	South Wall	598S	-	Interior	1.25 ± 4.09	39.5 ± 22.7
LA Smear	Steel Vault	West Wall	599S	-	Interior	5.42 ± 7.08	33.5 ± 22.1
					Minimum	-1.13 ± 4.09	-19.6 ± 15.2
					Maximum	11.67 ± 10.01	134.7 ± 30.8
					Average	2.21 ± 5.31	14.0 ± 19.5
					Standard Deviation	3.97 ± 2.01	37.8 ± 3.8
					Count	14	14
LA Smear	Tunnel	Ceiling	604S	-		7.50 ± 8.17	9.7 ± 19.5
LA Smear	Tunnel	Floor	605S	-		-0.83 ± 4.09	-7.0 ± 17.4
LA Smear	Tunnel	Service floor	420S	Inside		1.25 ± 4.09	6.3 ± 18.2
LA Smear	Tunnel	Wall North	606S	-		1.25 ± 4.09	-18.9 ± 15.8

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

						Smear Activity (dis/min)	
Type	Room	Location	No.	Coordinates	Item Number	Alpha	Beta
LA Smear	Tunnel	Wall South	607S	-		-0.83 ± 4.09	-18.9 ± 15.8
					Minimum	-0.83 ± 4.09	-18.9 ± 15.8
					Maximum	7.50 ± 8.17	9.7 ± 19.5
					Average	1.67 ± 4.91	-5.7 ± 17.3
					Standard Deviation	3.06 ± 1.63	12.1 ± 1.4
					Count	5	5
LA Smear	Vault Clerestory	Roof	608S	-		-0.83 ± 4.09	-16.5 ± 16.1
LA Smear	Vault Clerestory	Roof	609S	-		-0.83 ± 4.09	-5.8 ± 17.6
LA Smear	Vault Clerestory	Roof	610S	-		-0.83 ± 4.09	-2.2 ± 18.0
LA Smear	Vault Clerestory	Roof	611S	-		-0.83 ± 4.09	-8.2 ± 17.2
					Minimum	-0.83 ± 4.09	-16.5 ± 16.1
					Maximum	-0.83 ± 4.09	-2.2 ± 18.0
					Average	-0.83 ± 4.09	-8.2 ± 17.2
					Standard Deviation	0.00 ± 0.00	5.3 ± 0.7
					Count	4	4
	Summary of 211 Cyclotron Smear data		-	-			
					Minimum	-1.21 ± 4.09	-26.2 ± 13.9
					Maximum	8,474.17 ± 260.44	40,228.9 ± 429.3
					Average	67.94 ± 9.29	261.5 ± 24.7
					Standard Deviation	557.83 ± 21.72	1,965.2 ± 30.1
					Count	702	702

TABLE E.2 Summary of Smear Sample Analysis Using the Tennelec (Cont.)

Notes:
- Coordinate data are either two dimensional X,Y or three dimensional X,Y,Z.
- For walls, X is the horizontal coordinate and Y is the vertical coordinate.
- For floors, X is the east-west coordinate and Y is the north-south coordinate.
- All data are listed in feet.
- [Refer to Section VI, Survey and Sampling Design for complete description of coordinate system].

APPENDIX F:

SURFACE CONTAMINATION AND EXPOSURE RATE MEASUREMENTS ON MISCELLANEOUS EQUIPMENT LOCATED IN ROOM C101

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment

Room	Item #	Item	NE Direct (dpm/100 cm^2)		Exposure Rate (μR/h)
			α	βγ	
C001	1	Table	NCD	NCD	10
C001	2	Table	NCD	NCD	10
C001	3	Tubes & boxes	NCD	NCD	10
C001	4	Coil	NCD	NCD	10
C001	5	Wheel cart	NCD	NCD	10
C001	6	Box with coil	NCD	NCD	10
C001	7	Quadrapole	NCD	NCD	10
C001	8	Quadrapole	NCD	NCD	10
C001	9	Quadrapole	NCD	NCD	10
C001	10	Quadrapole	NCD	NCD	10
C001	11	Quadrapole	NCD	NCD	10
C001	12	Quadrapole	NCD	NCD	10
C001	13	Quadrapole	NCD	NCD	10
C001	14	Quadrapole	NCD	NCD	10
C001	15	Table	NCD	NCD	10
C001	16	Anode Power Supply	NCD	NCD	10
C001	17	Empty 55 gal. drum	NCD	NCD	10
C001	18	Empty box	NCD	NCD	10
C001	19	Filters	NCD	NCD	10
C001	20	Pan & misc. items	NCD	NCD	10
C001	21	Empty box	NCD	NCD	10
C001	22	Metal roller	NCD	NCD	10
C001	23	Periscope	NCD	NCD	10
C001	24	Metal box	NCD	NCD	10
C001	25	Metal plate & instrument	NCD	NCD	10
C001	26	3' stainless tube	NCD	NCD	10
C001	27	Table & misc. items	NCD	NCD	10
C001	28	Transformer	NCD	NCD	10
C001	29	Transformer	NCD	NCD	10
C001	30	Rad pail	NCD	NCD	10
C001	31	Rad pail	NCD	NCD	10
C001	32	Rad pail	NCD	NCD	10
C001	33	Rad pail	NCD	NCD	10

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment (Cont.)

Room	Item #	Item	NE Direct (dpm/100 cm^2)		Exposure Rate (μR/h)
			α	βγ	
C001	34	Rad pail	NCD	NCD	10
C001	35	Rad pail	NCD	NCD	10
C001	36	Empty pail	NCD	NCD	10
C001	37	Pump	NCD	NCD	10
C001	38	Coil	NCD	NCD	10
C001	39	Coil	NCD	NCD	10
C001	40	Crate - ceramic tube	NCD	NCD	10
C001	41	Crate - ceramic tube	NCD	NCD	10
C001	42	Aluminum valve	NCD	NCD	10
C001	43	Box with coil	NCD	NCD	10
C001	44	Box with coil	NCD	NCD	10
C001	45	Wood ladder	NCD	NCD	10
C101	46	Drain lines	NCD	NCD	10
C001	47	Garbage cans	NCD	NCD	10
C101	48	Motor, generator	NCD	NCD	10
C001	49	Motor, generator	NCD	NCD	10
C001	50	Motor, generator	NCD	NCD	10
C001	51	Wire chase & switches	NCD	NCD	10
C001	52	Motor, generator	NCD	NCD	10
C001	53	Motor, generator	NCD	NCD	10
C001	54	Metal stand	NCD	NCD	10
C001	55	Wire chase, control panel	NCD	NCD	10
C001	56	Electronic cabinet	NCD	NCD	10
C001	57	Motor generators	NCD	NCD	10
C001	58	Current supply	NCD	NCD	10
C001	59	Metal stand	NCD	NCD	10
C101	60	Motor, generator	NCD	NCD	10
C101	61	Cable spool	NCD	NCD	10
C101	62	Cable spool	NCD	NCD	10
C101	63	Shelves & cables	NCD	NCD	10
C101	64	Pump	NCD	NCD	10
Service platform	65	Pump	NCD	NCD	10

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment (Cont.)

Room	Item #	Item	NE Direct (dpm/100 cm^2)		Exposure Rate (μR/h)
			α	βγ	
C001	66	Wire equip. on shelves	NCD	NCD	10
C001	67	Electric panels	NCD	NCD	10
C001	68	Electric panels	NCD	NCD	10
C001	69	Duct vent	NCD	NCD	10
C001	70	Electric panels	NCD	NCD	10
C001	71	Dust vent	NCD	NCD	10
C001	72	Source assembly	NCD	16,100	120
C001	73	Source assembly	NCD	4,100	44
C001	74	Source assembly	NCD	8,700	74
C001	75	Source assembly	--	7,750	70
C001	76	Source assembly	NCD	10,750	120
C001	77	Source assembly	NCD	15,600	160
C001	78	Source assembly	NCD	NCD	10
C001	79	Source assembly	NCD	NCD	10
C001	80	Source assembly	NCD	NCD	10
C001	81	Source assembly	NCD	NCD	10
C001	82	Tripod	NCD	NCD	10
C001	83	Source assembly	NCD	NCD	10
C001	84	Source assembly	NCD	NCD	10
C001	85	Source assembly	NCD	NCD	10
C001	86	Current regulator - "dial"	NCD	10,000	70
C001	87	D.C. Generator	NCD	NCD	10
C001	88	Current regulator - "dial"	NCD	11,000	60
C001	89	D.C. Generator	NCD	NCD	70
C001	90	Ladder	NCD	NCD	20
C001	91	Transformer	NCD	NCD	20
C001	92	3 - powerstats	NCD	NCD	20
C001	93	Rectifier	NCD	NCD	20
C001	94	Westinghouse panels	NCD	NCD	20
C001	95	Motor in crate	NCD	NCD	20
C001	96	Cart with mop & bucket	NCD	1,700	20
C101	97	Box - nuts, bolts, washers	NCD	8,300	50
C101	98	East wall cabinets	NCD	3100 (bkgd)	40

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment (Cont.)

Room	Item #	Item	NE Direct (dpm/100 cm^2)		Exposure Rate (μR/h)
			α	βγ	
C101	99	East wall cabinets	NCD	3100 (bkgd)	40
C101	100	East wall cabinets	NCD	3100 (bkgd)	40
C101	101	East wall cabinets	NCD	3100 (bkgd)	40
C101	102	East wall cabinets	NCD	3100 (bkgd)	40
C101	103	East wall cabinets	NCD	3100 (bkgd)	40
C101	104	Target	13,000	137,000	7,500
C101	105	Bucket & stainless steel	NCD	6,000	80
C101	106	Bucket	NCD	6,000	70
C101	107	Bucket - ss fittings	NCD	27,000	800
C101	108	Stainless steel pipe	NCD	1,000,000	750
C101	109	Bucket of parts	NCD	2,000,000	10,000
C101	110	Hood	NCD	2,300	40
-	111	Unassigned	-	-	-
C101	112	Manifold	45,000	1,000	40
C101	113	Aluminum pipe wrench	NCD	12,000	100
C101	114	Bucket of beam parts	NCD	140,000	800
C101	115	5 gal. pail beam parts	NCD	21,000	200
C101	116	Plastic from trimmer box	NCD	13,000	100
-	117	Power supply	NCD	112,000	800
C101	118	Televac valve	NCD	16,000	200
C101	119	5 gal. bucket of target holders	NCD	1,430,000	2,000
C001	120	Pump	NCD	NCD	15
C101	121	Cabinets, Northeast wall	NCD	2,000	50
C101	122	Cabinets, Northeast wall	NCD	3,300	50
C101	123	Cabinets, Northeast wall	NCD	9,100	70
C101	124	Cabinets, Northeast wall	NCD	3,300	50
C101	125	1 foot fiber drum	NCD	6,000	50
C101	126	Man lift	NCD	7,000	100
C101	127	Helium 3 recovery cart	NCD	319,000	1,500
C101	128	Tools in cabinet - north wall	NCD	8,000	70
C101	129	Full SRW can - north wall	NCD	10,000	80
C101	130	Cabinet - north wall	NCD	5,000	100
C101	131	Cabinet - north wall	NCD	6,000	50

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment (Cont.)

Room	Item #	Item	NE Direct (dpm/100 cm^2)		Exposure Rate (μR/h)
			α	βγ	
C101	132	Cabinet	NCD	7,000	50
C101	133	Table & misc. items	NCD	108,000	500
C101	134	Sink	NCD	NCD	70
C101	135	Hood - inside	NCD		100
C101	136	TV carton with stands	NCD	4,000 (bkgd.)	40
C101	137	Table & misc. items	NCD	5,000 (bkgd.)	40
C101	138	Diffusion pump	2,500	27,000	200
C101	139	Southeast cabinet	NCD	3,100 (bkgd.)	20
C101	140	Southeast cabinet drawers	NCD	3,100 (bkgd.)	20
C101	141	Meters - dials	NCD	34,000	200
C101	142	Leak checker	NCD	8,000	80
C101	143	NEPA vacuum	NCD	45,000	200
C101	144	Box of pipes	NCD	20,000	20
C101	145	Leak checker	120	13,200	100
C101	146	Pipes on floor	NCD	18,000	100
C101	147	Motor on cart	NCD	2,300	25
C101	148	Flux meter	NCD	NCD	20
C101	149	Motor	NCD	4,500	35
C101	150	Stands	NCD	4,800	50
C101	151	Vacuum pump	NCD	7,100	35
C101	152	Table and hoses - Southwest	NCD	12,000 (bkgd.)	120
C101	153	Table - Southwest	NCD	10,000 (bkgd.)	70
C101	154	Aluminum table -Southwest	NCD	9,000 (bkgd.)	70
C101	155	Table & paraffin -Southwest	1,000	70,00060	60
C101	156	Ion source cart -Southwest	NCD	9,000 (bkgd.)	80
C101	157	Closed loop H^2O system	NCD	1,400	160

TABLE F.1 Direct Surface Contamination and Exposure Rate Measurements Performed on Miscellaneous Equipment (Cont.)

Room	Item #	Item	NE Direct ($dpm/100 cm^2$)		Exposure Rate ($\mu R/h$)
			α	$\beta\gamma$	
C101	158	Beam stand	250	210,000	700
C101	159	Dee cover plate	NCD	31,000	300
C001	160	Filter housing	NCD	NCD	15
C001	161	Heater	NCD	8,500	100
C001	162	Open beam line	NCD	3,800	20
-	163	Unassigned	-	-	-
-	164	Unassigned	-	-	-
-	165	Unassigned	-	-	-
C101	166	Magnet	NCD	163,000	1,400
C101	167	Leaded glass window	500	4,000	50

Notes: NCD ~ No contamination detected: <1000 dpm $\beta\gamma$ per 100 cm^2 $\beta\gamma$ and <100 dpm α per 100 cm^2

APPENDIX G:

SUMMARY OF AIR SAMPLING RESULTS

TABLE G.1 Cyclotron Facility Air Sample Results

Sample No.	Room No.	Started Sampling		Stopped Sampling		Filter Activity (dis/min)	
		Date	Time	Date	Time	Alpha	Beta
10A	B-118	9/26/97	11:00	9/29/97	10:10	7.48± 3.66	14.3 ± 8.9
12A	B-118	9/29/97	10:10	10/3/97	11:10	1.65 ± 2.02	12.9 ± 8.8
11A	B-126	9/27/97	08:30	9/29/97	10:10	0.81 ± 1.65	-2.6 ± 8.0
13A	B-126	9/29/97	10:10	10/3/97	11:10	1.23 ± 1.84	17.2 ± 9.0
2A	C-001	9/17/97	11:30	9/19/97	9:30	0.81 ± 1.65	34.6 ± 9.9
5A	C-001	9/19/97	09:30	9/23/97	9:45	2.48 ± 2.32	37.7 ± 10.0
6A	C-001	9/23/97	09:45	9/26/97	11:00	3.31 ± 2.60	51.2 ± 10.6
8A	C-001	9/26/97	11:00	9/29/97	10:10	1.23 ± 1.84	11.7 ± 8.7
14A	C-001	9/29/97	10:10	10/3/97	11:10	0.40 ± 1.44	6.2 ± 8.4
3A	C-101	9/17/97	11:30	9/19/97	9:30	0.81 ± 1.65	59.6 ± 11.0
4A	C-101	9/19/97	09:30	9/23/97	9:45	3.31 ± 2.60	27.2 ± 9.5
7A	C-101	9/23/97	09:45	9/26/97	11:00	0.81 ± 1.65	11.2 ± 8.7
9A	C-101	9/26/97	11:00	9/29/97	10:10	0.81 ± 1.65	11.7 ± 8.7
15A	C-101	9/29/97	10:10	10/3/97	11:10	-0.85 ± 0.86	15.8 ± 8.9
		Minimum				-0.85 ± 0.86	-2.6 ± 8.0
		Maximum				7.48 ± 3.66	59.6 ± 11.0
		Average				1.74 ± 1.96	22.0 ± 9.2
		Standard Deviation				1.92 ± 0.64	17.1 ± 0.8
		Count				14	14

TABLE G.1 Cyclotron Facility Air Sample Results (Cont.)

		Sample Analysis				Activity Concentration (x 1,000 dpm/m^3)	
Sample No.	Room No.	Time	Date	Total days	Vol. Sampled m^3	Alpha	Beta
10A	B-118	20:52:23	10/11/97	2.9	171	43.79 ± 21.44	83.8 ± 51.9
12A	B-118	21:12:39	10/11/97	4.0	233	7.07 ± 8.67	55.4 ± 37.8
11A	B-126	21:02:31	10/11/97	2.1	119	6.82 ± 13.88	-21.7 ± 66.7
13A	B-126	21:22:46	10/11/97	4.0	233	5.28 ± 7.92	73.8 ± 38.7
2A	C-001	19:31:20	10/11/97	1.9	110	7.36 ± 14.98	313.0 ± 89.3
5A	C-001	20:01:44	10/11/97	4.0	231	10.73 ± 10.06	163.0 ± 43.3
6A	C-001	20:11:52	10/11/97	3.0	176	18.8 ± 14.77	291.4 ± 60.3
8A	C-001	20:32:07	10/11/97	2.9	171	7.20 ± 10.80	68.5 ± 51.1
14A	C-001	21:32:54	10/11/97	4.0	233	1.70 ± 6.18	26.7 ± 36.3
3A	C-101	19:41:28	10/11/97	1.9	110	7.36 ± 14.98	539.5 ± 99.3
4A	C-101	19:51:36	10/11/97	4.0	231	14.34 ± 11.24	117.7 ± 41.2
7A	C-101	20:21:59	10/11/97	3.0	176	4.62 ± 9.41	63.9 ± 49.5
9A	C-101	20:42:15	10/11/97	3.0	171	4.76 ± 9.68	68.5 ± 51.1
15A	C-101	21:43:02	10/11/97	4.0	233	-3.67 ± 3.68	67.7 ± 38.4
		Minimum				-3.67 ± 3.68	-21.7 ± 36.3
		Maximum				43.79 ± 21.44	539.5 ± 99.3
		Average				9.73 ± 11.26	136.5 ± 53.9
		Standard Deviation				10.73 ± 4.30	143.5 ± 18.60
		Count				14.00	14.0

Notes: (1) Sampling flow rate was 40 liters per minute
(2) All measurements made using the Tennelec gas-flow proportional counter.
(3) Divide concentration values by 1,000 to obtain dpm/m^3.

APPENDIX H:

RADIOLOGICAL SAMPLE ANALYSES

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Oils, 211 Cyclotron
Submitted by: Dolores Geraghty, ESH/HP
Date Received: 10/2/97
Date Reported: 10/27/97

Submitter's Sample No.	ACL Sample No.	Gross α/β Activity (pCi/g)	
		Gross Alpha	Gross Beta
3 ACL	98-8004-01	<0.3	<0.4
6 ACL	98-8004-02	<0.4	0.8 ± 0.3
13 ACL	98-8004-03	<0.3	<0.4
32 ACL	98-8004-04	<0.3	<0.4

NOTE:
The uncertainty is based on propagation of counting statistical error.
Less than value is 3.29 sigma.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate / F. Markun at 2- 4291 .

Reference(s): CMT Notebook No. 1498, p. 6; CMT Notebook No. 1377, pp. 99, 184.

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Analyst(s): T. TenKate
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11/4/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Orphan Waste, Oil, 211 Cyclotron
Submitted by: Dolores Geraghty, ESH/HP
Date Received: 10/2/97
Date Reported: 10/31/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/g)			
		^{214}Bi	^{226}Ra	^{232}Th	^{137}Cs
3 ACL	98-8004-01	1.10 ± 0.11	0.79 ± 0.08	0.67 ± 0.07	<0.2
6 ACL	-02	<0.2	<0.2	<0.2	<0.2
13 ACL	-03	<0.2	<0.2	0.21 ± 0.02	<0.2
32 ACL	-04	<0.2	<0.2	<0.2	<0.2

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1498, p. 6; CMT Logbook No. 1110, Det 2, 4, 7, 11, pp. 59, 61.

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Analyst(s): T. TenKate

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11/3/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Orphan Waste, Liquids, Crystalline Salts
Submitted by: Dolores Geraghty, ESH/HP
Date Received: 9/30/97
Date Reported: 10/28/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/g)		
		^{214}Bi	^{226}Ra	^{232}Th
10 ACL	98-8000-01	0.28 ± 0.03	0.28 ± 0.03	0.42 ± 0.04
		Gross Alpha/Beta (pCi/g)		
		Alpha		Beta
10 ACL	98-8000-01	<0.04		<0.07

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1110, Det. 2, 4, 7, 11, p. 59;
CMT Logbook No. 1498, p. 3.

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10/29/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS *Revision 12/11/97

Sample Material: Cyclotron Orphan Waste
Submitted by: Dolores Geraghty, ESH, 200
Date Received: 10/10/97
Date Reported: *12/8/97

Submitter's Sample No.	ACL Sample No.	Gross α/β Activity pCi/Unit		
		Unit	Gross Alpha	Gross Beta
26 ACL	98-8014-01	Smear	430 ± 75	32400 ± 500
11 ACL-S	98-8017-01	mL	0.6 ± 0.2	<0.3

NOTE: The uncertainity is based on propagation of counting statistical error. The less than value is 3.29 σ

***Reason for Revision:** Incorrect date.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Notebook No. 1498, p. 8; CMT Notebook No. 1377, pp. 100, 185.

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12/8/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
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REPORT OF ANALYTICAL RESULTS

Sample Material: Water
Submitted by: Dolores Geraghty
Date Received: 10/2/97
Date Reported: 10/27/97

Submitter's Sample No.	ACL Sample No.	Gross α/β Activity pCi/unit		
		Unit	Gross Alpha	Gross Beta
19 ACL	98-8005-01	mL	<0.1	<0.3
20 ACL	98-8005-02	mL	<0.1	<0.3
31 ACL	98-8005-03	mL	<0.2	0.4 ± 0.2

NOTE:
The uncertainity is based on progagation of counting statistical error.
Less than value is 3.29 sigma.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate / F. Markun at 2- 4291.

Reference(s): CMT Notebook No. 1498, p. 10; CMT Notebook No. 1377, pp. 100, 185.

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11/3/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Water, Cyclotron, D-211
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/2/97
Date Reported: 10/31/97

Submitter's Sample No.	ACL Sample No.	Gamma (pCi/mL)			
		^{214}Bi	^{226}Ra	^{232}Th	^{137}Cs
19ACL	98-8005-01	<0.2	<0.2	<0.2	<0.2
20ACL	-02	<0.2	<0.2	<0.2	<0.2
31ACL	-03	0.60 ± 0.06	0.40 ± 0.04	0.59 ± 0.06	<0.2

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1110, Det. 2, 4, 7, 11, pg. 61; CMT Logbook No. 1498, pg. 9.

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11/04/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	Cyclotron Rad Waste	Date Received:	10/2/97
Submitted by:	Dolores Geraghty, ESH-HP, 200	Date Reported:	12/19/97

Submitter's Sample No.	ACL Sample No.	Tritium Activity (pCi/mL)
		^3H
19 ACL	98-8005-01	< 5

NOTE: Unused sample material will be returned to the Customer. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate / F. Markun at 2- 4291 .

Reference(s): CMT Notebook No. 1498, p. 20.

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CMT-84 (4-94)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 Cyclotron

Submitted by: Dolores Geraghty, ESH/HP, 200

Date Received: 10/10/97

Date Reported: 12/4/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/g)	
		^{60}Co	
21 ACL	98-8012-01	$(1.14 \pm 0.02) \times 10^2$	
			^{54}Mn
23 ACL	-02	$(2.07 \pm 0.04) \times 10^2$	7.4 ± 0.2
		^{241}Am	^{226}Ra
42 ACL	98-8013-01	0.50 ± 0.05	0.30 ± 0.03
		Gamma Spec.: (pCi/smear)	
		^{60}Co	
26 ACL	98-8014-01	$(1.05 \pm 0.05) \times 10^5$	

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1498, pp. 7, 8; CMT Logbook No. 938, Det 3, p. 155; CMT Logbook No. 1112, Det 2, 4, 7, 11, p. 61.

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Analyst(s): T. TenKate

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12/8/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS REVISED REPORT 2/12/98*

Sample Material: Metal Turnings
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/10/97
Date Reported: 12/4/97

Submitter's Sample No.	ACL Sample No.	Gross Alpha/Beta Activity, pCi/unit		
		Unit	Gross Alpha	Gross Beta
21ACL	98-8012-01	g	<25.4	127.5 ± 18.0
23ACL	-02	g	<24.9	118.7 ± 20.6

NOTE: The uncertainty is based on propagation of counting statistical error.

Less than value is 3.29 sigma.

***Revised to correct submitter's sample number for 98-8012-02.**

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate/F. Markun at 2- 4291 .

Reference(s): CMT Notebook No. 1498, pg. 9; CMT Notebook No. 1377, pp. 100, 185.

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12/5/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	211 Cyclotron, Oil	Date Received:	10/9/97
Submitted by:	Dolores Geraghty, ESH/HP, 200	Date Reported:	12/4/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/g)		
		^{137}Cs	^{60}Co	^{241}Am
24ACL	98-8010-01	<0.2	<0.2	<0.2
25ACL	-02	<0.2	<0.2	<0.2
		Gross Alpha/Beta: (pCi/g)		
		Alpha		Beta
24ACL	98-8010-01	<4		<7
25ACL	-02	<4		<7

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1498, pp. 9, 14; CMT Logbook No. 938, Det. 3, pg. 155; CMT Logbook No. 1110, Det. 2, 4, 7, 11, pg. 61.

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12/4/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Orpan Waste; Cyclotron, D 211

Submitted by: Dolores Geraghty, ESH/HP

Date Received: 9/30/97

Date Reported: 10/29/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/unit)			
		Unit	^{22}Na	^{54}Mn	^{57}Co
29 ACL	98-8002-01	sample	(2.75 ± 0.28) x 10^4	(1.26 ± 0.13) x 10^2	(5.99 ± 0.60) x 10^2
			^{60}Co	^{88}Y	^{137}Cs
			33.7 ± 3.4	(1.20 ± 0.12) x 10^3	70.3 ± 7.0
			^{241}Am		
			48.7 ± 4.9		
			^{228}Th	^{109}Cd	
37 ACL	98-8002-02	g	30.7 ± 3.1	(1.35 ± 0.14) x 10^2	

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 938, Det 3, p. 153
CMT Logbook No. 1498, p. 3; CMT Logbook No. 1112, Det. 1, 9, 10, p. 115.

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Analyst(s): T. TenKate

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10/29/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 Cooling Tower Water
Submitted by: Dolores Geraghty, HP, 200
Date Received: 9/24/97
Date Reported: 9/26/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/mL)			
		^{137}Cs	^{214}Bi	^{226}Ra	^{228}Th
35ACL - M	97-8258-01	<0.2	<0.2	<0.2	<0.2
		Gross Alpha/Beta (pCi/mL)			
		Alpha		Beta	
35ACL - M	97-8258-01	0.89 ± 0.09		0.44 ± 0.04	

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 938, Det 3, p. 153;
CMT Logbook No. 1498, p. 2.

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Analyst(s): T. TenKate

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9/26/97
MT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Orphan Waste, Cyclotron D211
Submitted by: Dolores Geraghty, EHS/HP, 200
Date Received: 9/30/97
Date Reported: 10/28/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/Unit)				
		Unit	^{214}Bi	^{226}Ra	^{232}Th	^{137}Cs
38ACL	98-8001-01	g	0.70 ± 0.07	0.54 ± 0.05	0.54 ± 0.05	1.60 ± 0.16
			^{237}Np	^{241}Am	^{243}Am	
39ACL	-02	g	$(4.34 \pm 0.43) \times 10^2$	17.5 ± 1.8	74.0 ± 7.4	
			^{144}Ce	^{241}Am	^{243}Am	^{228}Th
40ACL	-03	Sample	$(3.22 \pm 0.32) \times 10^4$	$(3.61 \pm 0.36) \times 10^4$	$(2.79 \pm 0.28) \times 10^5$	$(3.56 \pm 0.36) \times 10^5$
			^{226}Ra			
	-03		$(1.34 \pm 0.13) \times 10^3$			
			^{109}Cd	^{214}Bi	^{228}Th	^{226}Ra
41ACL	-04	Sample	$(2.09 \pm 0.21) \times 10^4$	$(7.70 \pm 0.77) \times 10^3$	$(1.24 \pm 0.12) \times 10^4$	$(7.03 \pm 0.70) \times 10^3$

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1498, pg. 3; CMT Logbook No. 1110, Det. 2, 4, 7, 11, pg. 59; CMT Logbook No. 938, Det. 3, pg. 153.

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Analyst(s): T. TenKate

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10/29/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	Liquids and Crystalline Salts	Date Received:	9/30/97
Submitted by:	Dolores Geraghty, EHS/HP, 200	Date Reported:	10/31/97

Submitter's Sample No.	ACL Sample No.	Gross α/β Activity pCi/Unit $\pm 2\sigma$		
		Unit	Gross Alpha	Gross Beta
38ACL	98-8001-01	mL	<1.1	1.5 ± 0.5
39ACL	-02	mL	95 ± 10	$1.9 \times 10^3 \pm 3.0 \times 10^1$
40ACL	-03	g	$6.0 \times 10^5 \pm 1.2 \times 10^4$	$3.2 \times 10^5 \pm 6.5 \times 10^3$
41ACL	-04A	mL	$1.7 \times 10^4 \pm 3.0 \times 10^2$	$5.4 \times 10^3 \pm 1.3 \times 10^2$
41ACL	-04B	Sample	60 ± 10	44.3 ± 6.6
41ACL	-04C	mL	$2.4 \times 10^4 \pm 4.2 \times 10^2$	$8.2 \times 10^3 \pm 1.3 \times 10^1$

NOTE: Uncertainty is based on propagation of counting statistical error.

NOTE: Less than value is 3.29 sigma.

NOTE: Sample 41ACL - 98-8001-04 consisted of 3 separate vials and each was analyzed individually.
-04A - scintillation vial with broken ampule
-04B - 15mL conical centrifuge tube
-04C - 50mL conical centrifuge tube with broken ampule

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate/F. Markun at 2- 4291 .

Reference(s): CMT Notebook No. 1498, pp. 3, 4, 11; CMT Notebook No. 1377, pp. 99, 100, 183, 184, 185.

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11/03/97

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Cyclotron Rad Waste

Submitted by: Dolores Geraghty, ESH-HP, 200

Date Received: 10/10/97

Date Reported: 12/8/97

Submitter's Sample No.	ACL Sample No.	^{90}Sr Activity pCi/mL
42 ACL	98-8013-01	$(3.9 \pm 0.6) \times 10^3$ p Ci/mL **NOTE:** Using liquid scintillation counting method.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call F. Markun at 2- 7521 .

Reference(s): CMT Notebook No. 1498, p. 8.

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12/10/97

CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Cyclotron Rad Waste

Submitted by: Dolores Geraghty, ESH/HP, 200

Date Received: 10/10/97

Date Reported: 12/8/97

Submitter's Sample No.	ACL Sample No.	^{90}Sr Activity pCi/mL
45ACL	98-8015-03	$(3.2 \pm 0.5) \times 10^4$ pCi/mL NOTE: Using liquid scintillation method.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call F. Markun at 2- 7521 .

Reference(s): CMT Notebook No. 1498, pg. 16.

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12/12/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
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REPORT OF ANALYTICAL RESULTS Revision: 10/30/97

Sample Material: Orphan Waste - D - 211 Cyclotron
Date Received: 10/10/97
Submitted by: Dolores Geraghty, ESH/HP
Date Reported: 10/28/97

Submitter's Sample No.	ACL Sample No.	^{90}Sr / ^{90}Y (d/m)
46 ACL	98-8015-04	$(1.1 \pm 0.2) \times 10^9$
48 ACL	-06	$(5.2 \pm 1) \times 10^8$
52 ACL	-10	$(1.4 \pm 0.4) \times 10^3$
		I.D. of α emitting contamination on outside of vials.
52 ACL	-10	^{229}Th with associated daughters.

NOTE:
97-8015-04; ^{90}Sr /^{90}Y in ~ 10 mL of $2NHNO_3$
97-8015-06; ^{90}Sr/^{90}Y in ~ 15 mL of dilute HNO_3 / HCl
97-8015-10; ^{90}Sr/^{90}Y is liquid scintillation fluid (~ 80 mL). Majority of activity is present as the ^{229}Th contaminate.

Reason for Revision:
ACL job number incorrect.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call D. Bowers at 2- 4354 .

Reference(s): CMT Logbook No. 1427 pp. 191, 192.

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/law
10/28/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 Cyclotron Waste
Submitted by: Dolores Geraghty, ESH, 200
Date Received: 10/10/97
Date Reported: 12/4/97

Submitter's Sample No.	ACL Sample No.	Gross Alpha/Beta Activity pCi/mL ± 2σ	
		Gross Alpha	Gross Beta
43 ACL	98-8015-01	2.7 ± 0.9	0.8 ± 0.3
44 ACL	98-8015-02	1.8 ± 0.8	< 0.4
45 ACL	98-8015-03	190 ± 40	(2.9 ± 0.4) x 10^4
50 ACL	98-8015-08A	< 2.0	5.7 ± 2.3
50 ACL	98-8015-08B	< 2.0	4.4 ± 2.2
53 ACL	98-8015-11	36.3 ± 11.5	184 ± 9

NOTE: Uncertainty based on progation of counting statistical error. Less than value is 3.29 σ.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate / F. Markun at 2- 4291 .

Reference(s): CMT Notebook No. 1498, p. 16; CMT Notebook No. 1377, pp. 101, 187.

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Bowers
F. Martino
L. TenKate
D. Graczyk
L. Smith

Analyst(s):
T. TenKate
F. Markun

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12/8/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 Cyclotron Waste
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/10/97
Date Reported: 3/11/98

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (DPM/sample)		
		^{226}Ra	^{214}Bi	^{228}Th
47ACL	98-8015-05	$(1.37 \pm 0.07) \times 10^6$	$(1.42 \pm 0.07) \times 10^6$	$(3.78 \pm 0.38) \times 10^4$

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 938, Det. 3, pg. 165.

Copies To:
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Analyst(s): T. TenKate

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3/11/98
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: ANL-E, 211 Cyclotron Waste
Date Received: 10/10/97
Submitted by: Dolores Geraghty, ESH, 200
Date Reported: 3/5/98

Submitter's Sample No.	ACL Sample No.	^{14}C Activity (pCi/mL)
		^{14}C
49ACL	98-8015-07	4600 ± 900
51ACL	-09	$(9.0 \pm 1.8) \times 10^5$

NOTE: Measurements done by liquid scintillation. In case of 98-8015-09, total sample used up in analysis.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call F. Markun at 2- 7521 .

Reference(s): CMT Notebook No. 1498, Pg. 49.

Copies To:
- D. Geraghty
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- L. Smith
- T. TenKate
- F. Markun

Analyst(s): F. Markun FM
D. Bowers

/lac
3/10/98
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	211 60" Cyclotron D&D	Date Received:	11/26/97
Submitted by:	Dolores Geraghty, ESH/HP, 200	Date Reported:	03/12/98

Alpha Scan

The analytical samples listed below were large metal pieces from the 211 60" Cyclotron D&D project. Following acid digestion, the actinides and lanthanides were separated as a group from the other matrix constituents. A TruSpec™ extraction chromatographic column was utilized for this purpose. The samples were then electrodeposited prior to alpha spectrometry.

The resulting alpha spectra are attached. Since tracers were not added to the samples, standard alpha sources were counted in the appropriate detectors to define the proper energy calibration for each detector.

Submitters Sample No.	**ACL Sample No.**	**Peak Energy (MeV)**	**Isotope**[1]	**% Activity**[2]
54ACL	98-8045-01	No actinides or trivalent actinides were present.		
55ACL	98-8045-02	4.40	$^{235/236}U$	3
		4.79	$^{233/234}U$ ^{237}Np	87
		5.30	^{232}U ^{210}Po	9

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[1] Because no elemental separations were performed, alpha emitters of equivalent energies may be present in the spectra, and, therefore, more than one alpha emitter may be listed for each peak. Process knowledge of the data user may be used to eliminate some of the listed nuclides.

[2] This value is based upon the ratio of the counts under the individual peak to the total counts of all the peaks. This value also assumes equivalent electrodeposition efficiencies for all analytes, which is only true to a gross approximation for different elements. Since electrodeposition is matrix dependent, and will vary from sample to sample, no attempt has been made to assign an analytical uncertainty to these values.

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 60" Cyclotron D & D

Submitted by: Dolores Geraghty, ESH/HP, 200

Date Received: 11/26/97

Date Reported: 12/4/97

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/sample)	
		^{54}Mn	^{60}Co
54 ACL	98-8045-01	(2.74 ± 0.41) x 10^4	(2.19 ± 0.04) x 10^6
		^{60}Co	
55 ACL	-02	(2.54 ± 0.05) x 10^5	

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 938, Det 3, p. 159.

Copies To:
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Analyst(s): T. TenKate

T

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12/8/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 60" Cyclotron D&D
Submitted by: Dolores Geraghty, EHS/HP, 200
Date Received: 11/26/97
Date Reported: 2/16/98

Submitter's Sample No.	ACL Sample No.	Gross α/β (pCi/sample ± 2σ)		
		Gross α	Gross β	Sample Wt. (g)
54ACL	98-8045-01	$(5.3 \pm 0.8) \times 10^3$	$(1.2 \pm 0.2) \times 10^5$	1500
55ACL	-02	$(3.7 \pm 0.1) \times 10^3$	$(1.0 \pm 0.1) \times 10^3$	1881

NOTE: Uncertainty based upon propagation of counting statistical error. Values represent activity which was leachable from sample surface.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Smith at 2- 1890.

Reference(s): CMT Notebook No. 1493, pg. 55.

Copies To:
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D. Graczyk
D. Bowers
F. Martino
L. Smith

Analyst(s): L. Smith

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2/16/98
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

REVISED - 3/10/98

Sample Material: 211 Cyclotron Characterization, Iron Filings
Date Received: 1/28/98
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Reported: 2/25/98

Submitter's Sample No.	ACL Sample No.	Gamma Spec.; (pCi/g)	
		^{60}Co	^{241}Am
57ACL (181)	98-8098-01	25.9 ± 2.6	<0.2
58ACL (182)	-02	10.7 ± 1.1	<0.2
59ACL (183)	-03	**10.8 ± 0.5**	**<0.2**
60ACL (184)	-04	6.5 ± 0.6	<0.2
61ACL (185)	-05	5.5 ± 0.5	<0.2
62ACL (186)	-06	<0.2	<0.2
63ACL (187)	-07	**5.4 ± 0.5**	**<0.2**
64ACL (188)	-08	7.7 ± 1.2	<0.2
65ACL (189)	-09	<0.2	<0.2

Reason for Revision: Customer requested a recount of 98-8098-03 and 98-8098-07.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call T. TenKate at 2- 4291 .

Reference(s): CMT Logbook No. 1498, pg. 47; CMT Logbook No. 1110, Det. 2, 4, 7, 11, pp. 81, 83, 85.

Copies To:
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Analyst(s): T. TenKate

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2/25/98
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Smear; 211 Cyclotron D&D — Date Received: 11/25/97

Submitted by: Dolores Geraghty, ESH/HP, 200 — Date Reported: 02/17/98

Alpha Scan

The analytical sample listed below was a smear sample from the ANL-E, 211 60" Cylcotron Characterization - D&D project. Following acid digestion, the actinides and lanthanides were separated as a group from the other matrix constituents. A TruSpec™ extraction chromatographic column was utilized for this purpose. The sample was then electrodeposited prior to alpha spectrometry.

The resulting alpha spectrum is attached. Since tracers were not added to the sample, standard alpha sources were counted in the appropriate detectors to define the proper energy calibration for each detector.

Submitters Sample No.	**ACL Sample No.**	**Peak Energy (MeV)**	**Isotope[1]**	**% Activity[2]**
56ACL	98-8046-01	4.79	$^{233/234}U$ ^{237}Np	100

[1] Because no elemental separations were performed, alpha emitters of equivalent energies may be present in the spectra, and, therefore, more than one alpha emitter may be listed for each peak. Process knowledge of the data user may be used to eliminate some of the listed nuclides.

[2] This value is based upon the ratio of the counts under the individual peak to the total counts of all the peaks. This value also assumes equivalent electrodeposition efficiencies for all analytes, which is only true to a gross approximation for different elements. Since electrodeposition is matrix dependent, and will vary from sample to sample, no attempt has been made to assign an analytical uncertainty to these values.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded (1) month after the date of this receipt unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Smith at 2-1890.

Reference(s): CMT Logbook No. 1493, p. 56

/lac
2/19/98

Copies To:
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- C. Sholeen
- M. Robinet
- D. Green
- D. Bowers
- F. Martino
- L. Smith

Analyst (s): L. Smith

ARGONNE
NATIONAL
LABORATORY

Intra-Laboratory Memo

February 6, 1998

To: Dolores Geraghty ESH-HP

From: Don Nelson ESH-AS

Subject: Black tape from 211

On (or about) 9/30/97 Mike O'Connor delivered a piece of thick black tape (found on the top of the Sr cave in 211) to the analytical laboratory. The tape was counted in a gamma spectrometer and then a small piece was removed and dissolved. A small fraction of the dissolved sample was electrodeposited and counted on an alpha spectrometer. The results are tabulated below.

Isotope	Activity (dpm ± 1σ)
Cm-244	3,380,000 ± 200,000
Cs-137	38,000 ± 120
Pu-239	35,000 ± 2,500
Am-241	3,830 ± 130
Am-243	1,580 ± 40
Eu-154	1,790 ± 60
Cm-245	500 ± 100

cc: RA Schlenker
File
AS letter log

APPENDIX I:

SUMMARY OF METAL SAMPLES COLLECTED AND ANALYZED

TABLE I.1 Metal Sample Analyses

					Measured Activity (dis/min)		Sample Analysis		
Type	Room	Sample LocationNo.	Coordinates	Item No.	Alpha	Beta	Date	Time	Plncht No.
Metal Shaving	C-101	Pole	11,25,4	181	0.104 ± 0.381	-2.13 ± 2.48	10/12/97	01:41:35	64
Metal Shaving	C-101	Yoke drillings	13,27,6	182	-0.188 ± 0.349	21.82 ± 2.69	10/12/97	05:01:43	65
Metal Shaving	C-101	Yoke drillings	15,30,7	183	0.042 ± 0.374	7.57 ± 2.57	10/12/97	08:21:51	66
Metal Shaving	C-101	Yoke drillings	22,13,4	184	-0.083 ± 0.361	9.79 ± 2.59	10/12/97	11:41:59	67
Metal Shaving	C-101	Yoke drillings	23,15,10	185	-0.333 ± 0.332	1.62 ± 2.51	10/12/97	15:02:07	68
Metal Shaving	C-101	Yoke drillings	18,20,11	186	-0.542 ± 0.306	4.39 ± 2.54	10/12/97	18:22:15	69
Metal Shaving	C-101	Yoke drillings	12,14,11	187	0.042 ± 0.374	5.86 ± 2.55	10/12/97	21:42:23	70
Metal Shaving	C-101	Yoke drillings	13,22,-2	188	-0.271 ± 0.339	4.64 ± 2.54	10/13/97	01:02:31	71
Metal Shaving	C-101	Yoke drillings	14,23,-3	189	-0.208 ± 0.346	4.04 ± 2.54	10/13/97	04:22:39	72
Paraffin Sample	Steel Vault Interior				-0.063 ± 0.363	0.13 ± 2.50	10/13/97	07:42:46	73
			Minimum		-0.542 ± 0.306	-2.13 ± 2.48			
			Maximum		0.104 ± 0.381	21.82 ± 2.69			
			Average		-0.150 ± 0.352	5.77 ± 2.55			
			Standard Deviation		0.189 ± 0.022	6.28 ± 0.06			
			Count		10	10			

Note: 1) All analyses performed using the Tennelec gas flow proportional counter.
2) All coordinate data are listed in feet.
3) [Refer to Section VI, Survey and Sampling Design for complete description of coordinate system].

APPENDIX J:

SUMMARY OF PAINT AND CONCRETE SAMPLES ANALYZED

TABLE J.1 Paint and Concrete Sample Analyses

Type	Room	Location	Coordinates	Measured Activity (dis/min) Alpha	Measured Activity (dis/min) Beta	Sample Analysis Date	Sample Analysis Time	Plncht No.
Paint Scraping	B-118	North Wall	5,1	1.23 ± 4.09	0.8 ± 17.9	10/11/97	21:55:51	43
Paint Scraping	B-118	South Wall	3,5	-0.85 ± 4.09	-8.8 ± 16.6	10/11/97	21:57:58	44
Paint Scraping	B-118	South Wall	5,7	-0.85 ± 4.09	-6.4 ± 16.9	10/11/97	21:53:43	45
Paint Scraping	B-126	East Wall	5,6	-0.85 ± 4.09	9.1 ± 18.9	10/11/97	22:04:22	46
Paint Scraping	B-126	North Wall	6,4	-0.85 ± 4.09	19.8 ± 20.2	10/11/97	22:00:06	47
Paint Scraping	B-126	South Wall	5,3	-0.85 ± 4.09	-0.4 ± 17.7	10/11/97	22:02:14	48
Paint Scraping	C-101	Ceiling Hole	23,20,28	3.31 ± 5.78	-13.5 ± 15.9	10/11/97	22:10:45	49
Paint Scraping	C-101	Ceiling Hole	23,20,28	1.23 ± 4.09	-1.6 ± 17.6	10/11/97	22:12:53	50
Paint Scraping	C-101	East Wall	9,14	1.23 ± 4.09	-12.3 ± 16.1	10/11/97	21:45:12	51
Paint Scraping	C-101	Floor	23,10	-0.85 ± 4.09	-4.0 ± 17.2	10/11/97	22:08:38	52
Paint Scraping	C-101	North Wall	3,30	-0.85 ± 4.09	-7.6 ± 16.8	10/11/97	21:47:19	54
Paint Scraping	C-101	South Wall	10,4	1.23 ± 4.09	0.8 ± 17.9	10/11/97	21:49:27	56
Paint Scraping	C-101	Steel floor plt	4,4	1.23 ± 4.09	-4.0 ± 17.2	10/11/97	22:06:30	58
Paint Scraping	C-101	West Wall	9,6	3.31 ± 5.78	18.6 ± 20.0	10/11/97	21:51:35	59
Concrete sample	C-101	East Wall	32,4	1.23 ± 4.09	-5.2 ± 17.1	10/11/97	22:19:17	60
Concrete sample	C-101	North Wall	20,5	1.23 ± 4.09	16.2 ± 19.7	10/11/97	22:17:09	61
Concrete sample	C-101	South Wall	31,5	-0.85 ± 4.09	21.0 ± 20.3	10/11/97	22:21:25	62
Concrete sample	C-101	West Wall	9,5	-0.85 ± 4.09	30.5 ± 21.3	10/11/97	22:15:01	63
			Minumum	-0.85 ± 4.09	-13.5 ± 15.9			
			Maximum	3.31 ± 5.78	30.5 ± 21.3			
			Average	0.42 ± 4.28	2.9 ± 18.1			
			Standard Deviation	1.41 ± 0.53	12.6 ± 1.6			
			Count	18	18			

Note: 1) All samples analyzed using the Tennelec gas-flow proportional counting system.
2) All coordinate data are listed in feet.
3) [Refer to Section VI, Survey and Sampling Design for complete description of coordinate system].

APPENDIX K:

SAMPLE IDENTIFICATION MATRIX

TABLE K.1 Sample Identification Matrix

			ACL	Gross	Requested Sample Analyses									Sample
Type	Room	Location	No.	$\alpha\beta\gamma$	γ spec	α spec	Pure β	VOC	SVOC	PCB	pH	Hg	Metal	Date
Oil sample	A-011	Vac. pumps 1 & 2	3ACL	x	x	-	-	-	-	x	-	x	x	10/01/97
Hydraulic fluid	A-020/ B-012	hydraulic sys	6ACL	x	x	-	-	-	-	x	-	x	x	10/01/97
Liquid	B-126	hood #1 poly bottle	10ACL	x	x	-	-	x	x	-	x	x	x	09/30/97
Water Sample	B-126	Sump area	11ACL	x	-	-	-	x	x	-	x	x	x	-
Oil Sample	C-001	vacuum pumps	13ACL	x	x	-	-	-	-	x	-	x	x	10/01/97
ZnBr\\H_2O	C-101	window	19ACL	x	x	-	x	-	-	-	x	x	x	10/01/97
H_2O	Control Room	viewing port	20ACL	x	x	-	-	-	-	-	x	x	x	10/01/97
Iron filings	Cyclotron	pole	21ACL			-	-						x	-
Drill shavings	Cyclotron	magnet face	23ACL			-	-							
Oil sample	Cyclotron	pumps 1&2	24ACL	x	x	-	-	-	-	x	x	x	x	10/07/97
Oil sample	Cyclotron	^{3}He pumps	25ACL	x	x	-	-	-	-	x	x	x	x	10/07/97
Smear	Cyclotron	Trimmer box	26ACL			-	-							-
Powder	Jr. Cave	all bottles, beakers	29ACL	x	x	-	-	-	-	-	-	x	x	09/30/97
H_2O Sample	Service Platform	manifold	31ACL	x	x	-	-	-	-	-	x	x	x	10/01/97
Oil Sample	Service Platform	1-2 vac pumps	32ACL	x	x	-	-	-	-	x	-	x	x	10/01/97
H_2O-Sludge	Tower	bottom	35ACL	x	x	-	-	x	x	x	x	x	x	09/24/97
Paraffin	Vault	vault lining	36ACL					Counted on Tennelec Scaler						
Wet-Crystals	B-126	Hood #1	37ACL	x	x	-	-	-	-	-	-	x	x	09/30/97
Liquid	B-126	Hood #1 bottle	38ACL	x	x	-	-	x	x	-	x	x	x	09/30/97
Liquid	B-126	1 liter glass bottle from 5 gallon waste container	39ACL	x	x	-	-	x	x	-	x	x	x	09/30/97

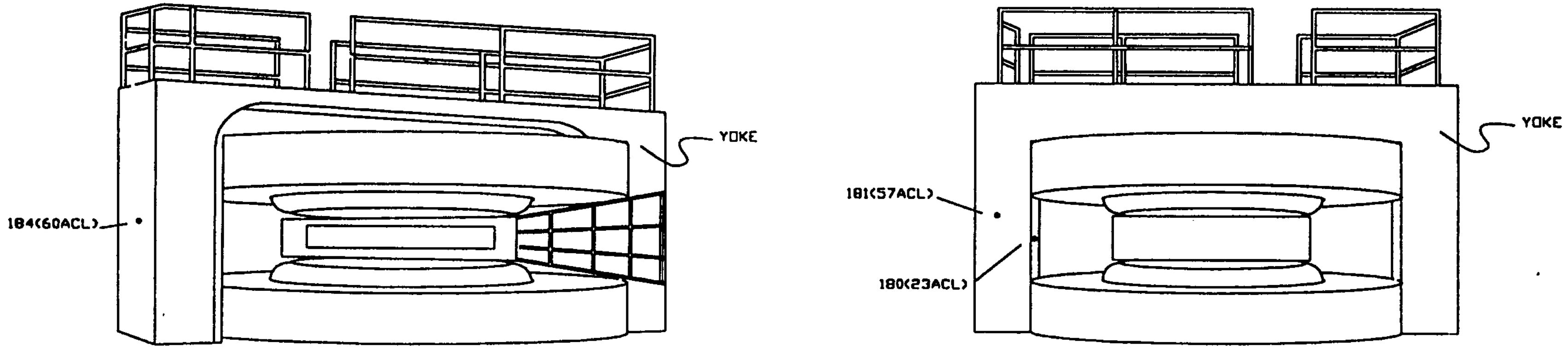
TABLE K.1 (Cont.)

					Requested Sample Analyses									
Type	Room	Location	ACL No.	Gross $\alpha\beta\gamma$	γ spec	α spec	Pure β	VOC	SVOC	PCB	pH	Hg	Metal	Sample Date
Solid-Crystals	B-126	Hood #1	40ACL	x	x	-	-	x	x	-	x	x	x	09/30/97
Liquid	B-126	Hood #1 ampules (3)	41ACL	x	x	-	-	x	x	-	x	x	x	09/30/97
Liquid	B-126	Scintillation Vials	42ACL	x	x	-	-	x	-	-	-	x	x	-
Liquid	B-126	Ferrous Ion Solution	43ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Liquid	B-126	$FeHSO_4$	44ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Liquid & Solid	B-126	Glass Wool	45ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Paste	B-126	Unknown Solid	46ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
1 wet, 3 dry	B-126	^{230}Th, ^{228}Th, ^{232}Th	47ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
1 wet, 2 dry	B-126	^{90}Sr vials	48ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Liquid	B-126	^{14}C Vial	49ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
2 wet, 2 dry	B-126	^{87}Y vials (4)	50ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Powder	B-126	^{14}C residue	51ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Liquid	B-126	(9) Scint. Vials	52ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Liquid	B-126	Lu-176	53ACL	x	x	Identify and quantify radioisotopes & chemical characteristics								-
Copper metal	C-101	Trimmer box cover	54ACL	-	x	-	x	-	-	-	-	-	-	11/25/97
Metal	C-101	Beam line bellows	55ACL	-	x	-	x	-	-	-	-	-	-	11/25/97
Smear	C-101	Trimmer box	56ACL	-	x	x	x	-	-	-	-	-	-	11/25/97
Iron filings	C-101	#181 on map	57ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#182 on map	58ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#183 on map	59ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#184 on map	60ACL	-	x	-	-	-	-	-	-	-	-	-

TABLE K.1 (Cont.)

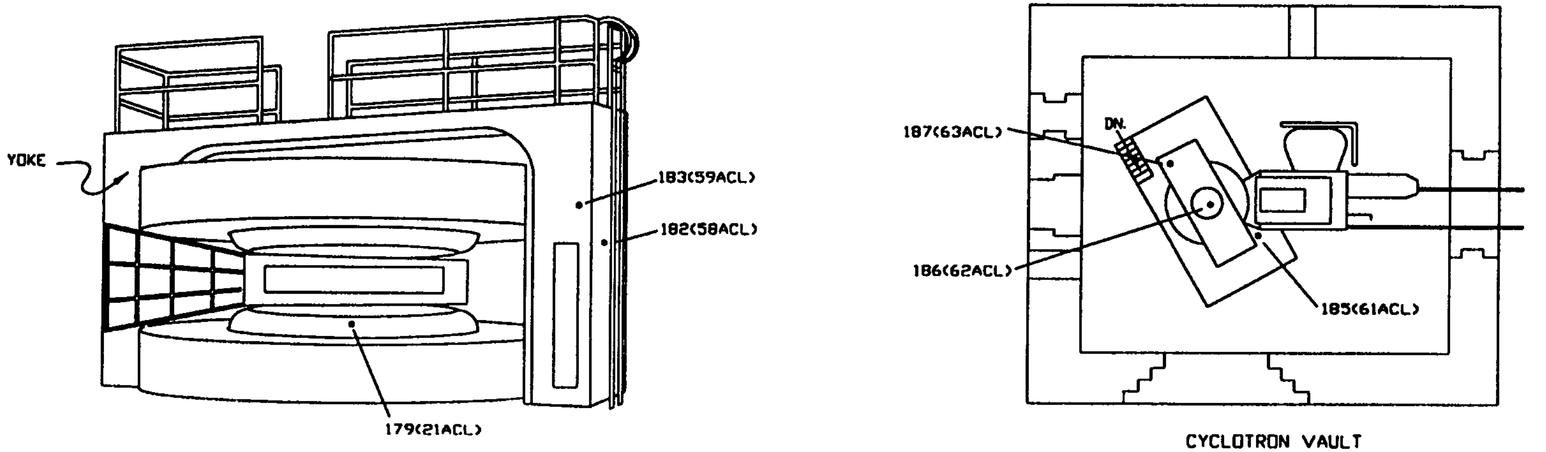
					Requested Sample Analyses									
Type	Room	Location	ACL No.	Gross αβγ	γ spec	α spec	Pure β	VOC	SVOC	PCB	pH	Hg	Metal	Sample Date
Iron filings	C-101	#185 on map	61ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#186 on map	62ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#187 on map	63ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#188 on map	64ACL	-	x	-	-	-	-	-	-	-	-	-
Iron filings	C-101	#189 on map	65ACL	-	x	-	-	-	-	-	-	-	-	-

Notes:
(1) x denotes requested sample analysis type
(2) Chemical analyses can be found in Appendix L.
(3) Radiological sample analyses can be found in Appendix H.
(4) Map on Page K-6 can be used to locate where Samples 57 ACL–65 ACL were taken.



SOUTH FACE

WEST FACE



NORTH FACE

CYCLOTRON VAULT

No. 188 & 189 WERE TAKEN FROM THE AREA OF THE YOKE UNDER THE CYCLOTRON ON THE SERVICE PLATFORM

IRON FILLING LOCATIONS

TABLE K.2 Description of Orphan Waste Samples from Cyclotron Facility

Sample ID	ACL #	Description
3ACL	98-8004-01	Wide mouth 6 oz. bottle containing oil transferred into 4 oz. poly bottle for γ-counting.
6ACL	98-8004-02	Wide mouth 6 oz. bottle containing very thick, heavy oil, which was transferred into 4 oz. poly bottle for γ-counting.
10ACL	98-8000-01	~100 mL viscous yellowish brown liquid in 4 oz. poly bottle with wide mouth.
11ACL	98-8016	Sump water from B126.
13ACL	98-8004-03	Wide mouth 6 oz. glass bottle containing oil, which was transferred into 4 oz. poly bottle for γ-counting.
19ACL	98-8005-01	C101 window liquid.
20ACL	98-8005-02	Control room window.
21ACL	98-8012-01	Metal turnings in 4 oz. poly bottle.
23ACL	98-8012-02	Metal turnings in 4 oz. poly bottle.
24ACL	98-8010-01	Used oil substance in 6 oz. wide mouth glass
25ACL	98-8010-02	Oil sample from helium pump
26ACL	98-8014-01	Smear from trimmer box.
29ACL	98-8002-01	Wide mouth low plastic dish with cover, containing glass beaker ~150 mL containing white crystalline salt. Beaker covered with duct tape. Survey shows 1.2 mR/h over open beaker; 155,000 dis/min β over open top and 24,000 dis/min βγ through glass.
31ACL	98-8005-03	Water from manifold on service floor.
35ACL	97-8258	At present ~120 mL in 4 oz. wide mouth poly bottle, ~volume 120 mL of clear liquid.
37ACL	98-8002-02	Large 2L plastic bottle containing wet crystallized substance. Both marked "ORGANIC".
38ACL	98-8001-01	2 L clear plastic bottle half full clear yellowish liquid. Bottle has writing where it says #40 ORGANIC, PBS 12/11/90 JT. PH20.
39ACL	98-8001-02	1 L glass narrow mouth bottle, sample taken from 5 gallon rad waste container in B-126 ~3 gallon of liquid with white residue on bottom.
40ACL	98-8001-03	~20 mL glass vial with small amount of solid crystalline yellowish substance in the bottom of vial. Total ~3.5 gram; γ dose rate of 0.5 mrem/h.

TABLE K.2 (Cont.)

Sample ID	ACL #	Description
41ACL	98-8001-04	Plastic envelope containing 3 items: (1) a 50 mL conical plastic centrifuge tube with sealed stol ampule inside containing liquid. Some liquid appears to be on the outside of glass ampule even though the ampule does not appear to be open. (2) 20 mL glass scintillation vial containing open glass ampule containing liquid in and outside of ampule. (3) 15 mL plastic conical tube with a "drop" of viscous yellowish liquid at bottom of tube. Writing on tube "Filter B-212."
42ACL	98-8013-01	1 qt. mason jar full of composite from scintillation vials. Very viscous yellowish gelatinous substance. Survey tag shows 5,000 dpm γ.
43ACL	98-8015-01	1/2 liter glass reagent bottle with solid glass stopper. Bottle containing reddish brown solution ~1/2 full. Markings on bottle. Ferrous Ion 10 mg/mL in H_2O L.W. 6/10/91.
44ACL	98-8015-02	~250 mL glass reagent bottle w/solid glass stopper containing reddish brown liquid with yellowish residue. Markings on bottle: $Fe^{++}SO_4$ from $FeSO_4$.
45ACL	98-8015-03	500 mL plastic bottle with loose β contamination inside plastic bag. Survey shows ~600 d/m β. Bottle markings: 3 M nitric acid leached glass wool now. Sitting in H_2O 3-15-91 RB.
46ACL	98-8015-04	1 qt. mason jar with 50 mL centrifuge tube inside. The tube contains dark brown solid at bottom, which turned out to be rubber septum. Survey shows 6 R/h $\beta\gamma$, 2.5 mR/h γ contact with 0.4 mR/h $\beta\gamma$ at 1 ft.
47ACL	98-8015-05	Large plastic zipper bag with smaller bag inside. Small bag contains 2 small plastic vials both marked ^{228}Th. Smaller of the two vials in 7,000 dis/min $\beta\gamma$. 2-15 mL conical centrifuge tube also inside larger plastic bag. One stopped with blue screw cap containing yellowish liquid of ^{232}Th and second stoppered with cork stopper is dry and small speck of yellow at bottom of tube and vial appears to be marked as ^{230}Th.
48ACL	98-8015-06	One 15 mL tube and 50 mL centrifuge tube with ~20 mL liquid both wrapped in plastic zipper bag. Bag was marked as ^{90}Sr/^{90}Y; 150 mR/h $\beta\gamma$ and 0.2 mR/h $\beta\gamma$. 150 mL dry vial, ^{90}Sr 1 mR/h γ, 200 mR/h $\beta\gamma$ in plastic bag.
49ACL	98-8015-07	Small plastic zippered bag containing 50 mL centrifuge tube. Tube is marked C-14 SCNBZDTPA and contains ~20 mL clear liquid.
50ACL	98-8015-08	Large zippered plastic bag with four 50 mL plastic centrifuge tubes, inside each tube in small ion exchange column two of which contain ~10 mL of liquid. The plastic bag is also wet, contaminated?
51ACL	98-8015-09	Large zippered plastic bag with one 50 mL centrifuge tube w/screw cap. Inside the tube is another vial and some brownish powder. Markings on tube: NC1-Ba cdta ^{14}C?

TABLE K.2 (Cont.)

Sample ID	ACL #	Description
52ACL	98-8015-10	9-20 mL glass scintillation vials wrapped in a plastic bag. Some vials have markings indicating ^{90}Sr, ^{90}Y. 11,000 dis/min α and loose contamination on exterior of vials 4,000 dis/min βγ.
53ACL	98-8015-11	Small plastic bag with glass beaker (30 mil) w/small volumetric flask. Dark brown viscous liquid inside the flask. Beaker marked as Lu-176.

Notes: (1) Sample 32 ACL was combined with another oil sample.
(2) Sample 36 ACL was a paraffin sample counted using the Tennelec gas-flow proportional counting system.
(3) Samples 54 ACL, 55 ACL, and 57-65 ACL were all metal samples.
(4) Sample 56 ACL was a smear taken of the trimmer box.

APPENDIX L:

CHEMICAL SAMPLE ANALYSES

TABLE L.1 Summary of Oil Sample Analysis

Contaminant	3 ACL	6 ACL	13 ACL	24 ACL	25 ACL	32 ACL
Ba (µg/g)	<5	<5	<5	<5	<5	31.6
Cd (µg/g)	<3	<3	<3	15.8	8.4	<3
Pb (µg/g)	<50	<50	77.9	<50	<50	<50
Hg (µg/g)	0.02	0.33	0.01	<0.02	4.7	0.03
Aroclor 1016/1242 (ppb)	1,780	20,140	1,750	1,020	940	3,990
Gross α (pCi/g)	<0.3	<0.4	<0.3	<4	<4	<0.3
Gross β (pCi/g)	<0.4	0.8 " 0.3	<0.4	<7	<7	<0.4
^{214}Bi (pCi/g)	1.1 ± 0.11	<0.2	<0.2			<0.2
^{226}Ra (pCi/g)	0.79 ± 0.08	<0.2	<0.2			<0.2
^{232}Th (pCi/g)	0.67 ± 0.07	<0.2	0.21 ± 0.02			<0.2
^{137}Cs (pCi/g)	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
^{60}Co (pCi/g)				<0.2	<0.2	
^{241}Am (pCi/g)				<0.2	<0.2	

TABLE L.2 Summary of Aqueous Solution Analyses

Contaminant	11 ACL-M	19 ACL	20 ACL	31 ACL	35 ACL-M
pH	5.43 and rising	6.95 " 0.05	7.73 " 0.05	6.75 " 0.05	5.87 6 8.40 and rising
Ba (μg/mL)	<0.02	10.0	<0.02	<0.02	0.26
Cd (μg/mL)	0.11	0.10	<0.01	0.07	<0.01
Cr (μg/mL)	0.14	0.06	<0.01	0.90	1.00
Pb (μg/mL)	<0.20	0.55	<0.20	1.08	0.40
Ag (μg/mL)	<0.02	<0.02	<0.02	0.06	0.03
Hg (μg/L)	5.73	2.10	1.00	2.15	<0.04
bis(2-ethylhexyl) phthalate (μg/L)	in blank				40.6
Gross α (pCi/mL)	0.6 ± 0.2	<0.1	<0.1	<0.2	0.89 ± 0.09
Gross β (pCi/mL)	<0.3	<0.3	<0.3	0.4 ± 0.2	0.44 ± 0.04
^{214}Bi (pCi/mL)	N/A	<0.2	<0.2	0.60 ± 0.06	<0.2
^{226}Ra (pCi/mL)	N/A	<0.2	<0.2	0.40 ± 0.04	<0.2
^{232}Th (pCi/mL)	N/A	<0.2	<0.2	0.59 ± 0.06	
^{137}Cs (pCi/mL)	N/A	<0.2	<0.2	<0.2	<0.2
^{228}Th (pCi/mL)					<0.2
^{3}H (pCi/mL)		<5			

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Oils
Date Received: 10/2/97
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Reported: 10/6/97

Submitter's Sample No.	ACL Sample No.	Hg (µg/g)
3 ACL	98-8004-01	0.02
6 ACL	-02	0.33
13 ACL	-03	0.01
32 ACL	-04	0.03
	Blank	<0.005

ICV 81897:	1.17 µg/L	Recovery:	93.6%
	1.22		97.4
	1.32		105
	1.36		109

Known concentration of ICV 81897 = 1.25 µg/L.

NOTE: Mercury was determined by Cold Vapor Atomic Absorption (CVAA) according to U.S. EPA Method 7470A, SW-846. Samples were digested according to SOP: ACL-214 (microwave).

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. TenKate at 2- 7398 .

Reference(s): CMT Notebook No. 1262, p. 149 (Hg); CMT Notebook No. 1448, p. 154 (Digestion).

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
P. Lindahl
F. Martino
ACL 200 File

Analyst(s): A. Essling
L. TenKate

L. TenKate

/amb
10/7/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

ICP-AES Analysis Report

Spec. No.: 58959

Sample Material: Oil

Submitted by: Dolores Geraghty ESH/HP-200 Date Received:10-02-97

Reporting Units: ug/g Date Reported:10-13-97

ACL Number	Your Number	As	Ba	Cd	Cr	Pb	Se	Ag		
98-8004-01	3ACL	<50.	<5.	<3.	<3.	<50.	<50.	<5.		
98-8004-02	6ACL	<50.	<5.	<3.	<3.	<50.	<50.	<5.		
98-8004-03	13ACL	<50.	<5.	<3.	<3.	77.9	<50.	<5.		
98-8004-04	32ACL	<50.	31.6	<3.	<3.	<50.	<50.	<5.		

NOTE: Samples will be discarded one (1) month after date of report unless otherwise arranged. When making future inquiries regarding this work, you must reference **OUR** number(s) above. For further information about the results reported here, please call E. A. Huff at extension 2-3633.
Reference Number: AE Notebook No.1448-p.154,155

Estimated Accuracy:+/-20%

Copies To: D. Geraghty, C. Sholeen, M. Robinet, A. Essling, ACL Office, D. Graczyk, D. Green, F. Martino

Analyst(s): E. Huff, D. Huff, A. Essling

Remarks:

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	Oil	Date Received:	10/2/97
Submitted by:	Dolores Geraghty, ESH/HP, 200	Date Reported:	11/18/97

Submitter's Sample No.	ACL Sample No.	PCB Analysis
3ACL	98-8004-01	1780 ppb Aroclor 1016/1242
6ACL	-02	20,140 ppb Aroclor 1016/1242
13ACL	-03	1750 ppb Aroclor 1016/1242
32ACL	-04	3990 ppb Aroclor 1016/1242
		Accuracy = ± 20% Precision = ± 10%
		NOTE: Sample preparation was based on EPA-Method 3580A (SW-846, Revision 1, July 1992). Sample analysis was based on EPA-Method 8081 (SW-846, Revision 0, September 1994) for the determination of polychlorinated biphenyls (PCBs) as Aroclors. Surrogate recoveries are within QC limits. Surrogate recovery limits are based upon limits established by CLP.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Chromizky at 2- 7732 .

Reference(s): Data Recorded in Logbook No. 1403, pp. 158-159; and File Folder in Cabinet in R-129: "PCB Samples \data\1\110797."

Copies To:
C. Sholeen
M. Robinet
D. Geraghty
D. Green
A. Boparai
F. Martino
L. Chromizky

Analyst(s): L. Chromizky

/lac
11/19/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

ICP-AES Analysis Report

Spec. No.: 58999

Sample Material: Liquid

Submitted by: Dolores Geraghty ESH/HP-200 Date Received:10-16-97

Reporting Units: ug/mL Date Reported:11-26-97

ACL Number	Your Number	As	Ba	Cd	Cr	Pb	Se	Ag		
98-8016-01	11ACL-M	<0.20	<0.02	0.11	0.14	<0.20	<0.20	<0.02		

NOTE: Samples will be discarded one (1) month after date of report unless otherwise arranged. When making future inquiries regarding this work, you must reference **OUR** number(s) above. For further information about the results reported here, please call E. A. Huff at extension 2-3633. Reference Number: LT Notebook No.1257-p.103

Estimated Accuracy:+/-20%

Copies To:
- D. Geraghty
- C. Sholeen
- M. Robinet
- L. TenKate
- ACL Office
- D. Green
- D. Graczyk
- F. Martino

Analyst(s):
- E. Huff
- D. Huff
- L. TenKate

Remarks:

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Liquid
Submitted by: Dolores Geraghty, ESH, 200
Date Received: 10/16/97
Date Reported: 11/11/97

Submitter's Sample No.	ACL Sample No.	pH[a]
11ACL-M	98-8016-01[b]	5.43 and rising

---

[a] pH was determined in accordance with U.S. EPA Method 9040B, SW-846 Update IIB, January 1995, "pH Electrometric Measurement."

[b] A stable pH reading could not be obtained for this sample, indicating that the sample is deionized. The lowest observed pH value was 5.43 and the pH was rising rapidly when readings were terminated.

Calibration Verification Standard Results:

	Initial	Final
pH 7.00 Buffer	6.99	7.01
pH 4.00 Buffer	4.00	4.00

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. TenKate at 2- 7398 .

Reference(s): CMT Notebook No. 1491, p. 11.

Copies To: D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
F. Martino
ACL 200 File

Analyst(s): L. TenKate

L. TenKate

/amb
11/12/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Water
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/16/97
Date Reported: 11/25/97

Submitter's Sample No.	ACL Sample No.	Volatile Organic Analysis (VOA)
11ACL-V	98-8018-01	Analysis of this sample for volatile organics was performed using method 8260 in the U.S. EPA Document SW-846 (Third Edition). Attached are CLP (Contract Laboratory Program)-type reporting forms listing concentration of Method 8260 target compounds and a recovery report for surrogate compounds with which the sample was spiked. The EPA-defined qualifier used on the data sheet is defined as follows: U - Indicates compound was analyzed for, but not detected above the give quantitation limit.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Chromizky at 2- 7732 .

Reference(s): Data Recorded in Logbook No. 1418, pg. 65; and File Folder in Cabinet Located in Room E-127A.

Copies To:
C. Sholeen
M. Robinet
D. Geraghty
D. Green
D. Graczyk
A. Boparai
F. Martino
L. Chromizky

Analyst(s): L. Chromizky

/lac
11/26/97
CMT-84 (9-96)

Data File: /users/chem/msd1.i/1oct297.b/988018.d
Report Date: 25-Nov-1997 13:12

Page 1

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-V
Sample Location: building 211
Lab Sample ID: 98-8018-01A
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 11ACL-V

Client SDG: 1oct297.b
Sample Date: 10/16/97
Sample Point: cyclotron
Date Received: 10/16/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-71-8	DICHLORODIFLUOROMETHANE	10.0	U
74-87-3	CHLOROMETHANE	10.0	U
75-01-4	VINYL CHLORIDE	10.0	U
74-83-9	BROMOMETHANE	10.0	U
75-00-3	CHLOROETHANE	10.0	U
75-69-4	TRICHLOROFLUOROMETHANE	10.0	U
75-35-4	1 1-DICHLOROETHENE	10.0	U
75-09-2	METHYLENE CHLORIDE	10.0	U
156-60-5	TRANS-1 2-DICHLOROETHENE	10.0	U
75-34-3	1 1-DICHLOROETHANE	10.0	U
594-20-7	2 2-DICHLOROPROPANE	10.0	U
156-59-2	CIS-1,2-DICHLOROETHENE	10.0	U
74-97-5	BROMOCHLOROMETHANE	10.0	U
67-66-3	CHLOROFORM	10.0	U
71-55-6	1 1 1-TRICHLOROETHANE	10.0	U
56-23-5	CARBON TETRACHLORIDE	10.0	U
563-58-6	1 1-DICHLOROPROPENE	10.0	U
71-43-2	BENZENE	10.0	U
107-06-2	1 2-DICHLOROETHANE	10.0	U
79-01-6	TRICHLOROETHENE	10.0	U
78-87-5	1 2-DICHLOROPROPANE	10.0	U
74-95-3	DIBROMOMETHANE	10.0	U
75-27-4	BROMODICHLOROMETHANE	10.0	U
10061-02-06	CIS-1 3-DICHLOROPROPENE	10.0	U
108-88-3	TOLUENE	10.0	U
10061-01-05	TRANS-1 3-DICHLOROPROPENE	10.0	U
79-00-5	1 1 2-TRICHLOROETHANE	10.0	U
127-18-4	TETRACHLOROETHENE	10.0	U
142-28-9	1 3-DICHLOROPROPANE	10.0	U
124-48-1	DIBROMOCHLOROMETHANE	10.0	U
106-93-4	1 2-DIBROMOETHANE	10.0	U
108-90-7	CHLOROBENZENE	10.0	U
630-20-6	1 1 1 2-TETRACHLOROETHANE	10.0	U
100-41-4	ETHYL BENZENE	10.0	U
----------------	m&p-XYLENE	10.0	U
95-47-6	o-XYLENE	10.0	U
100-42-5	STYRENE	10.0	U

Data File: /users/chem/msd1.i/1oct297.b/988018.d
Report Date: 25-Nov-1997 13:12

Page 2

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-V
Sample Location: building 211
Lab Sample ID: 98-8018-01A
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 11ACL-V

Client SDG: 1oct297.b
Sample Date: 10/16/97
Sample Point: cyclotron
Date Received: 10/16/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-25-2	BROMOFORM	10.0	U
98-82-8	ISOPROPYLBENZENE	10.0	U
108-86-1	BROMOBENZENE	10.0	U
79-34-5	1 1 2 2-TETRACHLOROETHANE	10.0	U
96-18-4	1 2 3-TRICHLOROPROPANE	10.0	U
103-65-1	n PROPYLBENZENE	10.0	U
95-49-8	2 CHLOROTOLUENE	10.0	U
95-49-8	4 CHLOROTOLUENE	10.0	U
108-67-8	1 3 5-TRIMETHYLBENZENE	10.0	U
98-06-6	TERT BUTYLBENZENE	10.0	U
95-63-6	1,2,4-TRIMETHYLBENZENE	10.0	U
135-98-8	SEC-BUTYLBENZENE	10.0	U
541-73-1	1 3 DICHLOROBENZENE	10.0	U
106-46-7	1 4 DICHLOROBENZENE	10.0	U
99-87-6	p ISOPROPYLTOLUENE	10.0	U
95-50-1	1 2-DICHLOROBENZENE	10.0	U
104-51-8	n BUTYLBENZENE	10.0	U
96-12-8	1 2-DIBROMO-3-CHLOROPROPANE	10.0	U
120-82-1	1 2 4-TRICHLOROBENZENE	10.0	U
87-68-3	HEXACHLOROBUTADIENE	10.0	U
91-20-3	NAPHTHALENE	10.0	U
87-61-6	1 2 3-TRICHLOROBENZENE	10.0	U

```
Data File: /users/chem/msd1.i/1oct297.b/988018.d
Report Date: 25-Nov-1997 13:12
```

Page 3

```
                              RECOVERY REPORT

Client Name: D. Geraghty                  Client SDG: 1oct297.b
Sample Matrix: LIQUID                     Fraction: VOA
Client ID: 11ACL-V                        Level: LOW
Data Type: MS DATA                        SampleType: SAMPLE
SpikeList File: CLPSOILMS.spk             Quant Type: ISTD
Method File: /users/chem/msd1.i/1oct297.b/rcrav2.m
Misc Info: 11ACL-V

| SURROGATE COMPOUND         | AMOUNT  |  AMOUNT   |     %     | LIMITS |
|                            | ADDED   | RECOVERED | RECOVERED |        |
|                            | ug/L    |   ug/L    |           |        |
|----------------------------|---------|-----------|-----------|--------|
| $  16 DIBROMOFLUOROMETHA   |   50.0  |     49.6  |    99.18  | 86-118 |
| $  28 TOLUENE d-8          |   50.0  |     50.6  |   101.23  | 88-110 |
| $  45 4 BROMOFLUOROBENZE   |   50.0  |     49.4  |    98.79  | 86-115 |
|----------------------------|---------|-----------|-----------|--------|

* - Values outside of QC limits
Spike Recovery: 0 out of 3 outside limits
                0 out of 3 not found
```

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Water
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/16/97
Date Reported: 11/26/97

Submitter's Sample No.	ACL Sample No.	Semivolatile Organic Results		
		Semivolatile Target Compound	Concentration (µg/L)	Q
	Lab Blank (97-1029)	Di-n-butylphthalate bis(2-Ethylhexyl)phthalate	27.4 3.4	 J
11ACL-S	98-8017-01	Di-n-butylphthalate bis(2-Ethylhexyl)phthalate	27.3 3.5	B BJ

NOTE: Sample preparation is based on EPA-Method 3510 (SW-846, Revision 1, July 1992). The analytical method used is based on EPA-Method 8270A (SW-846, Revision 1, July 1992) for determination of semivolatile organic compounds. The attached data sheets contain data for one sample and one laboratory blank. The surrogate recoveries are within QC limits for 12 out of 12 values reported.

For some of the compounds found in the sample that are not on the semivolatile target compound list, table of tentatively identified compounds (TICs) is included. TICs were identified by library search. Quantitation is carried out using total ion chromatogram peak area compared to the peak area of the nearest internal standard.

The EPA-defined qualifier to be used on the data sheets is as follows:

U - Indicates compound was analyzed for, but not detected above the given quantitation limit.

J - Indicates an estimated value. This flag is used under the following circumstances: (1) when estimating a concentration for tentatively identified compounds (TICs) where a 1:1 response is assumed, (2) when the mass spectral and retention time data indicate the presence of a compound that meet the SV GC/MS identification criteria, and the results is less than the estimated quantitation limit, but greater then zero.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call Y. Tsai at 2- 7732 .

Reference(s): GC/.MSD-2 Run Logbook No. 2, pg. 59.

Copies To: D. Geraghty
C. Sholeen
M. Robinet
D. Green
A. Boparai
D. Graczyk
F. Martino
Y. Tsai

Analyst(s): Y. Tsai
YT

Attachment
(10 Pages)

/lac
12/01/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Water
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/16/97
Date Reported: 11/26/97

Submitter's Sample No.	ACL Sample No.	Semivolatile Organic Results
		Semivolatile Target Compound — Concentration (µg/L) — Q N - Indicates presumptive evidence of a compound. This flag is only used for TICs where the identification is based on a mass spectral library search. B - This flag is used when the analyte is found in the associated blank as well as the sample. It indicates possible blank contamination.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call Y. Tsai at 2- 7732 .

Reference(s): GC/.MSD-2 Run Logbook No. 2, pg. 59.

Copies To: D. Geraghty, C. Sholeen, M. Robinet, D. Green, A. Boparai, D. Graczyk, F. Martino, Y. Tsai

Analyst(s): Y. Tsai

Attachment
(10 Pages)

/lac
12/01/97
CMT-84 (9-96)

Data File: /data/msd2.i/2nov257.b/0101001.d
Report Date: 25-Nov-1997 13:18

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: Lab Blank, 97-1029
Sample Location:
Lab Sample ID: Lab Blank, 97-1029
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	10.0	U
109-06-8	2-Picoline	10.0	U
66-27-3	Methyl methansulfonate	20.0	U
62-50-0	Ethyl methansulfonate	10.0	U
62-53-3	Aniline	10.0	U
108-95-2	Phenol	10.0	U
95-57-8	2-Chlorophenol	10.0	U
111-44-4	bis(2-Chloroethyl)ether	10.0	U
541-73-1	1,3-Dichlorobenzene	10.0	U
106-46-7	1,4-Dichlorobenzene	10.0	U
95-50-1	1,2-Dichlorobenzene	10.0	U
100-51-6	Benzyl alcohol	10.0	U
95-48-7	2-Methylphenol	10.0	U
108-60-1	bis(2-Chloroisopropyl)ether	10.0	U
98-86-2	Acetophenone	10.0	U
621-64-7	N-nitroso-di-n-propylamine	10.0	U
106-44-5	4-Methylphenol	10.0	U
67-72-1	Hexachloroethane	10.0	U
98-95-3	Nitrobenzene	10.0	U
100-75-4	N-Nitrosopiperidine	10.0	U
78-59-1	Isophorone	10.0	U
88-75-5	2-Nitrophenol	10.0	U
105-67-9	2,4-Dimethyphenol	10.0	U
111-91-1	bis(2-Chloroethoxy)methane	10.0	U
120-83-2	2,4-Dichlorophenol	10.0	U
65-85-0	Benzoic acid	10.0	U
120-82-1	1,2,4-Trichlorobenzene	10.0	U
91-20-3	Naphthalene	10.0	U
122-09-8	a,a-Dimethylphenethylamine	20.0	U
87-65-0	2,6-Dichlorophenol	10.0	U
106-47-8	4-Chloroaniline	10.0	U
87-68-3	Hexachlorobutadiene	10.0	U
924-16-3	N-Nitrosodibutylamine	10.0	U
59-50-7	4-Chloro-3-methylphenol	10.0	U
91-57-6	2-Methylnaphthalene	10.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	10.0	U
77-47-4	Hexachlorocyclopentadiene	20.0	U

Data File: /data/msd2.i/2nov257.b/0101001.d
Report Date: 25-Nov-1997 13:18

2

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: Lab Blank, 97-1029
Sample Location:
Lab Sample ID: Lab Blank, 97-1029
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	10.0	U
95-95-4	2,4,5-Trichlorophenol	10.0	U
91-58-7	2-Chloronaphthalene	10.0	U
90-13-1	1-Chloronaphthalene	10.0	U
88-74-4	2-Nitroaniline	10.0	U
131-11-3	Dimethyl phthalate	10.0	U
208-96-8	Acenaphthylene	10.0	U
606-20-2	2,6-Dinitrotoluene	10.0	U
----------------	3-Nitroaniline	10.0	U
83-32-9	Acenaphthene	10.0	U
51-28-5	2,4-Dinitrophenol	20.0	U
608-93-5	Pentachlorobenzene	10.0	U
132-64-9	Dibenzofuran	10.0	U
100-02-7	4-Nitrophenol	20.0	U
121-14-2	2,4-Dinitrotoluene	10.0	U
91-59-8	2-Napthylamine	10.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	10.0	U
134-32-7	1-Naphthylamine	10.0	U
86-73-7	Fluorene	10.0	U
84-66-2	Diethylphthalate	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	10.0	U
100-01-6	4-Nitroaniline	10.0	U
534-52-1	4,6-Dinitro-2-methylphenol	10.0	U
----------------	N-NitrosoDPA & Diphenylamine	5.00	U
122-66-7	1,2-Diphenylhydrazine	10.0	U
101-55-3	4-Bromophenyl phenyl ether	10.0	U
118-74-1	Hexachlorobenzene	10.0	U
62-44-2	Phenacetin	10.0	U
87-86-5	Pentachlorophenol	10.0	U
82-68-8	Pentachloronitrobenzene	10.0	U
92-67-1	4-Aminobiphenyl	10.0	U
23950-58-5	Pronamide	10.0	U
85-01-8	Phenanthrene	10.0	U
120-12-7	Anthracene	10.0	U
84-74-2	Di-n-butylphthalate	27.4	
206-44-0	Fluoranthene	10.0	U
92-87-5	Benzidine	20.0	U

Data File: /data/msd2.i/2nov257.b/0101001.d
Report Date: 25-Nov-1997 13:18

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: Lab Blank, 97-1029
Sample Location:
Lab Sample ID: Lab Blank, 97-1029
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	10.0	U
60-11-7	p-Dimethylaminoazobenzene	10.0	U
85-68-7	Butylbenzylphthalate	10.0	U
56-55-3	Benzo(a)anthracene	10.0	U
91-94-1	3,3'-Dichlorobenzidine	10.0	U
218-01-9	Chrysene	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	3.40	J
117-84-0	Di-n-octylphthalate	10.0	U
205-99-2	Benzo(b)fluoranthene	10.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	10.0	U
207-08-9	Benzo(k)fluoranthene	10.0	U
50-32-8	Benzo(a)pyrene	10.0	U
56-49-5	3-Methylcholanthrene	10.0	U
224-42-0	Dibenz(a,j)acridine	10.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.0	U
53-70-3	Dibenzo(a,h)anthracene	10.0	U
191-24-2	Benzo(g,h,i)perylene	10.0	U
=====	=====	=====	=====
367-12-4	2-Fluorophenol	88.8	
4165-62-2	Phenol-d5	77.8	
4165-60-0	Nitrobenzene-d5	81.0	
321-60-8	2-Fluorobiphenyl	78.4	
118-79-6	2,4,6-Tribromophenol	127	
98904-43-9	Terphenyl-d14	87.0	

4

Data File: /data/msd2.i/2nov257.b/0101001.d
Report Date: 25-Nov-1997 13:18

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: Lab Blank, 97-1029
Data Type: MS DATA
SpikeList File: HPMSS.spk
Method File: /data/msd2.i/2nov257.b/yt8270.m
Misc Info:

Client SDG: 2nov257.b
Fraction: SV
Level: LOW
SampleType: BLANK
Quant Type: ISTD

SURROGATE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
$ 4 2-Fluorophenol	200	88.8	44.41	21-100
$ 7 Phenol-d5	200	77.8	38.91	10-94
$ 22 Nitrobenzene-d5	100	81.0	80.97	35-114
$ 45 2-Fluorobiphenyl	100	78.4	78.37	43-116
$ 70 2,4,6-Tribromophen	200	127	63.34	10-123
$ 85 Terphenyl-d14	100	87.0	86.97	33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 6 outside limits
0 out of 6 not found

Data File: /data/msd2.i/2nov257.b/988017.d
Report Date: 25-Nov-1997 13:55

5

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-S
Sample Location:
Lab Sample ID: 98-8017-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	10.0	U
109-06-8	2-Picoline	10.0	U
66-27-3	Methyl methansulfonate	20.0	U
62-50-0	Ethyl methansulfonate	10.0	U
62-53-3	Aniline	10.0	U
108-95-2	Phenol	10.0	U
95-57-8	2-Chlorophenol	10.0	U
111-44-4	bis(2-Chloroethyl)ether	10.0	U
541-73-1	1,3-Dichlorobenzene	10.0	U
106-46-7	1,4-Dichlorobenzene	10.0	U
95-50-1	1,2-Dichlorobenzene	10.0	U
100-51-6	Benzyl alcohol	10.0	U
95-48-7	2-Methylphenol	10.0	U
108-60-1	bis(2-Chloroisopropyl)ether	10.0	U
98-86-2	Acetophenone	10.0	U
621-64-7	N-nitroso-di-n-propylamine	10.0	U
106-44-5	4-Methylphenol	10.0	U
67-72-1	Hexachloroethane	10.0	U
98-95-3	Nitrobenzene	10.0	U
100-75-4	N-Nitrosopiperidine	10.0	U
78-59-1	Isophorone	10.0	U
88-75-5	2-Nitrophenol	10.0	U
105-67-9	2,4-Dimethyphenol	10.0	U
111-91-1	bis(2-Chloroethoxy)methane	10.0	U
120-83-2	2,4-Dichlorophenol	10.0	U
65-85-0	Benzoic acid	10.0	U
120-82-1	1,2,4-Trichlorobenzene	10.0	U
91-20-3	Naphthalene	10.0	U
122-09-8	a,a-Dimethylphenethylamine	20.0	U
87-65-0	2,6-Dichlorophenol	10.0	U
106-47-8	4-Chloroaniline	10.0	U
87-68-3	Hexachlorobutadiene	10.0	U
924-16-3	N-Nitrosodibutylamine	10.0	U
59-50-7	4-Chloro-3-methylphenol	10.0	U
91-57-6	2-Methylnaphthalene	10.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	10.0	U
77-47-4	Hexachlorocyclopentadiene	20.0	U

Data File: /data/msd2.i/2nov257.b/988017.d
Report Date: 25-Nov-1997 13:55

6

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-S
Sample Location:
Lab Sample ID: 98-8017-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	10.0	U
95-95-4	2,4,5-Trichlorophenol	10.0	U
91-58-7	2-Chloronaphthalene	10.0	U
90-13-1	1-Chloronaphthalene	10.0	U
88-74-4	2-Nitroaniline	10.0	U
131-11-3	Dimethyl phthalate	10.0	U
208-96-8	Acenaphthylene	10.0	U
606-20-2	2,6-Dinitrotoluene	10.0	U
---------	3-Nitroaniline	10.0	U
83-32-9	Acenaphthene	10.0	U
51-28-5	2,4-Dinitrophenol	20.0	U
608-93-5	Pentachlorobenzene	10.0	U
132-64-9	Dibenzofuran	10.0	U
100-02-7	4-Nitrophenol	20.0	U
121-14-2	2,4-Dinitrotoluene	10.0	U
91-59-8	2-Napthylamine	10.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	10.0	U
134-32-7	1-Naphthylamine	10.0	U
86-73-7	Fluorene	10.0	U
84-66-2	Diethylphthalate	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	10.0	U
100-01-6	4-Nitroaniline	10.0	U
534-52-1	4,6-Dinitro-2-methylphenol	10.0	U
---------	N-NitrosoDPA & Diphenylamine	5.00	U
122-66-7	1,2-Diphenylhydrazine	10.0	U
101-55-3	4-Bromophenyl phenyl ether	10.0	U
118-74-1	Hexachlorobenzene	10.0	U
62-44-2	Phenacetin	10.0	U
87-86-5	Pentachlorophenol	10.0	U
82-68-8	Pentachloronitrobenzene	10.0	U
92-67-1	4-Aminobiphenyl	10.0	U
23950-58-5	Pronamide	10.0	U
85-01-8	Phenanthrene	10.0	U
120-12-7	Anthracene	10.0	U
84-74-2	Di-n-butylphthalate	27.3	
206-44-0	Fluoranthene	10.0	U
92-87-5	Benzidine	20.0	U

Data File: /data/msd2.i/2nov257.b/988017.d
Report Date: 25-Nov-1997 13:55

7

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-S
Sample Location:
Lab Sample ID: 98-8017-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	10.0	U
60-11-7	p-Dimethylaminoazobenzene	10.0	U
85-68-7	Butylbenzylphthalate	10.0	U
56-55-3	Benzo(a)anthracene	10.0	U
91-94-1	3,3'-Dichlorobenzidine	10.0	U
218-01-9	Chrysene	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	10.0	U
117-84-0	Di-n-octylphthalate	3.49	J
205-99-2	Benzo(b)fluoranthene	10.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	10.0	U
207-08-9	Benzo(k)fluoranthene	10.0	U
50-32-8	Benzo(a)pyrene	10.0	U
56-49-5	3-Methylcholanthrene	10.0	U
224-42-0	Dibenz(a,j)acridine	10.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.0	U
53-70-3	Dibenzo(a,h)anthracene	10.0	U
191-24-2	Benzo(g,h,i)perylene	10.0	U
==========	================	============	=====
367-12-4	2-Fluorophenol	84.2	
4165-62-2	Phenol-d5	56.5	
4165-60-0	Nitrobenzene-d5	81.4	
321-60-8	2-Fluorobiphenyl	77.9	
118-79-6	2,4,6-Tribromophenol	163	
98904-43-9	Terphenyl-d14	88.0	

Data File: /data/msd2.i/2nov257.b/988017.d
Report Date: 25-Nov-1997 13:55

TENTATIVELY IDENTIFIED COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 11ACL-S
Sample Location:
Lab Sample ID: 98-8017-01
Sample Matrix: WATER
Analysis Type: SV

Client SDG: 2nov257.b
Sample Date:
Sample Point:
Date Received:

Level: LOW

Number TICs found: 11

CONCENTRATION UNITS:
(ug/L or ug/KG) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	Unknown	10.350	1.91	J
2.	Unknown	10.478	1.98	J
3.	Unknown	17.068	1.86	J
4.	Unknown	21.836	1.13	J
5.	Unknown	22.920	1.66	J
6.	Unknown	31.413	4.49	J
7.	Unknown	33.786	2.82	J
8.	Unknown	34.154	4.86	J
9.	Unknown	34.224	3.22	J
10. 646-31-1	Tetracosane	34.881	2.57	NJ
11. 0-00-0	2,6,10,15,19,23-HEXAMETHYL -2,6,10,14,18,	38.229	2.62	NJ

Data File: /data/msd2.i/2nov257.b/988017.d
Report Date: 25-Nov-1997 13:55

9

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 11ACL-S
Data Type: MS DATA
SpikeList File: HPMSS.spk
Method File: /data/msd2.i/2nov257.b/yt8270.m
Misc Info:

Client SDG: 2nov257.b
Fraction: SV
Level: LOW
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
$ 4 2-Fluorophenol	200	84.2	42.11	21-100
$ 7 Phenol-d5	200	56.5	28.23	10-94
$ 22 Nitrobenzene-d5	100	81.4	81.37	35-114
$ 45 2-Fluorobiphenyl	100	77.9	77.95	43-116
$ 70 2,4,6-Tribromophen	200	163	81.65	10-123
$ 85 Terphenyl-d14	100	88.0	88.02	33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 6 outside limits
0 out of 6 not found

01

ARGONNE NATIONAL LABORATORY
ANALYTICAL CHEMISTRY LABORATORY

SEMIVOLATILE ORGANICS ANALYSIS BENCH SHEET
MATRIX: WATER

Bench Sheet Number ______

Sheet ______ of ______

ACL Sample Number	Customer Sample Number	Date Received	Sample Size, mL	pH	Extraction Date / Initial	Concentration Date / Initial	GPC [Y/N]	Extract Vol. A / BN	MS Analysis	Comments
97-1029	Lab Blank	–	1000 mL	6	10/29/97 YT	10/24/97 YT	N	1 mL	11/25/97	
98-8017-01	11ACL-S	10/16/97	1000 mL	6	"	"	N	1 mL	"	

Reagent Tracking:
$MeCl_2$ # B0090
Na_2SO_4 Lot 8034KMBJ
NaOH ______
H_2SO_4 ______

Standard Tracking:
1000 μL of Acid Surrogate Std # p.60 Book # 1078
1000 μL of Base Surrogate Std # ______
______ μL of Matrix Spike # ______
______ μL of Internal Std # ______

A = Acid 200 ug/mL
B = Base/Neutral 100 ug/mL

Extracts Transferred to: ______________ Date ______

CMT-94B (1/94)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Aqueous Solutions

Submitted by: Dolores Geraghty, ESH/HP, 200

Date Received: 10/1/97

Date Reported: 10/2/97

Submitter's Sample No.	ACL Sample No.	pH Measured at 25°C
19ACL	98-8005-01	6.95 ± 0.05
20ACL	-02	7.73 ± 0.05
31ACL	-03	6.75 ± 0.05
	-03 DUP	6.60 ± 0.10

SOP: ACL-014 was followed in the determination of the pH of the solutions.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call F. Smith at 2- 7980 .

Reference(s): F. Smith Notebook No. 1410, pg. 103.

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
F. Martino
ACL 200 File

Analyst(s): F. Smith

/lac
10/3/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS **REVISED REPORT 1/22/98***

Sample Material: Water

Submitted by: Dolores Geraghty, ESH/HP, 200

Date Received: 10/2/97

Date Reported: 10/14/97

Submitter's Sample No.	ACL Sample No.	µg/mL						
		As	Ba	Cd	Cr	Pb	Se	Ag
19 ACL	98-8005-01	<0.20	10.0	0.10	0.06	0.55	<0.20	<0.02
20 ACL	-02	<0.20	<0.02	<0.01	<0.01	<0.20	<0.20	<0.02
31 ACL	-03	<0.20	<0.02	0.07	0.90	1.08	<0.20	0.06
					QA Data			
	LCS 8005	Laboratory Control Sample:						
	Added:	5.00	10.0	1.00	1.00	5.00	1.00	1.00
	Found:	4.70	9.58	0.94	0.93	4.78	1.09	0.87
	% Recovery:	94.0	95.8	94.0	93.0	95.6	109.0	87.0
19 ACL Spike	98-8005-0IS	Spike:						
	Added:	5.00	10.0	1.00	1.00	5.00	1.00	1.00
	Found:	4.43	19.2	0.95	0.92	4.95	1.16	0.81
	% Recovery:	88.6	92.0	85.0	86.0	88.0	116.0	81.0
19 ACL Spike Duplicate	98-8005-0ISD	Spike Duplicate:						
	Added:	5.00	10.0	1.00	1.00	5.00	1.00	1.00
	Found:	4.26	19.1	0.94	0.91	4.89	1.01	0.80
	% Recovery:	85.2	91.0	84.0	85.0	86.8	101.0	80.0

NOTE: Samples were digested by U.S. EPA Method 3010A and digestates were analyzed by U.S. EPA Method 6010A (ICP), as described in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Third Edition, September 1994 update.

***Revised to correct submitter's sample number for 98-8005-03.**

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call D. Graczyk at 2- 3489 .

Reference(s): A. Essling Notebook No. 1448, pp. 154-155.

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
F. Martino
ACL 200 File

Analyst(s):
A. Essling
E. Huff/D. Huff

/amb
10/15/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Oils
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 10/7/97
Date Reported: 10/28/97

Submitter's Sample No.	ACL Sample No.	Hg, µg/g
24 ACL	98-8010-01	<0.02
25 ACL	-02	4.7

ICV 102397:	1.39 µg/L	Recovery: 111%
	1.34	107%

Known concentration of ICV 102397 = 1.25 µg/L.

NOTE: Mercury was determined by Cold Vapor Atomic Absorption (CVAA) according to U.S. EPA SW-846, Method 7470A. Sample 98-8010-01 was digested according to SOP: ACL-212. Sample 98-8010-02 was digested according to U.S. EPA SW-846, Method 3051 (microwave). Different digestion methods were necessary because sample 98-8010-01 contained components which interfered with the Hg determination.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. TenKate at 2- 7398 .

Reference(s): CMT Notebook No. 1262, pg. 150 (Hg); CMT Notebook No. 1448, pg. 156 (Microwave Digestion).

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
F. Martino
ACL 200 File

Analyst(s):
L. TenKate
A. Essling
L. TenKate

/amb
10/28/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

ICP-AES Analysis Report

Spec. No.: 58961

Sample Material: Oil

Submitted by: Dolores Geraghty ESH/HP-200 Date Received:10-07-97

Reporting Units: ug/g Date Reported:11-10-97

ACL Number	Your Number	As	Ba	Cd	Cr	Pb	Se	Ag		
98-8010-01	24ACL	<50.	<5.	15.8	<3.	<50.	<50.	<5.		
98-8010-02	25ACL	<50.	<5.	8.4	<3.	<50.	<50.	<5.		

NOTE: Samples will be discarded one (1) month after date of report unless otherwise arranged. When making future inquiries regarding this work, you must reference **OUR** number(s) above. For further information about the results reported here, please call E. A. Huff at extension 2-3633.
Reference Number: AE Notebook No.1448-p.156

Estimated Accuracy:+/-20%

Copies To:
- D. Geraghty
- C. Sholeen
- M. Robinet
- A. Essling
- ACL Office
- D. Green
- D. Graczyk
- F. Martino

Analyst(s):
- E. Huff
- D. Huff
- A. Essling

Remarks:

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Oil
Submitted by: D. Geraghty
Date Received: 10/7/97
Date Reported: 11/18/97

Submitter's Sample No.	ACL Sample No.	PCB Analysis
24ACL	98-8010-01	1020 ppb Aroclor 1016/1242
25ACL	-02	940 ppb Aroclor 1016/1242

Accuracy= ±20%
Precision=±10%

NOTE: Sample preparation was based on EPA-Method 3580A (SW-846, Revision 1, July 1992). Sample analysis was based on EPA-Method 8081 (SW-846, Revision 0, September 1994) for the determination of polychlorinated biphenyls (PCBs) as Aroclors. Surrogate recoveries are within QC limits. Surrogate recovery limits are based upon limits established by CLP.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Chromizky at 2- 7732 .

Reference(s): CMT Logbook No. 1403, p. 158; and file folder in cabinet in R-129: "PCB Samples\data\1\110797."

Copies To:
C. Sholeen
M. Robinet
D. Geraghty
D. Green
A. Boparai
F. Martino
L. Chromizky

Analyst(s): L. Chromizky

/law
11/18/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

ICP-AES Analysis Report

Spec. No.: 58970

Sample Material: 211 Cooling Tower Water

Submitted by: Dolores Geraghty ESH/HP-200 Date Received:09-25-97

Reporting Units: ug/mL Date Reported:10-13-97

ACL Number	Your Number	As	Ba	Cd	Cr	Pb	Se	Ag		
97-8258-01	35ACL-M	<0.20	0.26	<0.01	1.00	0.40	<0.20	0.03		

NOTE: Samples will be discarded one (1) month after date of report unless otherwise arranged. When making future inquiries regarding this work, you must reference **OUR** number(s) above. For further information about the results reported here, please call E. A. Huff at extension 2-3633.
Reference Number: AE Notebook No.1448-p.156

Estimated Accuracy:+/-20%

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
A. Essling
ACL Office
D. Graczyk
D. Green
F. Martino

Analyst(s):
E. Huff
D. Huff
A. Essling

Remarks:

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Waters
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Received: 9/24,10/2,10/16/97
Date Reported: 11/14/97

Submitter's Sample No.	ACL Sample No.	Hg (µg/L)
35 ACL-M	97-8258-01	<0.04
19 ACL	98-8005-01	2.10
20 ACL	-02	1.00
31 ACL	-03	2.15
11 ACL-M	98-8016-01	5.73
	-01S Spike	25.4 (98% Recovery)
	-01SD Spike Duplicate	26.5 (104% Recovery)
	Blanks	<0.04, 0.04, <0.04
		ICV 102397: 1.36 µg/L Recovery: 108% 1.15 91.6% 1.31 105% 1.14 91.2% 1.32 106% 1.34 107%
		Known concentration of ICV 102397 = 1.25 µg/L.
		NOTE: Mercury was determined by Cold Vapor Atomic Absorption (CVAA) according to U.S. EPA Method 7470A, SW-846. Samples were digested according to SOP: ACL-209. Samples were spiked with Hg at the 20 µg/L level.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. TenKate at 2- 7398 .

Reference(s): CMT Notebook No. 1262, pp. 150-151.

Copies To: D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
F. Martino
ACL 200 File

Analyst(s): L. TenKate
L. TenKate

/amb
11/19/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: 211 Cooling Tower Water
Submitted by: Dolores Geraghty, ESH, 200
Date Received: 9/24/97
Date Reported: 10/1/97

Submitter's Sample No.	ACL Sample No.	pH[a]
35ACL-M	97-8258-01[b]	5.87 → 8.40 and rising

[a] pH was determined per EPA SW-846 Method 9040, pH Electrometric Measurement.

[b] A stable pH reading could not be obtained for this sample, indicating that the sample is deionized. The lowest observed pH value was 5.87 and the pH was rising steadily when readings were terminated.

Calibration Verification Standard Results:

	Initial	Final
pH 7.00 Buffer	7.00	7.00
pH 4.00 Buffer	4.00	3.99

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. TenKate at 2- 7398 .

Reference(s): CMT Notebook No. 1491, pg. 8.

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
D. Graczyk
P. Lindahl
F. Martino
L. TenKate
ACL 200 File

Analyst(s): L. TenKate

Peter Lindahl
for LBT

/lac
10/2/97
CMT-84 (9-96)

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material: Water
Date Received: 9/24/97
Submitted by: Dolores Geraghty, ESH/HP, 200
Date Reported: 11/25/97

Submitter's Sample No.	ACL Sample No.	Volatile Organic Analysis (VOA)
35ACL-VOC1	97-8259-01	Analyses of these samples for volatile organics were performed using Method 8260 in the U.S. EPA Document SW-846 (Third Edition). Attached are CLP (Contract Laboratory Program)-type reporting forms listing concentrations of Method 8260 target compounds and recovery reports for compounds with which the samples were spiked. Data is included for one sample, one matrix spike (MS) sample, and one matrix spike duplicate (MSD) sample. The surrogate, MS, and MSD recoveries are within QC limits. The EPA-defined qualifier used on the data sheets is defined as follows: U - Indicates compound was analyzed for, but not detected above the given quantitation limit.
35ACL-VOC1MS	-01MS	
35ACL-VOC1MSD	-01MSD	

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call L. Chromizky at 2- 7732 .

Reference(s): Data Recorded in Logbook No. 1418, pp. 63-64; and File Folder in Cabinet Located in Room E-127A.

Copies To:
C. Sholeen
M. Robinet
D. Geraghty
D. Green
D. Graczyk
A. Boparai
F. Martino
L. Chromizky

Analyst(s): L. Chromizky

/lac
11/26/97
CMT-84 (9-96)

Data File: /users/chem/msd1.i/1oct037.b/1201003.d
Report Date: 25-Nov-1997 11:38

Page 1

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1
Sample Location: building 211
Lab Sample ID: 97-8259-01
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1

Client SDG: 1oct037.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-71-8	DICHLORODIFLUOROMETHANE	10.0	U
74-87-3	CHLOROMETHANE	10.0	U
75-01-4	VINYL CHLORIDE	10.0	U
74-83-9	BROMOMETHANE	10.0	U
75-00-3	CHLOROETHANE	10.0	U
75-69-4	TRICHLOROFLUOROMETHANE	10.0	U
75-35-4	1 1-DICHLOROETHENE	10.0	U
75-09-2	METHYLENE CHLORIDE	10.0	U
156-60-5	TRANS-1 2-DICHLOROETHENE	10.0	U
75-34-3	1 1-DICHLOROETHANE	10.0	U
594-20-7	2 2-DICHLOROPROPANE	10.0	U
156-59-2	CIS-1,2-DICHLOROETHENE	10.0	U
74-97-5	BROMOCHLOROMETHANE	10.0	U
67-66-3	CHLOROFORM	10.0	U
71-55-6	1 1 1-TRICHLOROETHANE	10.0	U
56-23-5	CARBON TETRACHLORIDE	10.0	U
563-58-6	1 1-DICHLOROPROPENE	10.0	U
71-43-2	BENZENE	10.0	U
107-06-2	1 2-DICHLOROETHANE	10.0	U
79-01-6	TRICHLOROETHENE	10.0	U
78-87-5	1 2-DICHLOROPROPANE	10.0	U
74-95-3	DIBROMOMETHANE	10.0	U
75-27-4	BROMODICHLOROMETHANE	10.0	U
10061-02-06	CIS-1 3-DICHLOROPROPENE	10.0	U
108-88-3	TOLUENE	10.0	U
10061-01-05	TRANS-1 3-DICHLOROPROPENE	10.0	U
79-00-5	1 1 2-TRICHLOROETHANE	10.0	U
127-18-4	TETRACHLOROETHENE	10.0	U
142-28-9	1 3-DICHLOROPROPANE	10.0	U
124-48-1	DIBROMOCHLOROMETHANE	10.0	U
106-93-4	1 2-DIBROMOETHANE	10.0	U
108-90-7	CHLOROBENZENE	10.0	U
630-20-6	1 1 1 2-TETRACHLOROETHANE	10.0	U
100-41-4	ETHYL BENZENE	10.0	U
----------------	m&p-XYLENE	10.0	U
95-47-6	o-XYLENE	10.0	U
100-42-5	STYRENE	10.0	U

Data File: /users/chem/msd1.i/1oct037.b/1201003.d
Report Date: 25-Nov-1997 11:38

Paged

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1
Sample Location: building 211
Lab Sample ID: 97-8259-01
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1

Client SDG: 1oct037.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-25-2	BROMOFORM	10.0	U
98-82-8	ISOPROPYLBENZENE	10.0	U
108-86-1	BROMOBENZENE	10.0	U
79-34-5	1 1 2 2-TETRACHLOROETHANE	10.0	U
96-18-4	1 2 3-TRICHLOROPROPANE	10.0	U
103-65-1	n PROPYLBENZENE	10.0	U
95-49-8	2 CHLOROTOLUENE	10.0	U
95-49-8	4 CHLOROTOLUENE	10.0	U
108-67-8	1 3 5-TRIMETHYLBENZENE	10.0	U
98-06-6	TERT BUTYLBENZENE	10.0	U
95-63-6	1,2,4-TRIMETHYLBENZENE	10.0	U
135-98-8	SEC-BUTYLBENZENE	10.0	U
541-73-1	1 3 DICHLOROBENZENE	10.0	U
106-46-7	1 4 DICHLOROBENZENE	10.0	U
99-87-6	p ISOPROPYLTOLUENE	10.0	U
95-50-1	1 2-DICHLOROBENZENE	10.0	U
104-51-8	n BUTYLBENZENE	10.0	U
96-12-8	1 2-DIBROMO-3-CHLOROPROPANE	10.0	U
120-82-1	1 2 4-TRICHLOROBENZENE	10.0	U
87-68-3	HEXACHLOROBUTADIENE	10.0	U
91-20-3	NAPHTHALENE	10.0	U
87-61-6	1 2 3-TRICHLOROBENZENE	10.0	U

Data File: /users/chem/msd1.i/1oct037.b/1201003.d
Report Date: 25-Nov-1997 11:38

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RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 35ACL-VOC1
Data Type: MS DATA
SpikeList File: CLPSOILMS.spk
Method File: /users/chem/msd1.i/1oct037.b/rcrav2.m
Misc Info: 35ACL-VOC1

Client SDG: 1oct037.b
Fraction: VOA
Level: LOW
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	AMOUNT ADDED ug/L	AMOUNT RECOVERED ug/L	% RECOVERED	LIMITS
$ 16 DIBROMOFLUOROMETHA	50.0	49.6	99.14	86-118
$ 28 TOLUENE d-8	50.0	49.6	99.24	88-110
$ 45 4 BROMOFLUOROBENZE	50.0	49.3	98.60	86-115

* - Values outside of QC limits
Spike Recovery: 0 out of 3 outside limits
0 out of 3 not found

Data File: /users/chem/msd1.i/1oct027.b/1301004.d
Report Date: 25-Nov-1997 11:16

Page 4

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1MS
Sample Location: building 211
Lab Sample ID: 97-8259-01MS
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1MS

Client SDG: 1oct027.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-71-8	DICHLORODIFLUOROMETHANE	10.0	U
74-87-3	CHLOROMETHANE	10.0	U
75-01-4	VINYL CHLORIDE	10.0	U
74-83-9	BROMOMETHANE	10.0	U
75-00-3	CHLOROETHANE	10.0	U
75-69-4	TRICHLOROFLUOROMETHANE	10.0	U
75-35-4	1 1-DICHLOROETHENE	47.8	
75-09-2	METHYLENE CHLORIDE	10.0	U
156-60-5	TRANS-1 2-DICHLOROETHENE	10.0	U
75-34-3	1 1-DICHLOROETHANE	10.0	U
594-20-7	2 2-DICHLOROPROPANE	10.0	U
156-59-2	CIS-1,2-DICHLOROETHENE	10.0	U
74-97-5	BROMOCHLOROMETHANE	10.0	U
67-66-3	CHLOROFORM	10.0	U
71-55-6	1 1 1-TRICHLOROETHANE	10.0	U
56-23-5	CARBON TETRACHLORIDE	10.0	U
563-58-6	1 1-DICHLOROPROPENE	10.0	U
71-43-2	BENZENE	47.6	
107-06-2	1 2-DICHLOROETHANE	10.0	U
79-01-6	TRICHLOROETHENE	42.3	
78-87-5	1 2-DICHLOROPROPANE	10.0	U
74-95-3	DIBROMOMETHANE	10.0	U
75-27-4	BROMODICHLOROMETHANE	10.0	U
10061-02-06	CIS-1 3-DICHLOROPROPENE	10.0	U
108-88-3	TOLUENE	46.8	
10061-01-05	TRANS-1 3-DICHLOROPROPENE	10.0	U
79-00-5	1 1 2-TRICHLOROETHANE	10.0	U
127-18-4	TETRACHLOROETHENE	10.0	U
142-28-9	1 3-DICHLOROPROPANE	10.0	U
124-48-1	DIBROMOCHLOROMETHANE	10.0	U
106-93-4	1 2-DIBROMOETHANE	10.0	U
108-90-7	CHLOROBENZENE	46.2	
630-20-6	1 1 1 2-TETRACHLOROETHANE	10.0	U
100-41-4	ETHYL BENZENE	10.0	U
----------------	m&p-XYLENE	10.0	U
95-47-6	o-XYLENE	10.0	U
100-42-5	STYRENE	10.0	U

Data File: /users/chem/msd1.i/1oct027.b/1301004.d
Report Date: 25-Nov-1997 11:16

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TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1MS
Sample Location: building 211
Lab Sample ID: 97-8259-01MS
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1MS

Client SDG: 1oct027.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-25-2	BROMOFORM	10.0	U
98-82-8	ISOPROPYLBENZENE	10.0	U
108-86-1	BROMOBENZENE	10.0	U
79-34-5	1 1 2 2-TETRACHLOROETHANE	10.0	U
96-18-4	1 2 3-TRICHLOROPROPANE	10.0	U
103-65-1	n PROPYLBENZENE	10.0	U
95-49-8	2 CHLOROTOLUENE	10.0	U
95-49-8	4 CHLOROTOLUENE	10.0	U
108-67-8	1 3 5-TRIMETHYLBENZENE	10.0	U
98-06-6	TERT BUTYLBENZENE	10.0	U
95-63-6	1,2,4-TRIMETHYLBENZENE	10.0	U
135-98-8	SEC-BUTYLBENZENE	10.0	U
541-73-1	1 3 DICHLOROBENZENE	10.0	U
106-46-7	1 4 DICHLOROBENZENE	10.0	U
99-87-6	p ISOPROPYLTOLUENE	10.0	U
95-50-1	1 2-DICHLOROBENZENE	10.0	U
104-51-8	n BUTYLBENZENE	10.0	U
96-12-8	1 2-DIBROMO-3-CHLOROPROPANE	10.0	U
120-82-1	1 2 4-TRICHLOROBENZENE	10.0	U
87-68-3	HEXACHLOROBUTADIENE	10.0	U
91-20-3	NAPHTHALENE	10.0	U
87-61-6	1 2 3-TRICHLOROBENZENE	10.0	U

Data File: /users/chem/msd1.i/1oct027.b/1301004.d
Report Date: 25-Nov-1997 11:16

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RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 35ACL-VOC1MS
Data Type: MS DATA
SpikeList File: CLPSOILMS.spk

Client SDG: 1oct027.b
Fraction: VOA
Level: LOW
SampleType: MS
Quant Type: ISTD

Method File: /users/chem/msd1.i/1oct027.b/rcrav2.m
Misc Info: 35ACL-VOC1MS

SPIKE COMPOUND	AMOUNT ADDED ug/L	AMOUNT RECOVERED ug/L	% RECOVERED	LIMITS
7 1 1-DICHLOROETHENE	50.0	47.8	95.65	59-172
23 TRICHLOROETHENE	50.0	42.3	84.58	62-137
20 BENZENE	50.0	47.6	95.16	66-142
29 TOLUENE	50.0	46.8	93.52	59-139
37 CHLOROBENZENE	50.0	46.2	92.38	60-133

SURROGATE COMPOUND	AMOUNT ADDED ug/L	AMOUNT RECOVERED ug/L	% RECOVERED	LIMITS
$ 16 DIBROMOFLUOROMETHA	50.0	58.9	117.80	86-118
$ 28 TOLUENE d-8	50.0	52.5	105.09	88-110
$ 45 4 BROMOFLUOROBENZE	50.0	48.6	97.22	86-115

* - Values outside of QC limits
Spike Recovery: 0 out of 8 outside limits
0 out of 8 not found

Data File: /users/chem/msd1.i/1oct027.b/1401005.d
Report Date: 25-Nov-1997 11:31

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TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1MSD
Sample Location: building 211
Lab Sample ID: 97-8259-01MSD
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1MSD

Client SDG: 1oct027.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-71-8	DICHLORODIFLUOROMETHANE	10.0	U
74-87-3	CHLOROMETHANE	10.0	U
75-01-4	VINYL CHLORIDE	10.0	U
74-83-9	BROMOMETHANE	10.0	U
75-00-3	CHLOROETHANE	10.0	U
75-69-4	TRICHLOROFLUOROMETHANE	10.0	U
75-35-4	1 1-DICHLOROETHENE	54.9	
75-09-2	METHYLENE CHLORIDE	10.0	U
156-60-5	TRANS-1 2-DICHLOROETHENE	10.0	U
75-34-3	1 1-DICHLOROETHANE	10.0	U
594-20-7	2 2-DICHLOROPROPANE	10.0	U
156-59-2	CIS-1,2-DICHLOROETHENE	10.0	U
74-97-5	BROMOCHLOROMETHANE	10.0	U
67-66-3	CHLOROFORM	10.0	U
71-55-6	1 1 1-TRICHLOROETHANE	10.0	U
56-23-5	CARBON TETRACHLORIDE	10.0	U
563-58-6	1 1-DICHLOROPROPENE	10.0	U
71-43-2	BENZENE	52.6	
107-06-2	1 2-DICHLOROETHANE	10.0	U
79-01-6	TRICHLOROETHENE	49.5	
78-87-5	1 2-DICHLOROPROPANE	10.0	U
74-95-3	DIBROMOMETHANE	10.0	U
75-27-4	BROMODICHLOROMETHANE	10.0	U
10061-02-06	CIS-1 3-DICHLOROPROPENE	10.0	U
108-88-3	TOLUENE	53.7	
10061-01-05	TRANS-1 3-DICHLOROPROPENE	10.0	U
79-00-5	1 1 2-TRICHLOROETHANE	10.0	U
127-18-4	TETRACHLOROETHENE	10.0	U
142-28-9	1 3-DICHLOROPROPANE	10.0	U
124-48-1	DIBROMOCHLOROMETHANE	10.0	U
106-93-4	1 2-DIBROMOETHANE	10.0	U
108-90-7	CHLOROBENZENE	52.1	
630-20-6	1 1 1 2-TETRACHLOROETHANE	10.0	U
100-41-4	ETHYL BENZENE	10.0	U
	m&p-XYLENE	10.0	U
95-47-6	o-XYLENE	10.0	U
100-42-5	STYRENE	10.0	U

Data File: /users/chem/msd1.i/1oct027.b/1401005.d
Report Date: 25-Nov-1997 11:31

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TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-VOC1MSD
Sample Location: building 211
Lab Sample ID: 97-8259-01MSD
Sample Matrix: WATER
Analysis Type: VOA
Data Type: MS DATA
Misc Info: 35ACL-VOC1MSD

Client SDG: 1oct027.b
Sample Date: 09/24/97
Sample Point: cooling tower
Date Received: 09/24/97
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
75-25-2	BROMOFORM	10.0	U
98-82-8	ISOPROPYLBENZENE	10.0	U
108-86-1	BROMOBENZENE	10.0	U
79-34-5	1 1 2 2-TETRACHLOROETHANE	10.0	U
96-18-4	1 2 3-TRICHLOROPROPANE	10.0	U
103-65-1	n PROPYLBENZENE	10.0	U
95-49-8	2 CHLOROTOLUENE	10.0	U
95-49-8	4 CHLOROTOLUENE	10.0	U
108-67-8	1 3 5-TRIMETHYLBENZENE	10.0	U
98-06-6	TERT BUTYLBENZENE	10.0	U
95-63-6	1,2,4-TRIMETHYLBENZENE	10.0	U
135-98-8	SEC-BUTYLBENZENE	10.0	U
541-73-1	1 3 DICHLOROBENZENE	10.0	U
106-46-7	1 4 DICHLOROBENZENE	10.0	U
99-87-6	p ISOPROPYLTOLUENE	10.0	U
95-50-1	1 2-DICHLOROBENZENE	10.0	U
104-51-8	n BUTYLBENZENE	10.0	U
96-12-8	1 2-DIBROMO-3-CHLOROPROPANE	10.0	U
120-82-1	1 2 4-TRICHLOROBENZENE	10.0	U
87-68-3	HEXACHLOROBUTADIENE	10.0	U
91-20-3	NAPHTHALENE	10.0	U
87-61-6	1 2 3-TRICHLOROBENZENE	10.0	U

Data File: /users/chem/msd1.i/1oct027.b/1401005.d
Report Date: 25-Nov-1997 11:31

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 35ACL-VOC1MSD
Data Type: MS DATA
SpikeList File: CLPSOILMS.spk
Method File: /users/chem/msd1.i/1oct027.b/rcrav2.m
Misc Info: 35ACL-VOC1MSD

Client SDG: 1oct027.b
Fraction: VOA
Level: LOW
SampleType: MSD
Quant Type: ISTD

SPIKE COMPOUND	AMOUNT ADDED ug/L	AMOUNT RECOVERED ug/L	% RECOVERED	LIMITS
7 1 1-DICHLOROETHENE	50.0	54.9	109.82	59-172
23 TRICHLOROETHENE	50.0	49.5	99.08	62-137
20 BENZENE	50.0	52.6	105.20	66-142
29 TOLUENE	50.0	53.7	107.39	59-139
37 CHLOROBENZENE	50.0	52.1	104.23	60-133

SURROGATE COMPOUND	AMOUNT ADDED ug/L	AMOUNT RECOVERED ug/L	% RECOVERED	LIMITS
$ 16 DIBROMOFLUOROMETHA	50.0	56.0	112.01	86-118
$ 28 TOLUENE d-8	50.0	51.9	103.89	88-110
$ 45 4 BROMOFLUOROBENZE	50.0	47.4	94.76	86-115

* - Values outside of QC limits
Spike Recovery: 0 out of 8 outside limits
0 out of 8 not found

ANALYTICAL CHEMISTRY LABORATORY
Argonne National Laboratory
Argonne, IL 60439

REPORT OF ANALYTICAL RESULTS

Sample Material:	Water	Date Received:	9/24/97
Submitted by:	Dolores Geraghty, ESH/HP, 200	Date Reported:	11/12/97

Submitter's Sample No.	ACL Sample No.	Semivolatile Organic Results		
		Semivolatile Target Compound	Concentration (ug/L)	Q
	Lab Blank (97-1003)	Di-n-butylphthalate	47.9	
35ACL-SVOC	97-8257-01	Di-n-butylphthalate bis(2-ethylhexyl)phthalate	22.9 40.6	
35ACL-SVOC-MS	-01MS	(See attachment for the recoveries of spiked compounds.)		
35ACL-SVOC-MSD	-01MSD	(See attachment for the recoveries of spiked compounds.)		

NOTE: Sample preparation is based on EPA-Method 3510 (SW-846, Revision 1, July 1992.) The analytical method used is based on EPA-Method 8270A (SW-846, Revision 1, July 1992) for determination of semivolatile organic compounds. The attached data sheets contain data for one sample, one matrix spike (MS) sample, one matrix spike duplicate (MSD) sample and one laboratory blank. The surrogate recoveries are within QC limits for 24 out of 24 values reported. MS and MSD recoveries are within QC limits for 22 out of 22 values reported.

The EPA-defined qualifier to be used on the data sheets is as follows:

U - Indicates compound was analyzed for, but not detected above the given quantitation limit.

NOTE: Unused sample material will be returned to the Client. Prepared samples will be discarded one (1) month after the date of this report unless other arrangements are made. When making future inquiries regarding this report, please reference the ACL sample number(s) above. For further information about the results reported here, please call Y. Tsai at 2- 7732 .

Reference(s): GC/.MSD-2 Run Logbook No. 2, pg. 59.

Copies To:
D. Geraghty
C. Sholeen
M. Robinet
D. Green
A. Boparai
D. Graczyk
F. Martino
Y. Tsai

Analyst(s): Y. Tsai

YT

Attachment
(18 Pages)

/lac
11/13/97
CMT-84 (9-96)

Data File: /data/msd2.i/2oct207.b/0101001.d
Report Date: 12-Nov-1997 14:12

ANL

TARGET COMPOUNDS

Client Name: D. Geraghty
Lab Smp Id: Lab Blank, 97-1003
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Client Smp ID: Lab Blank, 97-1003
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: Y. Tsai

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	20.0	U
109-06-8	2-Picoline	20.0	U
66-27-3	Methyl methansulfonate	40.0	U
62-50-0	Ethyl methansulfonate	20.0	U
62-53-3	Aniline	20.0	U
108-95-2	Phenol	20.0	U
95-57-8	2-Chlorophenol	20.0	U
111-44-4	bis(2-Chloroethyl)ether	20.0	U
541-73-1	1,3-Dichlorobenzene	20.0	U
106-46-7	1,4-Dichlorobenzene	20.0	U
95-50-1	1,2-Dichlorobenzene	20.0	U
100-51-6	Benzyl alcohol	20.0	U
95-48-7	2-Methylphenol	20.0	U
108-60-1	bis(2-Chloroisopropyl)ether	20.0	U
98-86-2	Acetophenone	20.0	U
621-64-7	N-nitroso-di-n-propylamine	20.0	U
106-44-5	4-Methylphenol	20.0	U
67-72-1	Hexachloroethane	20.0	U
98-95-3	Nitrobenzene	20.0	U
100-75-4	N-Nitrosopiperidine	20.0	U
78-59-1	Isophorone	20.0	U
88-75-5	2-Nitrophenol	20.0	U
105-67-9	2,4-Dimethyphenol	20.0	U
111-91-1	bis(2-Chloroethoxy)methane	20.0	U
120-83-2	2,4-Dichlorophenol	20.0	U
65-85-0	Benzoic acid	20.0	U
120-82-1	1,2,4-Trichlorobenzene	20.0	U
91-20-3	Naphthalene	20.0	U
122-09-8	a,a-Dimethylphenethylamine	40.0	U
87-65-0	2,6-Dichlorophenol	20.0	U
106-47-8	4-Chloroaniline	20.0	U
87-68-3	Hexachlorobutadiene	20.0	U
924-16-3	N-Nitrosodibutylamine	20.0	U
59-50-7	4-Chloro-3-methylphenol	20.0	U
91-57-6	2-Methylnaphthalene	20.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	20.0	U
77-47-4	Hexachlorocyclopentadiene	40.0	U

Data File: /data/msd2.i/2oct207.b/0101001.d
Report Date: 12-Nov-1997 14:12

2

ANL

TARGET COMPOUNDS

Client Name: D. Geraghty
Lab Smp Id: Lab Blank, 97-1003
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Client Smp ID: Lab Blank, 97-1003
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: Y. Tsai

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	20.0	U
95-95-4	2,4,5-Trichlorophenol	20.0	U
91-58-7	2-Chloronaphthalene	20.0	U
90-13-1	1-Chloronaphthalene	20.0	U
88-74-4	2-Nitroaniline	20.0	U
131-11-3	Dimethyl phthalate	20.0	U
208-96-8	Acenaphthylene	20.0	U
606-20-2	2,6-Dinitrotoluene	20.0	U
	3-Nitroaniline	20.0	U
83-32-9	Acenaphthene	20.0	U
51-28-5	2,4-Dinitrophenol	40.0	U
608-93-5	Pentachlorobenzene	20.0	U
132-64-9	Dibenzofuran	20.0	U
100-02-7	4-Nitrophenol	40.0	U
121-14-2	2,4-Dinitrotoluene	20.0	U
91-59-8	2-Napthylamine	20.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	20.0	U
134-32-7	1-Naphthylamine	20.0	U
86-73-7	Fluorene	20.0	U
84-66-2	Diethylphthalate	20.0	U
7005-72-3	4-Chlorophenyl phenyl ether	20.0	U
100-01-6	4-Nitroaniline	20.0	U
534-52-1	4,6-Dinitro-2-methylphenol	20.0	U
	N-NitrosoDPA & Diphenylamine	10.0	U
122-66-7	1,2-Diphenylhydrazine	20.0	U
101-55-3	4-Bromophenyl phenyl ether	20.0	U
118-74-1	Hexachlorobenzene	20.0	U
62-44-2	Phenacetin	20.0	U
87-86-5	Pentachlorophenol	20.0	U
82-68-8	Pentachloronitrobenzene	20.0	U
92-67-1	4-Aminobiphenyl	20.0	U
23950-58-5	Pronamide	20.0	U
85-01-8	Phenanthrene	20.0	U
120-12-7	Anthracene	20.0	U
84-74-2	Di-n-butylphthalate	47.9	
206-44-0	Fluoranthene	20.0	U
92-87-5	Benzidine	40.0	U

Data File: /data/msd2.i/2oct207.b/0101001.d
Report Date: 12-Nov-1997 14:12

3

ANL

TARGET COMPOUNDS

Client Name: D. Geraghty
Lab Smp Id: Lab Blank, 97-1003
Sample Location:
Sample Date:
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Client Smp ID: Lab Blank, 97-1003
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW
Operator: Y. Tsai

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	20.0	U
60-11-7	p-Dimethylaminoazobenzene	20.0	U
85-68-7	Butylbenzylphthalate	20.0	U
56-55-3	Benzo(a)anthracene	20.0	U
91-94-1	3,3'-Dichlorobenzidine	20.0	U
218-01-9	Chrysene	20.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	20.0	U
117-84-0	Di-n-octylphthalate	20.0	U
205-99-2	Benzo(b)fluoranthene	20.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	20.0	U
207-08-9	Benzo(k)fluoranthene	20.0	U
50-32-8	Benzo(a)pyrene	20.0	U
56-49-5	3-Methylcholanthrene	20.0	U
224-42-0	Dibenz(a,j)acridine	20.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	20.0	U
53-70-3	Dibenzo(a,h)anthracene	20.0	U
191-24-2	Benzo(g,h,i)perylene	20.0	U
367-12-4	2-Fluorophenol	224	
4165-62-2	Phenol-d5	165	
4165-60-0	Nitrobenzene-d5	162	
321-60-8	2-Fluorobiphenyl	164	
118-79-6	2,4,6-Tribromophenol	293	
98904-43-9	Terphenyl-d14	163	

Data File: /data/msd2.i/2oct207.b/0101001.d
Report Date: 12-Nov-1997 14:12

4

ANL

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Lab Smp Id: Lab Blank, 97-1003
Level: LOW
Data Type: MS DATA
SpikeList File: HPMSS.spk
Method File: /data/msd2.i/2oct207.b/yt8270.m
Misc Info:

Client SDG: 2oct207.b
Fraction: SV
Client Smp ID: Lab Blank, 97-1003
Operator: Y. Tsai
SampleType: BLANK
Quant Type: ISTD

SURROGATE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
$ 4 2-Fluorophenol	200.00	111.88	55.94	21-100
$ 7 Phenol-d5	200.00	82.65	41.33	10-94
$ 22 Nitrobenzene-d5	100.00	81.28	81.28	35-114
$ 45 2-Fluorobiphenyl	100.00	81.77	81.77	43-116
$ 70 2,4,6-Tribromophen	200.00	146.62	73.31	10-123
$ 85 Terphenyl-d14	100.00	81.60	81.60	33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 6 outside limits
0 out of 6 not found

Data File: /data/msd2.i/2oct207.b/0201002.d
Report Date: 12-Nov-1997 15:00

5

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOC
Sample Location:
Lab Sample ID: 97-8257-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	10.0	U
109-06-8	2-Picoline	10.0	U
66-27-3	Methyl methansulfonate	20.0	U
62-50-0	Ethyl methansulfonate	10.0	U
62-53-3	Aniline	10.0	U
108-95-2	Phenol	10.0	U
95-57-8	2-Chlorophenol	10.0	U
111-44-4	bis(2-Chloroethyl)ether	10.0	U
541-73-1	1,3-Dichlorobenzene	10.0	U
106-46-7	1,4-Dichlorobenzene	10.0	U
95-50-1	1,2-Dichlorobenzene	10.0	U
100-51-6	Benzyl alcohol	10.0	U
95-48-7	2-Methylphenol	10.0	U
108-60-1	bis(2-Chloroisopropyl)ether	10.0	U
98-86-2	Acetophenone	10.0	U
621-64-7	N-nitroso-di-n-propylamine	10.0	U
106-44-5	4-Methylphenol	10.0	U
67-72-1	Hexachloroethane	10.0	U
98-95-3	Nitrobenzene	10.0	U
100-75-4	N-Nitrosopiperidine	10.0	U
78-59-1	Isophorone	10.0	U
88-75-5	2-Nitrophenol	10.0	U
105-67-9	2,4-Dimethyphenol	10.0	U
111-91-1	bis(2-Chloroethoxy)methane	10.0	U
120-83-2	2,4-Dichlorophenol	10.0	U
65-85-0	Benzoic acid	10.0	U
120-82-1	1,2,4-Trichlorobenzene	10.0	U
91-20-3	Naphthalene	10.0	U
122-09-8	a,a-Dimethylphenethylamine	20.0	U
87-65-0	2,6-Dichlorophenol	10.0	U
106-47-8	4-Chloroaniline	10.0	U
87-68-3	Hexachlorobutadiene	10.0	U
924-16-3	N-Nitrosodibutylamine	10.0	U
59-50-7	4-Chloro-3-methylphenol	10.0	U
91-57-6	2-Methylnaphthalene	10.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	10.0	U
77-47-4	Hexachlorocyclopentadiene	20.0	U

Data File: /data/msd2.i/2oct207.b/0201002.d
Report Date: 12-Nov-1997 15:00

6

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOC
Sample Location:
Lab Sample ID: 97-8257-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	10.0	U
95-95-4	2,4,5-Trichlorophenol	10.0	U
91-58-7	2-Chloronaphthalene	10.0	U
90-13-1	1-Chloronaphthalene	10.0	U
88-74-4	2-Nitroaniline	10.0	U
131-11-3	Dimethyl phthalate	10.0	U
208-96-8	Acenaphthylene	10.0	U
606-20-2	2,6-Dinitrotoluene	10.0	U
	3-Nitroaniline	10.0	U
83-32-9	Acenaphthene	10.0	U
51-28-5	2,4-Dinitrophenol	20.0	U
608-93-5	Pentachlorobenzene	10.0	U
132-64-9	Dibenzofuran	10.0	U
100-02-7	4-Nitrophenol	20.0	U
121-14-2	2,4-Dinitrotoluene	10.0	U
91-59-8	2-Napthylamine	10.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	10.0	U
134-32-7	1-Naphthylamine	10.0	U
86-73-7	Fluorene	10.0	U
84-66-2	Diethylphthalate	10.0	U
7005-72-3	4-Chlorophenyl phenyl ether	10.0	U
100-01-6	4-Nitroaniline	10.0	U
534-52-1	4,6-Dinitro-2-methylphenol	10.0	U
	N-NitrosoDPA & Diphenylamine	5.00	U
122-66-7	1,2-Diphenylhydrazine	10.0	U
101-55-3	4-Bromophenyl phenyl ether	10.0	U
118-74-1	Hexachlorobenzene	10.0	U
62-44-2	Phenacetin	10.0	U
87-86-5	Pentachlorophenol	10.0	U
82-68-8	Pentachloronitrobenzene	10.0	U
92-67-1	4-Aminobiphenyl	10.0	U
23950-58-5	Pronamide	10.0	U
85-01-8	Phenanthrene	10.0	U
120-12-7	Anthracene	10.0	U
84-74-2	Di-n-butylphthalate	22.9	
206-44-0	Fluoranthene	10.0	U
92-87-5	Benzidine	20.0	U

Data File: /data/msd2.i/2oct207.b/0201002.d
Report Date: 12-Nov-1997 15:00

7

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOC
Sample Location:
Lab Sample ID: 97-8257-01
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	10.0	U
60-11-7	p-Dimethylaminoazobenzene	10.0	U
85-68-7	Butylbenzylphthalate	10.0	U
56-55-3	Benzo(a)anthracene	10.0	U
91-94-1	3,3'-Dichlorobenzidine	10.0	U
218-01-9	Chrysene	10.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	40.6	
117-84-0	Di-n-octylphthalate	10.0	U
205-99-2	Benzo(b)fluoranthene	10.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	10.0	U
207-08-9	Benzo(k)fluoranthene	10.0	U
50-32-8	Benzo(a)pyrene	10.0	U
56-49-5	3-Methylcholanthrene	10.0	U
224-42-0	Dibenz(a,j)acridine	10.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	10.0	U
53-70-3	Dibenzo(a,h)anthracene	10.0	U
191-24-2	Benzo(g,h,i)perylene	10.0	U
==========	==========	============	=====
367-12-4	2-Fluorophenol	76.0	
4165-62-2	Phenol-d5	52.0	
4165-60-0	Nitrobenzene-d5	82.4	
321-60-8	2-Fluorobiphenyl	84.7	
118-79-6	2,4,6-Tribromophenol	159	
98904-43-9	Terphenyl-d14	84.9	

Data File: /data/msd2.i/2oct207.b/0201002.d
Report Date: 12-Nov-1997 15:00

8

TENTATIVELY IDENTIFIED COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOC
Sample Location:
Lab Sample ID: 97-8257-01
Sample Matrix: WATER
Analysis Type: SV

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:

Level: LOW

Number TICs found: 0

CONCENTRATION UNITS:
(ug/L or ug/KG) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q

Data File: /data/msd2.i/2oct207.b/0201002.d
Report Date: 12-Nov-1997 15:00

9

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 35ACL-SVOC
Data Type: MS DATA
SpikeList File: HPMSS.spk
Method File: /data/msd2.i/2oct207.b/yt8270.m
Misc Info:

Client SDG: 2oct207.b
Fraction: SV
Level: LOW
SampleType: SAMPLE
Quant Type: ISTD

SURROGATE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
$ 4 2-Fluorophenol	200	76.0	37.98	21-100
$ 7 Phenol-d5	200	52.0	25.99	10-94
$ 22 Nitrobenzene-d5	100	82.4	82.40	35-114
$ 45 2-Fluorobiphenyl	100	84.7	84.68	43-116
$ 70 2,4,6-Tribromophen	200	159	79.53	10-123
$ 85 Terphenyl-d14	100	84.9	84.93	33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 6 outside limits
0 out of 6 not found

Data File: /data/msd2.i/2oct207.b/0301003.d
Report Date: 12-Nov-1997 15:37

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOCMS
Sample Location:
Lab Sample ID: 97-8257-01MS
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	20.0	U
109-06-8	2-Picoline	20.0	U
66-27-3	Methyl methansulfonate	40.0	U
62-50-0	Ethyl methansulfonate	20.0	U
62-53-3	Aniline	20.0	U
108-95-2	Phenol	193	
95-57-8	2-Chlorophenol	306	
111-44-4	bis(2-Chloroethyl)ether	20.0	U
541-73-1	1,3-Dichlorobenzene	20.0	U
106-46-7	1,4-Dichlorobenzene	153	
95-50-1	1,2-Dichlorobenzene	20.0	U
100-51-6	Benzyl alcohol	20.0	U
95-48-7	2-Methylphenol	20.0	U
108-60-1	bis(2-Chloroisopropyl)ether	20.0	U
98-86-2	Acetophenone	20.0	U
621-64-7	N-nitroso-di-n-propylamine	167	
106-44-5	4-Methylphenol	20.0	U
67-72-1	Hexachloroethane	20.0	U
98-95-3	Nitrobenzene	20.0	U
100-75-4	N-Nitrosopiperidine	20.0	U
78-59-1	Isophorone	20.0	U
88-75-5	2-Nitrophenol	20.0	U
105-67-9	2,4-Dimethyphenol	20.0	U
111-91-1	bis(2-Chloroethoxy)methane	20.0	U
120-83-2	2,4-Dichlorophenol	20.0	U
65-85-0	Benzoic acid	20.0	U
120-82-1	1,2,4-Trichlorobenzene	150	
91-20-3	Naphthalene	20.0	U
122-09-8	a,a-Dimethylphenethylamine	40.0	U
87-65-0	2,6-Dichlorophenol	20.0	U
106-47-8	4-Chloroaniline	20.0	U
87-68-3	Hexachlorobutadiene	20.0	U
924-16-3	N-Nitrosodibutylamine	20.0	U
59-50-7	4-Chloro-3-methylphenol	348	
91-57-6	2-Methylnaphthalene	20.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	20.0	U
77-47-4	Hexachlorocyclopentadiene	40.0	U

Data File: /data/msd2.i/2oct207.b/0301003.d
Report Date: 12-Nov-1997 15:37

11

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOCMS
Sample Location:
Lab Sample ID: 97-8257-01MS
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	20.0	U
95-95-4	2,4,5-Trichlorophenol	20.0	U
91-58-7	2-Chloronaphthalene	20.0	U
90-13-1	1-Chloronaphthalene	20.0	U
88-74-4	2-Nitroaniline	20.0	U
131-11-3	Dimethyl phthalate	20.0	U
208-96-8	Acenaphthylene	20.0	U
606-20-2	2,6-Dinitrotoluene	20.0	U
----------------	3-Nitroaniline	20.0	U
83-32-9	Acenaphthene	159	
51-28-5	2,4-Dinitrophenol	40.0	U
608-93-5	Pentachlorobenzene	20.0	U
132-64-9	Dibenzofuran	20.0	U
100-02-7	4-Nitrophenol	205	
121-14-2	2,4-Dinitrotoluene	155	
91-59-8	2-Napthylamine	20.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	20.0	U
134-32-7	1-Naphthylamine	20.0	U
86-73-7	Fluorene	20.0	U
84-66-2	Diethylphthalate	20.0	U
7005-72-3	4-Chlorophenyl phenyl ether	20.0	U
100-01-6	4-Nitroaniline	20.0	U
534-52-1	4,6-Dinitro-2-methylphenol	20.0	U
----------------	N-NitrosoDPA & Diphenylamine	10.0	U
122-66-7	1,2-Diphenylhydrazine	20.0	U
101-55-3	4-Bromophenyl phenyl ether	20.0	U
118-74-1	Hexachlorobenzene	20.0	U
62-44-2	Phenacetin	20.0	U
87-86-5	Pentachlorophenol	405	
82-68-8	Pentachloronitrobenzene	20.0	U
92-67-1	4-Aminobiphenyl	20.0	U
23950-58-5	Pronamide	20.0	U
85-01-8	Phenanthrene	20.0	U
120-12-7	Anthracene	20.0	U
84-74-2	Di-n-butylphthalate	47.4	
206-44-0	Fluoranthene	20.0	U
92-87-5	Benzidine	40.0	U

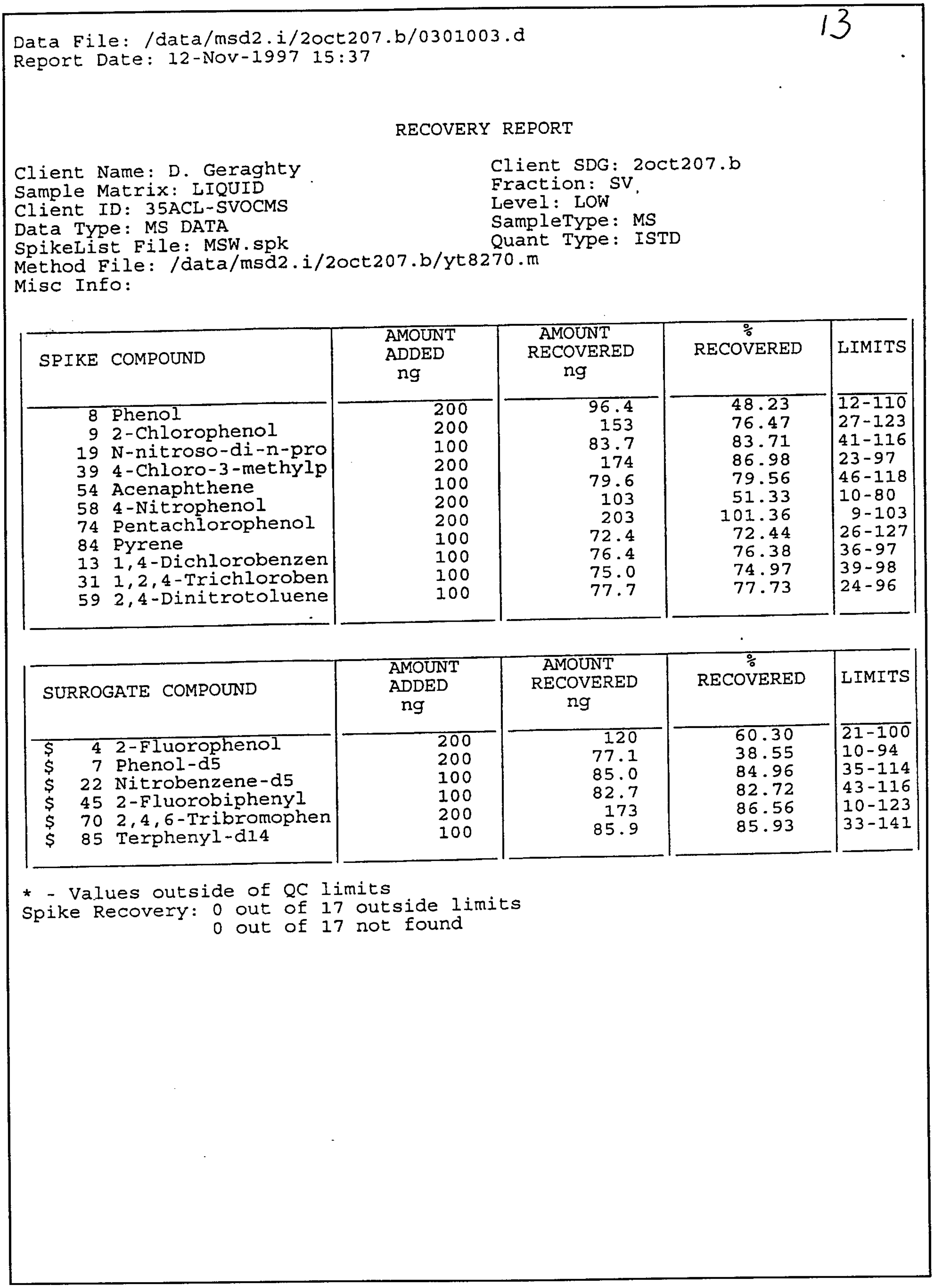
Data File: /data/msd2.i/2oct207.b/0301003.d
Report Date: 12-Nov-1997 15:37

12

TARGET COMPOUNDS

Client Name: D. Geraghty	Client SDG: 2oct207.b
Client Sample ID: 35ACL-SVOCMS	Sample Date:
Sample Location:	Sample Point:
Lab Sample ID: 97-8257-01MS	Date Received:
Sample Matrix: WATER	Quant Type: ISTD
Analysis Type: SV	Level: LOW
Data Type: MS DATA	
Misc Info:	

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	145	
60-11-7	p-Dimethylaminoazobenzene	20.0	U
85-68-7	Butylbenzylphthalate	20.0	U
56-55-3	Benzo(a)anthracene	20.0	U
91-94-1	3,3'-Dichlorobenzidine	20.0	U
218-01-9	Chrysene	20.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	54.3	
117-84-0	Di-n-octylphthalate	20.0	U
205-99-2	Benzo(b)fluoranthene	20.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	20.0	U
207-08-9	Benzo(k)fluoranthene	20.0	U
50-32-8	Benzo(a)pyrene	20.0	U
56-49-5	3-Methylcholanthrene	20.0	U
224-42-0	Dibenz(a,j)acridine	20.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	20.0	U
53-70-3	Dibenzo(a,h)anthracene	20.0	U
191-24-2	Benzo(g,h,i)perylene	20.0	U
367-12-4	2-Fluorophenol	241	
4165-62-2	Phenol-d5	154	
4165-60-0	Nitrobenzene-d5	170	
321-60-8	2-Fluorobiphenyl	165	
118-79-6	2,4,6-Tribromophenol	346	
98904-43-9	Terphenyl-d14	172	



13

```
Data File: /data/msd2.i/2oct207.b/0301003.d
Report Date: 12-Nov-1997 15:37

                             RECOVERY REPORT

Client Name: D. Geraghty                  Client SDG: 2oct207.b
Sample Matrix: LIQUID                     Fraction: SV
Client ID: 35ACL-SVOCMS                   Level: LOW
Data Type: MS DATA                        SampleType: MS
SpikeList File: MSW.spk                   Quant Type: ISTD
Method File: /data/msd2.i/2oct207.b/yt8270.m
Misc Info:

 SPIKE COMPOUND           | AMOUNT   | AMOUNT    |     %     | LIMITS
                          | ADDED    | RECOVERED | RECOVERED |
                          |   ng     |    ng     |           |
 -------------------------|----------|-----------|-----------|--------
      8 Phenol            |   200    |   96.4    |   48.23   | 12-110
      9 2-Chlorophenol    |   200    |    153    |   76.47   | 27-123
     19 N-nitroso-di-n-pro|   100    |   83.7    |   83.71   | 41-116
     39 4-Chloro-3-methylp|   200    |    174    |   86.98   | 23-97
     54 Acenaphthene      |   100    |   79.6    |   79.56   | 46-118
     58 4-Nitrophenol     |   200    |    103    |   51.33   | 10-80
     74 Pentachlorophenol |   200    |    203    |  101.36   |  9-103
     84 Pyrene            |   100    |   72.4    |   72.44   | 26-127
     13 1,4-Dichlorobenzen|   100    |   76.4    |   76.38   | 36-97
     31 1,2,4-Trichloroben|   100    |   75.0    |   74.97   | 39-98
     59 2,4-Dinitrotoluene|   100    |   77.7    |   77.73   | 24-96

 SURROGATE COMPOUND       | AMOUNT   | AMOUNT    |     %     | LIMITS
                          | ADDED    | RECOVERED | RECOVERED |
                          |   ng     |    ng     |           |
 -------------------------|----------|-----------|-----------|--------
 $    4 2-Fluorophenol    |   200    |    120    |   60.30   | 21-100
 $    7 Phenol-d5         |   200    |   77.1    |   38.55   | 10-94
 $   22 Nitrobenzene-d5   |   100    |   85.0    |   84.96   | 35-114
 $   45 2-Fluorobiphenyl  |   100    |   82.7    |   82.72   | 43-116
 $   70 2,4,6-Tribromophen|   200    |    173    |   86.56   | 10-123
 $   85 Terphenyl-d14     |   100    |   85.9    |   85.93   | 33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 17 outside limits
                0 out of 17 not found
```

Data File: /data/msd2.i/2oct207.b/0401004.d
Report Date: 12-Nov-1997 15:35

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOCMSD
Sample Location:
Lab Sample ID: 97-8257-01MSD
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
62-75-9	N-Nitrosodimethylamine	20.0	U
109-06-8	2-Picoline	20.0	U
66-27-3	Methyl methansulfonate	40.0	U
62-50-0	Ethyl methansulfonate	20.0	U
62-53-3	Aniline	20.0	U
108-95-2	Phenol	200	
95-57-8	2-Chlorophenol	306	
111-44-4	bis(2-Chloroethyl)ether	20.0	U
541-73-1	1,3-Dichlorobenzene	20.0	U
106-46-7	1,4-Dichlorobenzene	151	
95-50-1	1,2-Dichlorobenzene	20.0	U
100-51-6	Benzyl alcohol	20.0	U
95-48-7	2-Methylphenol	20.0	U
108-60-1	bis(2-Chloroisopropyl)ether	20.0	U
98-86-2	Acetophenone	20.0	U
621-64-7	N-nitroso-di-n-propylamine	166	
106-44-5	4-Methylphenol	20.0	U
67-72-1	Hexachloroethane	20.0	U
98-95-3	Nitrobenzene	20.0	U
100-75-4	N-Nitrosopiperidine	20.0	U
78-59-1	Isophorone	20.0	U
88-75-5	2-Nitrophenol	20.0	U
105-67-9	2,4-Dimethyphenol	20.0	U
111-91-1	bis(2-Chloroethoxy)methane	20.0	U
120-83-2	2,4-Dichlorophenol	20.0	U
65-85-0	Benzoic acid	20.0	U
120-82-1	1,2,4-Trichlorobenzene	151	
91-20-3	Naphthalene	20.0	U
122-09-8	a,a-Dimethylphenethylamine	40.0	U
87-65-0	2,6-Dichlorophenol	20.0	U
106-47-8	4-Chloroaniline	20.0	U
87-68-3	Hexachlorobutadiene	20.0	U
924-16-3	N-Nitrosodibutylamine	20.0	U
59-50-7	4-Chloro-3-methylphenol	338	
91-57-6	2-Methylnaphthalene	20.0	U
95-94-3	1,2,4,5-Tetrachlorobenzene	20.0	U
77-47-4	Hexachlorocyclopentadiene	40.0	U

Data File: /data/msd2.i/2oct207.b/0401004.d
Report Date: 12-Nov-1997 15:35

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TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOCMSD
Sample Location:
Lab Sample ID: 97-8257-01MSD
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
88-06-2	2,4,6-Trichlorophenol	20.0	U
95-95-4	2,4,5-Trichlorophenol	20.0	U
91-58-7	2-Chloronaphthalene	20.0	U
90-13-1	1-Chloronaphthalene	20.0	U
88-74-4	2-Nitroaniline	20.0	U
131-11-3	Dimethyl phthalate	20.0	U
208-96-8	Acenaphthylene	20.0	U
606-20-2	2,6-Dinitrotoluene	20.0	U
----------------	3-Nitroaniline	20.0	U
83-32-9	Acenaphthene	154	
51-28-5	2,4-Dinitrophenol	40.0	U
608-93-5	Pentachlorobenzene	20.0	U
132-64-9	Dibenzofuran	20.0	U
100-02-7	4-Nitrophenol	217	
121-14-2	2,4-Dinitrotoluene	151	
91-59-8	2-Napthylamine	20.0	U
58-90-2	2,3,4,6-Tetrachlorophenol	20.0	U
134-32-7	1-Naphthylamine	20.0	U
86-73-7	Fluorene	20.0	U
84-66-2	Diethylphthalate	20.0	U
7005-72-3	4-Chlorophenyl phenyl ether	20.0	U
100-01-6	4-Nitroaniline	20.0	U
534-52-1	4,6-Dinitro-2-methylphenol	20.0	U
----------------	N-NitrosoDPA & Diphenylamine	10.0	U
122-66-7	1,2-Diphenylhydrazine	20.0	U
101-55-3	4-Bromophenyl phenyl ether	20.0	U
118-74-1	Hexachlorobenzene	20.0	U
62-44-2	Phenacetin	20.0	U
87-86-5	Pentachlorophenol	400	
82-68-8	Pentachloronitrobenzene	20.0	U
92-67-1	4-Aminobiphenyl	20.0	U
23950-58-5	Pronamide	20.0	U
85-01-8	Phenanthrene	20.0	U
120-12-7	Anthracene	20.0	U
84-74-2	Di-n-butylphthalate	52.3	
206-44-0	Fluoranthene	20.0	U
92-87-5	Benzidine	40.0	U

Data File: /data/msd2.i/2oct207.b/0401004.d
Report Date: 12-Nov-1997 15:35

TARGET COMPOUNDS

Client Name: D. Geraghty
Client Sample ID: 35ACL-SVOCMSD
Sample Location:
Lab Sample ID: 97-8257-01MSD
Sample Matrix: WATER
Analysis Type: SV
Data Type: MS DATA
Misc Info:

Client SDG: 2oct207.b
Sample Date:
Sample Point:
Date Received:
Quant Type: ISTD
Level: LOW

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/KG) ug/L	Q
129-00-0	Pyrene	148	
60-11-7	p-Dimethylaminoazobenzene	20.0	U
85-68-7	Butylbenzylphthalate	20.0	U
56-55-3	Benzo(a)anthracene	20.0	U
91-94-1	3,3'-Dichlorobenzidine	20.0	U
218-01-9	Chrysene	20.0	U
117-81-7	bis(2-Ethylhexyl)phthalate	9.56	J
117-84-0	Di-n-octylphthalate	20.0	U
205-99-2	Benzo(b)fluoranthene	20.0	U
57-97-6	7,12Dimethylbenz(a)anthracen	20.0	U
207-08-9	Benzo(k)fluoranthene	20.0	U
50-32-8	Benzo(a)pyrene	20.0	U
56-49-5	3-Methylcholanthrene	20.0	U
224-42-0	Dibenz(a,j)acridine	20.0	U
193-39-5	Indeno(1,2,3-cd)pyrene	20.0	U
53-70-3	Dibenzo(a,h)anthracene	20.0	U
191-24-2	Benzo(g,h,i)perylene	20.0	U
367-12-4	2-Fluorophenol	238	
4165-62-2	Phenol-d5	164	
4165-60-0	Nitrobenzene-d5	171	
321-60-8	2-Fluorobiphenyl	164	
118-79-6	2,4,6-Tribromophenol	332	
98904-43-9	Terphenyl-d14	168	

Data File: /data/msd2.i/2oct207.b/0401004.d
Report Date: 12-Nov-1997 15:35

17

RECOVERY REPORT

Client Name: D. Geraghty
Sample Matrix: LIQUID
Client ID: 35ACL-SVOCMSD
Data Type: MS DATA
SpikeList File: MSW.spk
Method File: /data/msd2.i/2oct207.b/yt8270.m
Misc Info:

Client SDG: 2oct207.b
Fraction: SV
Level: LOW
SampleType: MSD
Quant Type: ISTD

SPIKE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
8 Phenol	200	100	50.11	12-110
9 2-Chlorophenol	200	153	76.52	27-123
19 N-nitroso-di-n-pro	100	83.1	83.14	41-116
39 4-Chloro-3-methylp	200	169	84.52	23-97
54 Acenaphthene	100	76.9	76.89	46-118
58 4-Nitrophenol	200	108	54.22	10-80
74 Pentachlorophenol	200	200	100.06	9-103
84 Pyrene	100	73.9	73.89	26-127
13 1,4-Dichlorobenzen	100	75.6	75.57	36-97
31 1,2,4-Trichloroben	100	75.6	75.64	39-98
59 2,4-Dinitrotoluene	100	75.6	75.65	24-96

SURROGATE COMPOUND	AMOUNT ADDED ng	AMOUNT RECOVERED ng	% RECOVERED	LIMITS
$ 4 2-Fluorophenol	200	119	59.60	21-100
$ 7 Phenol-d5	200	82.1	41.05	10-94
$ 22 Nitrobenzene-d5	100	85.4	85.39	35-114
$ 45 2-Fluorobiphenyl	100	81.9	81.87	43-116
$ 70 2,4,6-Tribromophen	200	166	83.04	10-123
$ 85 Terphenyl-d14	100	84.1	84.13	33-141

* - Values outside of QC limits
Spike Recovery: 0 out of 17 outside limits
0 out of 17 not found

ANL-E. CYCLOTRON
per Dolores Geraghty

ARGONNE NATIONAL LABORATORY
ANALYTICAL CHEMISTRY LABORATORY

SEMIVOLATILE ORGANICS ANALYSIS BENCH SHEET
MATRIX: WATER

Bench Sheet Number ______

Sheet ______ of ______

ACL Sample Number	Customer Sample Number	Date Received	Sample Size, mL	pH	Extraction Date / Initial	Concentration Date / Initial	GPC [Y/N]	Extract Vol. A / BN	MS Analysis	Comments
97-1003	Lab Blank	—	500	6	10/3/97 LC YT	10/6/97 YT	N	1 mL	10/20/97 Y	
97-8257-01	35ACL-SVOC	9/24/97	1000	5	↓	↓	↓	↓	↓	
-01MS	MS	"	500	5	↓	↓	↓	↓	↓	
-01MSD	MSD	"	500	5	↓	↓	↓	↓	↓	

Reagent Tracking:
$MeCl_2$ #B0090
Na_2SO_4 Lot 8024KMBJ
NaOH ______
H_2SO_4 ______

Standard Tracking:
1000 µL of Acid Surrogate Std # P.60 Book #1078
______ µL of Base Surrogate Std # ______
1000 µL of Matrix Spike # Acid 200 ug/mL, B/N 100 ug/mL 1/27/97 mJS
______ µL of Internal Std # ______

A = Acid 200 ug/mL
B = Base/Neutral 100 ug/mL

Extracts Transferred to: ______________ Date ______

CMT-94B (1/94)

APPENDIX M:

INDUSTRIAL HYGIENE SUMMARY REPORT FOR LEADED PAINT

Date: November 20, 1997

To: C. Sholeen ESH-Health Physics

From: M. Bonkalski MB ESH-Industrial Hygiene
R. Utesch RU ESH-Industrial Hygiene

Subject: **Industrial Hygiene Survey Summary Report**

Operation Surveyed:	Paint Samples
Location Surveyed:	Building 211
Material or Hazard Measured:	Lead
Method of Measurement:	TN-*spectrace* XRF Lead Analyzer *Limit of Detection: 0.0001 mg/cm^2*

Sample Description and Results:

All painted materials in Building 211 scheduled for demolition in association with the D&D of the 60" Cyclotron Facility were checked for lead using the XRF lead analyzer (15 second sample interval). See table for results. Where possible, lead in paint concentrations were indicated directly on the painted materials.

Applicable Standards:

OSHA Lead Standard - 1926.62 (Construction)

Recommendations:

Demolition or renovation work is required to meet the provisions of the OSHA Lead Standard, which specifies maintaining exposures below 50 $\mu g/m^3$ with certain items triggered at an Action Level of 30 $\mu g/m^3$. No specific definition of "lead-containing paint" is included in the standard.

However, an amendment to the Toxic Substance Control Act (TOSCA), PL 102-550, SEC 1021, Title IV, "Lead Exposure Reduction," defines lead-based paint as a surface coating containing lead in excess of 1 mg/cm^2, or 0.5% lead by weight. The Consumer Product Safety Act (CPSA), 16 CFR 1303, defines lead-containing paint as that in excess of 0.06% by weight. The survey results indicate which materials have paint with lead. The Steel Structures Painting Council reports that many contractors use the 0.06% level to define their lead projects. Painted materials with results in excess of the limit of detection for the XRF lead analyzer should be considered lead-containing.

For materials determined to be coated with lead-containing paint, workers should use NIOSH-approved respirators for lead dust or fume during the demolitions activities.

If feasible, the lead-containing paint can be chemically stripped from the area to be cut. The paint must be stripped down to bare metal and expose an area around the projected cut so that the mechanical saw, arc or torch will not come in contact with paint.

Industrial Hygiene Survey Summary Report

Recommendations: Continued

The demolition contractor should assure that employees are informed of the Lead Standard requirements and that good work practices are followed to keep the job site as free as practicable from accumulation of lead.

The results of this survey, pertaining to lead-containing paint, should be discussed with Mark Kamiya - EMO. He will assist you in determining whether or not the waste from this project will be considered hazardous.

Date of Survey October 2, 1997
Survey by M. Bonkalski
Analysis by ---------------

ct: D. Gerhety
M. Robinet
J. Woodring
R. Wynveen
IH File: Building 211
Lead-ANL Projects

Table: Lead Check Results on Various Paint Materials in Building 211
October 2, 1997

Sample Number	Sample Location	Results (mg/cm^2)
29108	Green Multi-layered Paint on Cinder Block Walls of A-119	0.3
29109	Green Multi-layered Paint on Concrete South Wall of A-119	0.1
29110	Green Multi-layered Paint on Door and Door Frame of A-119	0.6 (Frame) 4.7 (Door)
29111	Tan Multi-layered Paint on Cinder Block Walls of A-111	0.3
29112	Tan Multi-layered Paint on Concrete South Wall of A-111	0.2
29113	Tan Paint on Air Handling System in A-111	0.2
29114	Tan Multi-layered Paint on Door and Door Frame of A-111	0.5 (Frame) 5.8 (Door)
29115	Green Multi-layered Paint on Cinder Block Walls in B-102	0.02
29116	Green Multi-layered Paint on Double Doors and Door Frame on B-102	0.05 (Frame) 1.2 (Door)
29117	White Paint from Overhead Ductwork in B-102	<LOD - Negative for Lead
29118	Tan Paint on Walls of C-101 (Vault)	0.2
29119	Brownish Red Paint from Steel Walk-way and Stairs	0.3
29120	Brownish Red Paint on Yoke	0.1
29121	Tan Paint on Hood	0.1
29122	Gray Paint on Magnet Support (Gray Magnet)	2.3
29123	Gray Paint on Magnets	0.3
29124	Gray Paint on Crane Ladder	0.67
29125	White Paint on Floor	0.02
29126	Yellow Paint on Magnet	0.7

Table: Lead Check Results on Various Paint Materials in Building 211 (Cont.)
October 2, 1997

29127	Gray Paint on Magnet Structural Support (Yellow Magnet)	0.04
29128	Yellow Paint on Floor of C-001	0.05
29129	Yellow Paint on Walls of C-001	0.09
29130	Gray Paint on DC Generators in C-001	0.02
29131	Yellow Paint with Red Undercoat on Personnel Door to C-101	0.08
29132	Tan Paint on Walls of B-118	0.8
29133	Yellow Paint on Double Doors and Door Frame in B-118	0.3 (Frame) 0.3 (Door)
29134	Tan Paint on Differential Coupling in A-004	<LOD - Negative for Lead
29135	Green Paint on Steel Vault in A-051	0.2
29136	Gray Paint from Hydraulic Pumps and Associated Piping in A-020	4.9
29137	Gray Paint from Hydraulic Pumps and Associated Piping in B-007	3.2
29138	White Paint from Cooling Towers (Outside Building)	<LOD - Negative for Lead

APPENDIX N:

SUMMARY OF ASBESTOS MEASUREMENT RESULTS

Date: March 16, 1998

To: C. Sholeen ESH-HP

From: D. R. Lucas DRL ESH-Industrial Hygiene
R. C. Utesch RCU ESH-Industrial Hygiene

Subject: **Industrial Hygiene Survey Summary Report**

Operation Surveyed: Building Material

Location: Bldg. 211

Material or Hazard Measured: Fiber Identification

Method of Measurement: Polarized Light Microscopy with Dispersion Staining

Sample Description and Results:

See attached table: (Bldg. 211)

Applicable Standards: OSHA Asbestos Standard (29CFR1926.1101)

Recommendations:

These samples were collected to determine the fiber content of the material before removal or demolition.

Since most of the materials were identified as asbestos-containing, employees working near the identified materials should be notified and precautions should be taken during the removal of the material. Only PFS-FPE administered licensed asbestos removal contractor or qualified EMO-Waste Management Mechanics can handle, repair, and/or remove asbestos-containing material.

As for the cyclotron area which was not included in the survey due to inaccessibility, asbestos containing pipe wrap material was only identified in room C-001. The pipe containing asbestos was labeled chilled water and contained approximately 30 linear feet and five pipe joints.

If you or employees have questions regarding results or precaution to be taken, contact Industrial Hygiene (2-3310) or Doug Lucas (2-9781).

Date of Survey: Nov 1992- April 1993
Survey by: D. R. Lucas/BEC
Laboratory Analyses by: Stat Analysis Corp.

ct: D. Geraghty
J. Woodring
R. Wynveen
File: Bldg. 221
Asbestos- ANL
Projects

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	014	Floor Tile Mastic	211-014-FTM-01	ND
			211-014-FTM-02	1-5% Chrysotile
			211-014-FTM-03	NA
211	015	Vibration Duct Isolator	211-015-TSI-01	ND
			211-015-TSI-02	ND
			211-015-TSI-03	ND
211	016	Drywall, Tape and Joint Compound	211-016-DW-01	ND
			211-016-DW-02	ND
			211-016-DW-03	ND
211	017	Ceiling Tile - 2x4 Lay-in w/Grvs & Dots	211-017-CT-01	ND
			211-017-CT-02	ND
			211-017-CT-03	ND
211	018	Baseboard - 4' Brown with Bottom Lip	211-018-BB-01	ND
			211-018-BB-02	ND
			211-018-BB-03	ND
211	019	Baseboard Mastic	211-019-BBM-01	ND
			211-019-BBM-02	ND
			211-019-BBM-03	ND
211	020	Transite Wall Panels	211-020-TR-01	30-40% Chrysotile
			211-020-TR-02	NA
			211-020-TR-03	NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	021	Floor Tile - 12x12 Tan Mottled	211-021-FT-01 211-021-FT-02 211-021-FT-03	ND ND ND
211	022	Floor Tile Mastic	211-022-FTM-01 211-022-FTM-02 211-022-FTM-03	ND ND ND
211	023	Baseboard - 4" Black w/Bottom Lip	211-023-BB-01 211-023-BB-02 211-023-BB-03	ND ND ND
211	024	Baseboard Mastic	211-024-BBM-01 211-024-BBM-02 211-024-BBM-03	ND ND ND
211	025	Transite Panels Above Door		Not Sampled; Assumed ACM
211	026	Floor Tile - 12x12 Tan w/Brn & Wht Swirl		Not Sampled; Assumed ACM
211	027	Floor Tile Mastic		Not Sampled; Assumed ACM

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	028	Chilled Water Supply Pipe Insulation	211-028-TSI-01 211-028-TSI-02 211-028-TSI-03	1-5% Chrysotile NA NA
211	029	Chilled Water Return Pipe Insulation	211-029-TSI-01 211-029-TSI-02 211-029-TSI-03	1-5% Chrysotile NA NA
211	030	Floor Tile - 12x12 Khaki w/White Flecks	211-030-FT-01 211-030-FT-02 211-030-FT-03	ND ND ND
211	031	Floor Tile Mastic	211-031-FTM-01 211-031-FTM-02 211-031-FTM-03	ND ND ND
211	032	Baseboard - 6" Black w/Bottom Lip	211-032-BB-01 211-032-BB-02 211-032-BB-03	ND ND ND
211	033	Baseboard Mastic	211-033-BBM-01 211-033-BBM-02 211-033-BBM-03	ND ND ND
211	034	Floor Tile - 9x9 Beige w/Gray Streaks	211-034-FT-01 211-034-FT-02 211-034-FT-03	ND ND ND

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
11	035	Floor Tile Mastic	211-035-FTM-01 211-035-FTM-02 211-035-FTM-03	1-5% Chrysotile NA NA
211	036	HSA NUMBER NOT USED		
211	037	Pipe Wrap	211-037-TSI-01 211-037-TSI-02 211-037-TSI-03	ND ND ND
11	038	Roof Drain		Not Accessible; Assumed ACM
11	039	HSA NUMBER NOT USED		
11	040	HSA NUMBER NOT USED		
211	041	Floor Tile - 12x12 Gry w/Wht & Brn Fleck	211-041-FT-01 211-041-FT-02 211-041-FT-03	1-5% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	042	Floor Tile Mastic	211-042-FTM-01	1-5%Chr 15-20%Amo
			211-042-FTM-02	NA
			211-042-FTM-03	NA
211	043	Tank Insulation	211-043-TSI-01	10-15%Chr 5-10%Amo
			211-043-TSI-02	NA
			211-043-TSI-03	NA
211	044	Reheat Tank Insulation	211-044-TSI-01	15-20% Chrysotile
			211-044-TSI-02	NA
			211-044-TSI-03	NA
211	045	Tank Insulation	211-045-TSI-01	10-15% Chrysotile
			211-045-TSI-02	NA
			211-045-TSI-03	NA
211	046	Chilled Drinking Water PJC	211-046-TSI-01	1-5% Chrysotile
			211-046-TSI-02	NA
			211-046-TSI-03	NA
211	047	Chilled Drinking Water Pipe Insulation	211-047-TSI-01	1-5% Chrysotile
			211-047-TSI-02	NA
			211-047-TSI-03	NA
211	048	Debris on Floor	211-048-TSI-01	ND
			211-048-TSI-02	ND
			211-048-TSI-03	5-10% Chrysotile

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	049	Fire Door		Not Sampled; Assumed ACM
211	050	Floor Tile - 12x12 Khaki w/White Flecks	211-050-FT-01 211-050-FT-02 211-050-FT-03	ND ND ND
211	051	Floor Tile Mastic	211-051-FTM-01 211-051-FTM-02 211-051-FTM-03	ND 1-5% Chrysotile NA
211	052	Baseboard - 6" w/Bottom Lip	211-052-BB-01 211-052-BB-02 211-052-BB-03	ND ND ND
211	053	Baseboard Mastic	211-053-BBM-01 211-053-BBM-02 211-053-BBM-03	ND ND ND
211	054	Steam PJC	211-054-TSI-01 211-054-TSI-02 211-054-TSI-03	1-5% Chrysotile NA NA
211	055	Condensate PJC	211-055-TSI-01 211-055-TSI-02 211-055-TSI-03	5-10% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	056	Steam Pipe Insulation	211-056-TSI-01 211-056-TSI-02 211-056-TSI-03	30-40% Chrysotile NA NA
211	057	Condensate Pipe Insulation	211-057-TSI-01 211-057-TSI-02 211-057-TSI-03	1-5%Chr 15-20%Amo NA NA
211	058	Floor Tile - 9x9 Tan w/Wht & Dk Brn Strk	211-058-FT-01 211-058-FT-02 211-058-FT-03	1-5% Chrysotile NA NA
211	059	Floor Tile Mastic	211-059-FTM-01 211-059-FTM-02 211-059-FTM-03	1-5% Chrysotile NA NA
211	060	Chilled Water Supply PJC	211-060-TSI-01 211-060-TSI-02 211-060-TSI-03	15-20% Chrysotile NA NA
211	061	Chilled Water Return PJC	211-061-TSI-01 211-061-TSI-02 211-061-TSI-03	10-15% Chrysotile NA NA
211	062	Freon Suction PJC	211-062-TSI-01 211-062-TSI-02 211-062-TSI-03	10-15% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	063	Steam PJC	211-063-TSI-01 211-063-TSI-02 211-063-TSI-03	10-15% Chrysotile NA NA
211	064	Condensate PJC	211-064-TSI-01 211-064-TSI-02 211-064-TSI-03	10-15% Chrysotile NA NA
211	065	Steam Pipe Insulation	211-065-TSI-01 211-065-TSI-02 211-065-TSI-03	10-15%Chr 10-15%Am NA NA
211	066	Laboratory Cold Water PJC	211-066-TSI-01 211-066-TSI-02 211-066-TSI-03	10-15% Chrysotile NA NA
211	067	Chilled Water Supply PJC	211-067-TSI-01 211-067-TSI-02 211-067-TSI-03	15-20% Chrysotile NA NA
211	068	Chilled Water Return PJC	211-068-TSI-01 211-068-TSI-02 211-068-TSI-03	10-15% Chrysotile NA NA
211	069	Domestic Cold Water PJC	211-069-TSI-01 211-069-TSI-02 211-069-TSI-03	10-15% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	070	Drain PJC	211-070-TSI-01 211-070-TSI-02 211-070-TSI-03	5-10% Chrysotile NA NA
211	071	Convective Heating Supply PJC	211-071-TSI-01 211-071-TSI-02 211-071-TSI-03	5-10% Chrysotile NA NA
211	072	Convective Heating Return PJC	211-072-TSI-01 211-072-TSI-02 211-072-TSI-03	5-10% Chrysotile NA NA
211	073	Floor Tile - 9x9 Gray w/Ivory Streaks	211-073-FT-01 211-073-FT-02 211-073-FT-03	ND ND ND
211	074	Floor Tile Mastic	211-074-FTM-01 211-074-FTM-02 211-074-FTM-03	1-5% Chrysotile NA NA
211	075	Baseboard - 4" Black w/Bottom Lip	211-075-BB-01 211-075-BB-02 211-075-BB-03	ND ND ND
211	076	Baseboard Mastic	211-076-BBM-01 211-076-BBM-02 211-076-BBM-03	ND ND ND

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	077	Floor Tile - 9x9 Beige w/White Streaks	211-077-FT-01 211-077-FT-02 211-077-FT-03	ND ND ND
211	078	Floor Tile Mastic	211-078-FTM-01 211-078-FTM-02 211-078-FTM-03	1-5% Chrysotile NA NA
211	079	Floor Tile - 12x12 Khaki w/White Flecks	211-079-FT-01 211-079-FT-02 211-079-FT-03	ND ND ND
211	080	Floor Tile Mastic	211-080-FTM-01 211-080-FTM-02 211-080-FTM-03	ND ND ND
211	081	Pipe Sealant	211-081-TSI-01 211-081-TSI-02 211-081-TSI-03	ND ND ND
211	082	Floor Tile - 9x9 Olive w/Blk & Wht	211-082-FT-01 211-082-FT-02 211-082-FT-03	ND ND ND
211	083	Floor Tile Mastic	211-083-FTM-01 211-083-FTM-02 211-083-FTM-03	1-5% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	084	Heater Insulation	211-084-TSI-01	15-20% Chrysotile
			211-084-TSI-02	NA
			211-084-TSI-03	NA
211	085	Roof Drain PJC	211-085-TSI-01	15-20% Chrysotile
			211-085-TSI-02	NA
			211-085-TSI-03	NA
211	086	Floor Tile - 9x9 Tan w/White Streaks	211-086-FT-01	ND
			211-086-FT-02	ND
			211-086-FT-03	ND
211	087	Floor Tile Mastic	211-087-FTM-01	1-5% Chrysotile
			211-087-FTM-02	NA
			211-087-FTM-03	NA
211	088	Domestic Cold Water PJC	211-088-TSI-01	5-10% Chrysotile
			211-088-TSI-02	NA
			211-088-TSI-03	NA
211	089	Floor Tile - 9x9 Gray w/Ivory Streaks	211-089-FT-01	1-5% Chrysotile
			211-089-FT-02	NA
			211-089-FT-03	NA
211	090	Floor Tile Mastic	211-090-FTM-01	1-5% Chrysotile
			211-090-FTM-02	NA
			211-090-FTM-03	NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	091	Baseboard - 4" Black w/Bottom Lip	211-091-BB-01	ND
			211-091-BB-02	ND
			211-091-BB-03	ND
211	092	Baseboard Mastic	211-092-BBM-01	ND
			211-092-BBM-02	ND
			211-092-BBM-03	ND
211	093	Drywall, Tape and Joint Compound	211-093-DW-01	ND
			211-093-DW-02	ND
			211-093-DW-03	ND
211	094	Floor Tile - 9x9 Tan w/Wht & Rust Strks	211-094-FT-01	ND
			211-094-FT-02	ND
			211-094-FT-03	ND
211	095	Floor Tile Mastic	211-095-FTM-01	ND
			211-095-FTM-02	1-5% Chrysotile
			211-095-FTM-03	NA
211	096	Roof Drain PJC	211-096-TSI-01	ND
			211-096-TSI-02	ND
			211-096-TSI-03	ND
211	097	Floor Tile - 9x9 Olive w/Blk & Wht	211-097-FT-01	ND
			211-097-FT-02	ND
			211-097-FT-03	ND

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	098	Floor Tile Mastic	211-098-FTM-01 211-098-FTM-02 211-098-FTM-03	1-5% Chrysotile NA NA
211	099	Steam PJC	211-099-TSI-01 211-099-TSI-02 211-099-TSI-03	ND ND ND
211	100	Condensate PJC	211-100-TSI-01 211-100-TSI-02 211-100-TSI-03	1-5% Chrysotile NA NA
211	101	Floor Tile - 9x9 Olive w/White Streaks	211-101-FT-01 211-101-FT-02 211-101-FT-03	1-5% Chrysotile NA NA
211	102	Floor Tile Mastic	211-102-FTM-01 211-102-FTM-02 211-102-FTM-03	ND ND ND
211	103	Roof Drain PJC		Not Accessible; Assumed ACM
211	104	Domestic Cold Water PJC	211-104-TSI-01 211-104-TSI-02 211-104-TSI-03	5-10% Chrysotile NA NA

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	105	Steam Supply PJC	211-105-TSI-01 211-105-TSI-02 211-105-TSI-03	ND ND 1-5% Chrysotile
211	106	Steam Return PJC	211-106-TSI-01 211-106-TSI-02 211-106-TSI-03	1-5% Chrysotile ND ND
211	107	Transite Wall Panels	211-107-TR-01 211-107-TR-02 211-107-TR-03	30-40% Chrysotile NA NA
211	108	HSA NUMBER NOT USED		
211	109	Steam PJC	211-109-TSI-01 211-109-TSI-02 211-109-TSI-03	ND ND ND
211	110	Condensate PJC	211-110-TSI-01 211-110-TSI-02 211-110-TSI-03	ND ND ND
211	111	Baseboard - 2" Black w/Bottom Lip	211-111-BB-01 211-111-BB-02 211-111-BB-03	ND ND ND

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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	112	Baseboard Mastic	211-112-BBM-01 211-112-BBM-02 211-112-BBM-03	ND ND ND
211	113	Baseboard - 4" Black w/Bottom Lip	211-113-BB-01 211-113-BB-02 211-113-BB-03	ND ND ND
211	114	Baseboard Mastic	211-114-BBM-01 211-114-BBM-02 211-114-BBM-03	ND ND ND
211	115	Convective Heating Supply PJC	211-115-TSI-01 211-115-TSI-02 211-115-TSI-03	5-10% Chrysotile NA NA
211	116	Convective Heating Return PJC	211-116-TSI-01 211-116-TSI-02 211-116-TSI-03	5-10% Chrysotile NA NA
211	117	Heater Insulation	211-117-TSI-01 211-117-TSI-02 211-117-TSI-03	5-10% Chrysotile NA NA
211	118	Chiller Insulation	211-118-TSI-01 211-118-TSI-02 211-118-TSI-03	10-20% Chrysotile NA NA

HSA DATABASE TABLE
SUSPECT ACM
HSA LIST BY BUILDING
November 1992 - April 1993
ARGONNE NATIONAL LABORATORY - EAST
ARGONNE, ILLINOIS

Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results
211	119	Heat Exchanger Insulation	211-119-TSI-01 211-119-TSI-02 211-119-TSI-03	20-25% Amosite NA NA
211	120	Vibration Duct Isolator	211-120-TSI-01 211-120-TSI-02 211-120-TSI-03	ND ND ND
211	121	Chilled Water Supply PJC	211-121-TSI-01 211-121-TSI-02 211-121-TSI-03	ND ND ND
211	122	Chilled Water Supply PJC	211-122-TSI-01 211-122-TSI-02 211-122-TSI-03	ND ND ND
211	123	Chilled Water Return PJC	211-123-TSI-01 211-123-TSI-02 211-123-TSI-03	ND ND ND
211	124	Condensate PJC	211-124-TSI-01 211-124-TSI-02 211-124-TSI-03	ND ND ND
211	125	Vibration Duct Isolator	211-125-TSI-01 211-125-TSI-02 211-125-TSI-03	ND ND ND

HSA DATABASE TABLE
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Bldg #	HSA #	Material Description	Sample Numbers	Analytical Results

NOTE: See KEY page in APPENDIX A for acronyms/abbreviations/notes.

Total Number of HSA's: 125

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