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SURFACE ACTIVITY AND RADIATION FIELD MEASUREMENTS OF THE TMI-2 REACTOR BUILDING GROSS DECONTAMINATION EXPERIMENT

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ABSTRACT

Surface samples were collected from concrete and metal surfaces within the Three Mile Island Unit 2 Reactor Building on December 15 and 17, 1981 and again on March 25 and 26, 1982. The Reactor Building was decontaminated by hydrolasing during the period between these dates. The collected samples were analyzed for radionuclide concentration at the Idaho National Engineering Laboratory. The sampling equipment and procedures, and the analysis methods and results are discussed in this report.

The measured mean surface concentrations of ^{137}Cs and ^{90}Sr on the 305-ft elevation floor before decontamination were, respectively, 3.6 ± 0.9 and 0.17 ± 0.04 $\mu Ci/cm^2$. Their mean concentrations on the 347-ft elevation floor were about the same. On both elevations, walls were found to be considerably less contaminated than floors. The fractions of the core inventories of ^{137}Cs, ^{90}Sr, and ^{129}I deposited on Reactor Building surfaces prior to decontamination were calculated using their mean concentrations on various types of surfaces. The calculated values for these three nuclides are 3.5 ± 0.4 E-4, 2.4 ± 0.8 E-5, and 5.7 ± 0.5 E-4, respectively.

The decontamination operations reduced the ^{137}Cs surface activity on the 305- and 347-ft elevations by factors of 20 and 13, respectively. The ^{90}Sr surface activity reduction was the same for both floors, that being a factor of 30. On the whole, decontamination of vertical surfaces was not achieved.

Beta and gamma exposure rates that were measured during surface sampling were examined to determine the degree to which they correlated with measured surface activities. The data were fit with power functions of the form $y = ax^b$. As might be expected, the beta exposure rates showed the best correlation. Of the data sets fit with the power function, the set of December 1981 beta exposure rates exhibited the least scatter. The coefficient of determination for this set was calculated to be 0.915.

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This sampling program was conducted as a joint effort of EG&G Idaho, General Public Utilities Nuclear Corporation (GPUNC)/Metropolitan Edison, and personnel of other technical companies providing support to GPUNC/ Metropolitan Edison. The author gratefully extends thanks to the individuals from these organizations who collected surface samples during one or more Reactor Building entries.

The evolution of the surface sampler from a concept to a tangible tool came about because of the contributions made by a number of individuals. The conceptual design of the sampler was a fusion of ideas and suggestions offered by T. E. Cox, C. V. McIsaac, P. D. Randolph, and O. D. Simpson. The design engineering work was performed by W. M. Laney. Special thanks are extended to Bill Miller, owner of the K&M Machine and Tool Company, Hummelstown, Pennsylvania, and his staff for the extra effort they made when fabricating the two prototype samplers. D. M. Anderson, D. C. Hetzer, C. V. McIsaac, Bill Miller and S. V. Rodriquez were instrumental in testing and modifying the prototype samplers.

CONTENTS

FIGURES

TABLES

INTRODUCTION

To measure the effectiveness of the gross decontamination experiment (principally a water spray technique) performed in the Three Mile Island Unit 2 (TMI-2) Reactor Building, the Technical Information and Examination Program's radiation and environment personnel made surface activity measurements before and after the experiment. Eighty-five surface samples were collected during Entries 25 and 26 (December 15 and 16, 1981) and an additional 95 surface samples were obtained during entries 54 and 55 (March 25 and 26, 1982). Radiological survey, thermoluminescent dosimetry, and gamma spectroscopy measurements were performed in conjunction with surface sampling to determine the correlation between surface contamination and radiation
fields.

The surface samples were analyzed at the Idaho National Engineering Laboratory (INEL) using gamma spectroscopy, gross beta, and neutron activation analysis (NAA) technques. These methods determined the surface concentrations of the gamma-emitting nuclides, ^{137}Cs, ^{134}Cs, ^{125}Sb, and ^{60}Co, the beta-emitting nuclide, ^{90}Sr, and the x-ray emitter, ^{129}I. The concentration of total fissile material (i.e. ^{235}U) was also determined for selected samples using a delayed fission neutron counting technique.

This report presents the results of these analyses as pre- and post-decontamination surface concentrations. Also presented are the beta and gamma exposure rates data that were collected concurrently with surface sampling using a gross beta/gamma survey instrument. In addition, decontamination factors (DFs) on a nuclide by nuclide basis are given for each location sampled.

SAMPLING EQUIPMENT

Surface Sampler

Prior to December 1981, efforts to measure the distribution of surface contamination within the TMI-2 Reactor Building relied primarily on the use of smears and radiological survey instruments. However, both of these methods were of limited use. Smears are of unquestioned value when used to determine the presence or absence of loose contamination, but are inadequate to quantify contamination especially if part of it is fixed. The survey instruments that were used lacked sufficient shielding to provide good collimation and, in addition, could not distinguish between gamma rays that originated from the surface of interest and those that passed through the surface having originated from other sources. This latter failing was particularly troublesome when survey measurements were made on the 305-ft elevation because of the contribution to the gamma flux from the highly contaminated water present in the Reactor Building basement. These shortcomings were serious enough to warrant development of a surface sampling device.

The surface sampler used to collect samples from horizontal surfaces at TMI-2 is shown in Figure 1. A similar tool having a smaller base plate was used to obtain samples from vertical surfaces. The sampler is a milling tool that has four major components: (a) a 1.27-cm diameter, 575 rpm, constant speed drill, (b) a drill support assembly that allows setting the sample collection depth, (c) filters for intake air purification and sample collection, and (d) an air pump that forces air across the surface being sampled and through the sample collection filter.

The drill support assembly serves several functions. It maintains a bit axis that is perpendicular to the plane of the base plate; it provides a positive stop for drill movement in the downward direction (the stop is the top surface of the cylindrical drill shaft extension receptacle), and it provides ports for connecting purification and sample filters. The disk-type flange that is welded at a height slightly below the top of the receptacle is marked in 22-1/2 degree intervals providing 16 numbered referenced marks.

Zero penetration depth is set while the base plate of the sampler is pressed firmly against the surface to be sampled. The depth setting disk is turned counterclockwise enough to have a separation between the setting disk and its stop while a slight downward pressure (towards the base plate) is applied on the drill. The setting disk turns freely when not in contact with the stop. While the milling bit is resting on the surface to be sampled, the reference zero is set by turning the depth setting disk clockwise until it just begins to bind against the stop. The reference zero is now read as the number that occupies the sector below the shaft of the disk locking 'T' handle.

Sampling depth may be set (after first zeroing the sampler) by turning the penetration depth setting disk counterclockwise the desired number of revolutions. Conterclockwise rotation of the disk from a zero setting will allow the bit to travel beyond the plane of the sampler's base plate when the drill is operated. Each counter revolution of the disk from a reference zero adds 0.635 mm to the penetration depth that will be achieved.

Figure 2 shows the oval sample vacuum chamber that is located on the bottom surface of the sampler's base plate. The chamber, which has an area of 39.03 cm^2 and is 1.575-mm tall, is surrounded by a foam rubber gasket that when compressed seals the chamber. Air is drawn into the chamber through the circular port on the left and exits through the port located at the extreme right end of the chamber. The bit receptacle is centered at the larger end of the chamber near the sloping exhaust port. A bit is fastened to the drill shaft by inserting the threaded end of the bit into the bit receptacle and turning the bit clockwise until snug.

A detailed sketch of the sample filter cartridge is shown in Figure 3. The cartridge body is composed of plastic pipe fittings. The sample collection filter, a Whatman 16 μm paper filter, is held in place in the coupler by two snap rings, a screen, and an 'o'-ring.

The cartridge is installed by removing the nylon tube cap and inserting the plastic intake tube into the exhaust port shown on the right of the cylinder that is the receptacle for the drill shaft extension (see Figure 1).

The stop for the tube is very near the point where the exhaust port enters the oval vacuum chamber so that cross-contamination between samples is minimized. The nylon tube plug is then removed and the coupler on the right in Figure 3 is inserted into the tygon tubing that is the header of the air pump.

Calibration

The vertical and horizontal surface samplers that were used during December 1981 and March 1982 to collect samples at TMI-2 were received at the INEL during May 1982. After decontamination, they were both re-fitted with new drills, 'o'-rings, gaskets, non-skid pads, air purification filters, tygon tubing, and air pumps. The samplers were subsequently used to collect samples from standardized concrete and metal surfaces.

Four standardized surfaces were prepared, two of concrete and two of metal. The concrete slabs, which were each 35.6-cm square and 8.9-cm thick, were poured during March 1982. Each was faced so that no aggregate was visible and the surface was smooth and unpitted. After about three months of curing, each was brush painted with Keeler and Long No. 7107 Epoxy White Primer. They were allowed to dry for two days and then three adhesive strips, each 1.91-cm wide by about 6-cm long, were taped to each surface at locations on the diagonal. The slabs were then brush painted with a Keeler and Long E-1-7938 Epoxy Ivory Cream Enamel that had ^{137}Cs added to produce a surface concentration of approximately 0.1 $\mu Ci/cm^2$. A similar procedure was used to prepare the two metal surfaces except that the primer and finish paints used were Carbo Zinc II and Phenoline 368 WG, respectively, both manufactured by Carboline Co. The paints used are the same as those that were used to paint the corresponding types of surfaces within the TMI-2 Reactor Building.[1]

The surfaces were allowed to dry several days and then the adhesive strips were removed, cut to 2.54-cm lengths, and analyzed at the Radiation Measurements Laboratory (RML) using gamma spectrometry with lithium-drifted germanium [Ge(Li)] detectors to determine the absolute ^{137}Cs surface concentrations.

Following the same sample collection procedure that was used at TMI-2, 15 samples were collected from one of the concrete blocks and four samples were collected from each of the other three standardized surfaces. The mean values of the ^{137}Cs surface concentrations on the four standardized surfaces that were determined by analyzing milled samples and adhesive strips are given in Table 1 for comparison. Although the horizontal concrete surface was sampled to depths of 0.25, 1.27, and 3.18 mm, only one value for the surface activity on the horizontal concrete surface is given in Table 1 under "Milled Samples." The surface activity data indicate that the activity retention efficiency of the horizontal surface sampler is essentially independent of sampling depth for the three depths used. The variability in sample mass among samples that were intended to be collected to the same depth was more pronounced in samples collected from the TMI-2 Reactor Building than in the samples collected from the standardized surface. Unfortunately, only the masses of the samples collected during March 1982 were measured but it is reasonable to assume that the designated and actual sampling depths for samples collected during December 1981 were often not the same. Therefore, for the purpose of calculating the sampler's activity collection efficiency the results for all 15 milled horizontal concrete samples were averaged.

The mean surface activities in Table 1 for the vertical concrete and horizontal steel surfaces were each calculated using the analysis results for four milled samples. One milled vertical steel sample was rejected when calculating the mean surface activity on that surface because the penetration achieved was inadequate and paint remained. The surface activities given in Table 1 that were determined by analyzing adhesive strips are, in each case, the mean value measured on three strips. In each case the uncertainty given is one standard deviation of the mean.

The activity collection efficiencies of the horizontal and vertical surface samplers were calculated using the mean ^{137}Cs surface concentrations given in Table 1. activity collection efficiency for each type of surface is defined here as the ratio of the mean value of ^{137}Cs concentration that was determined by analyzing milled samples to the mean value that

was determined by analyzing the corresponding adhesive strips. The efficiencies were found to be greater than one for all four surfaces. This implies that the actual surface areas removed by milling were larger than the cross sectional area of the bit, which was 1.27 cm^2. The efficiencies range from 1.1 for sampling done on vertical steel to 2.6 for sampling done on vertical concrete. The efficiency for vertical concrete surfaces is substantially higher than that for vertical steel surfaces probably because of the greater vibration induced when milling vertical concrete. The sampling efficiencies for horizontal steel and concrete surfaces are about the same, being 1.6 and 1.4, respectively. In each case, the uncertainty in the value for the efficiency was calculated at the one-sigma level by propagating the errors associated with the corresponding mean surface concentrations. The uncertainties in the efficiencies range from ± 14% for sampling done on horizontal concrete to ± 27% for sampling done on vertical steel. The efficiencies given in Table 1 were used to correct the surface activity concentrations on TMI-2 Reactor Building surfaces that were reported in EG&G Idaho internal technical reports.

Gross Beta/Gamma Survey Instrument

At each sampling location, measurements were made of the gross beta and gamma radiation fields prior to the collection of surface samples. The survey instruments used were all Eberline Instrument Corp. RO-2A's. The RO-2A is equipped with a Juno-type ionization chamber and a 0.0508-mm mylar window.[2] A slide on the bottom of the instrument can be moved to cover the window so as to allow measurement of the gamma component of a radiation field. A measurment made with the slide in the open-window provides a measure of the beta-plus-gamma field. Eberline states the accuracy of this instrument is ± 5% full scale and that its photon response is ± 15% from 12 keV to 1.3 MeV.[2]

To minimize contamination of the instruments each was bagged in plastic prior to use in the Reactor Building. Each instrument was similarly bagged in plastic during its calibration. A bracket having four pointed corner posts was attached to each survey instrument prior to use to provide a

constant source-detector geometry. The height of the corner posts was such as to provide a distance of one inch between the bottom surface of the instrument and the surface being measured.

SAMPLING PROCEDURE

The procedure that was followed during surface sample collection required that a gross beta-gamma survey be made of the surface to be sampled prior to sample collection. At each location, both open- and closed-window measurements were made while the corner posts of the bracket previously described were in contact with the surface.

To minimize cross-contamination between samples, a new milling bit was installed in the surface sampler prior to collecting each sample. A carbide bit was used for milling concrete and cinder block surfaces, and a hardened steel bit was used for milling metal surfaces. The sample collection procedure used for horizontal surfaces included an initial vacuum of the surface without drill operation to remove loose particulates. Following the vacuum and prior to surface milling, a new sample filter cartridge was installed while the sampler remained stationary. The sample collection procedure used for both horizontal and vertical surfaces is given in detail in Appendix A.

The types of surfaces sampled and the number of locations sampled at each elevation are listed in Table 2. These locations are indicated in Figures 4 and 5 as numbered circles and triangles. Figure 4 is the floor plan for the entry-level floor at the 305-ft elevation and Figure 5 is the floor plan for the fuel handling floor at the 347-ft, 6-in. elevation. The circles correspond to sampling locations on horizontal surfaces and the triangles indicate locations where samples were collected from vertical surfaces. Sample locations 26 and HI (see Figure 5) are both on the 'A' D-ring walkway at the 367-ft, 4-in. elevation and locations I and 22 are on the southern I beam that supports reactor coolant pump 2A. Not shown in Figure 5 is sample location H8 on the elevator shaft roof because the location was eliminated when samples were collected during March 1982.

The sampling procedure stipulated that samples were to be collected to a depth of 1.27 mm from all vertical and horizontal metal surfaces, and the standard sampling depth was to be 3.18 mm for all horizontal concrete surfaces. In an attempt to determine whether activity had migrated into painted concrete, samples were collected from floors at multiple depths at

each of six sampling locations before decontamination operations began and at seven locations following completion of decontamination. Sampling was intended to be done at depths from 0.25 to 3.18 mm in the same vicinity at each of these floor locations.

In order to estimate the actual sampling depths achieved during surface sampling, the net masses of the millings of the March 1982 surface samples were measured. For each milled sample, its net mass was calculated by subtracting the measured mean mass of the 38 vacuum samples collected in March, which was 0.23 ± 0.03 g, from the mass of its filter plus collected millings. The calculated net masses for these post-decontamination samples are given in Table 3 listed by type of surface. Negative net masses are reported as zeroes in the table. These masses may be compared with the theoretical masses corresponding to sampling depths of 0.25, 1.27, and 3.18 mm. If we assume that the sample core radius is a constant 6.35 mm (the radius of the milling bit) and that for concrete surfaces the sample density is 2 mg/mm^3, then these depths in concrete correspond to sample masses of 0.06, 0.32, and 0.80 g, respectively. The first assumption is based on the observation that milling of horizontal concrete usually removed an area of paint that was larger than the cross sectional area of the sample hole. The mean measured masses of the millings of concrete samples that were intended to be collected to depths of 0.25, 1.27, and 3.18 mm are, respectively, 0.26 ± 0.15, 0.24 ± 0.19, and 0.71 ± 0.35 g. It is apparent that on the average, the 0.25 mm samples were actually collected to a depth about the same as that of the 1.27 mm samples.

The masses of the horizontal concrete samples reported in Table 3 were converted to sampling depths after making the same assumptions previously used. The calculated depths for sampling the 0.25, 1.27, and 3.18 mm concrete samples are given in Table 4. The mean values of the calculated sampling depths corresponding to these intended sampling depths are 1.00 ± 0.60, 0.93 ± 0.75, and 2.75 ± 1.36 mm, respectively. Therefore, on the average, samples were collected at only two depths at floor locations where multiple samples were collected.

Keeler and Long, Inc. provided the paints that were applied on unlined concrete surfaces within the TMI-2 Reactor Building. They report[3] the dry film thicknesses of No. 6548 epoxy block filler, No. 7107 epoxy white primer, and No. 7475 epoxy white enamel finish paint as 0.142, 0.076, and 0.064 mm, respectively. The sum of these is 0.282 mm, a value substantially smaller than the calculated depths of sampling for all but three floor samples collected during March 1982. All of the March samples were visually examined following downloading of the sample filter cartridges into petri dishes, and these three samples, 34F2, 54F4 (1), and 54F4 (2) were found to contain a small amount of concrete dust in addition to paint shavings. The negligible sampling depths calculated for these three samples are probably due to larger than normal filter diameters.

ANALYSIS METHODS

The samples arrived at the INEL as filter cartridges containing concrete and paint shavings, metal and paint shavings, paint shavings only, or in the case of vacuum samples, just a few dozen small particles. To achieve a sample configuration compatible with existing RML gamma analysis geometries, the sample filter cartridges were downloaded and each sample was transfered to a 150-mL polyethylene bottle. The collected millings and filters in the sample cartridges were initially transfered to separate, preweighed petri dishes. After first removing the milling bit, each cartridge was opened with the exhaust side oriented down and then in turn each half of the cartridge was held over the petri dish and tapped with a small hand tool. The filter was then removed and placed in the same petri dish. The snap and 'o'-rings were replaced in the cartridge half that held the filter and the cartridge was reassembled.

The cartridge's internals were then washed with 50 mL 1N HCl spiked with 3.3 mg Na_2SO_3 and 3.3 mg KI. After the solution was poured into the cartridge, the cartridge was shaken vigorously and the liquid was then decanted into a 150-mL polythylene bottle. This procedure was repeated using 50 mL of deionized water. The milling bit was placed in a test tube, 5 mL of the same acidic solution was added, the test tube was shaken vigorously, and the liquid was decanted into the same polyethylene bottle. This was repeated using 5 mL of deionized water.

With each sample, a small amount of wash solution was poured from the sample bottle into the corresponding petri dish containing the millings and filter. Using tweezers, the filter was rolled into a cylinder and inserted into the sample bottle. The liquid in the petri dish was then decanted into the same bottle. The petri dish was washed again using about 5 mL of the same solution from the sample bottle. A spatula was used to remove any remaining particulates and they were transferrd to the sample bottle. Thus, after the preparations described above, the 110 mL of liquid that had been used to wash the sample cartridge and milling bit, and the sample filter and collected millings were combined in a 150-mL polyethylene bottle.

Analysis techniques that were used on these samples included gamma spectroscopy, gross beta counting, NAA, and NAA/delayed fission neutron (DFN) counting. Each of the 180 surface samples was analyzed for gamma emitting nuclides; however, because of cost and time considerations not all samples were analyzed for ^{90}Sr, ^{129}I, or fissile material. Ninety-two samples were analyzed for ^{90}Sr, 44 were analyzed for ^{129}I, and 37 were analyzed for fissile material. Certain samples were combined prior to analysis for ^{90}Sr, ^{129}I, or ^{235}U. The vacuum and milled samples collected at sampling location 34 were separately consolidated prior to analyzing for ^{90}Sr. The same applies to samples collected at sampling locations H10 and 91 that were analyzed for ^{129}I. The vacuum samples collected at sampling locations H7, 54, and 149 were separately combined prior to analysis for ^{90}Sr and ^{235}U.

Measured activities in μCi/sample were converted to surface concentrations in $\mu Ci/cm^2$ by two diffrent methods depending on whether the sample was collected by vacuuming only or by milling. The results for milled samples were divided by the bit milling area, 1.27 cm^2, and by the sampler activity collection efficiency corresponding to the type of surface sampled to provide surface activities in $\mu Ci/cm^2$. The efficiencies used are those listed in Table 1. The results for vacuum samples in μCi/sample were converted to surface activities in $\mu Ci/cm^2$ by assuming (a) the surface vacuumed in each case had an area of 39.03 cm^2, which is the area enclosed by the sampler's vacuum chamber, (b) the activity collected during vacuuming without drill operation was evenly distributed over 39.03 cm^2, and (c) the activity collection efficiency of the sampler during vacuuming was 100%. These assumptions were necessary because the loose particulates activity collection efficiency of the sampler was not measured during sampler calibration. The total surface activity concentration was determined by summing for each sample set the milled and vacuum sample results in $\mu Ci/cm^2$. A detailed description of each analysis method that was used is given in Appendix B.

RESULTS

The data tables that follow often present surface concentrations by sample (e.g. 70F1) or by sample location (e.g. 70). These two identification numbers are simply related; samples collected at a given location were all given sample numbers prefixed with the sample location number.

The surface activity concentration results for both the December 1981 and March 1982 samples are presented in $\mu Ci/cm^2$ (decay-corrected to March 26, 1982) in Tables 5 through 29. Tables 5 through 16 present the results for each sample while Tables 17 through 29 give mean surface concentrations of the detected radionuclides by sampling location. The uncertainties in the concentrations determined by analysis of milled samples are given at the one sigma level and are due to counting statistics and the uncertainties in the activity collection efficiencies of the samplers. The uncertainties in the concentrations determined by analysis of vacuum samples are given at the one sigma level and are due to counting statistics only. Unfortunately, the analysis software of the gamma spectrometry system used for this work did not have as a feature automatic detection limit calculation. Therefore, less-than detectable concentrations of ^{125}Sb and ^{60}Co are simply footnoted in the tables.

Table 30 presents the December 1981 mean ^{137}Cs surface concentration in $\mu Ci/cm^2$ (decay-corrected to March 26, 1982) at each sampling location arranged by type of surface and elevation (i.e., 305 ft-0 in., etc.). Similar results for ^{134}Cs, ^{90}Sr, ^{129}I, and ^{125}Sb are given in Tables 31, 32, 33, and 34, respectively. Mean surface concentrations presented in these tables were calculated for horizontal and vertical concrete and horizontal and vertical metal at each of three sampling elevations. The uncertainties in the means are each the standard deviation of the mean calculated at the one sigma level. The mean December 1981 surface concentrations of these five radionuclides are compiled in Table 35. The mean values of the ratios of the December 1981 surface concentrations of several radionuclides to the concentration of ^{137}Cs measured in each surface sample are given for both vacuum and milled samples in Table 36.

Table 37 presents the March 1982 mean ^{137}Cs surface concentration in $\mu Ci/cm^2$ (decay-corrected to March 26, 1982) at each sampling location arranged by type of surface and elevation. Similar results for ^{134}Cs, ^{90}Sr, ^{129}I, and ^{125}Sb are given in Tables 38, 39, 40, and 41, respectively. The mean March 1982 surface concentrations of these five radionuclides on horizontal and vertical concrete and metal surfaces are listed in Table 42 by sampling location elevation. Table 43 presents the mean values of the ratios of the March 1982 surface concentrations of five radionuclides to the concentration of ^{137}Cs measured in each surface sample. The ratios for both vacuum and milled samples are given in this table.

Tables 44 and 45 present, respectively, the beta and gamma exposure rates that were measured during December 1981 and March 1982 using RO2-A survey meters. Mean values of these exposure rates are listed in Table 46 arranged by type of surface and Reactor Building elevation. Beta exposure rates are given in mRad/h and gamma exposure rates are given in mR/h. These data were not decay-corrected.

DFs for ^{137}Cs, ^{90}Sr, and ^{129}I are given, respectively, in Tables 47, 48, and 49. The DFs for vacuum and milled samples are given separately for each location sampled. The DF for each nuclide was calculated as the ratio of the mean surface activity measured at a given sampling location before decontamination to the mean surface activity measured at the same location after decontamination. All activities were decay-corrected to March 26, 1982 prior to calculation of DFs. The data in these tables are arranged by type of surface and by Reactor Building elevation. Decontamination factors were also calculated using total surface activities, these totals being for each nuclide the sum of the mean loose particulate activity and the mean fixed activity measured at a given sampling location. Values of these DFs for ^{137}Cs, ^{90}Sr, and ^{129}I are presented by sampling location in Tables 50, 51, and 52 respectively. Mean DFs for several radionuclides are listed by type of surface and by Reactor Building elevation in Table 53. The results for both vacuum and milled samples are presented separately in this table. Table 54 presents the DFs by sampling location that were calculated using pre- and post-decontamination beta and gamma exposure rates. Mean exposure rate DFs for four generic surfaces are also given in this table.

DISCUSSION

Surface Activities

Prior to decontamination, floors on both Reactor Building elevations were considerably more contaminated than walls, as might be expected. The ratios of the average surface concentrations of ^{137}Cs and ^{90}Sr on the concrete floor to their corresponding average concentrations on the D-ring wall are, respectively 90 to 1 and 190 to 1 on the 305-ft elevation and 80 to 1 and 160 to 1 for the 347-ft elevation. The mean surface concentrations compiled in Table 35 indicate that the average concentrations of all nuclides except ^{125}Sb were about the same on both floors. The concentration of this nuclide was about a factor of 10 higher on the 305-ft elevation floor than it was on the 347-ft elevation, and its concentration was less than detectible on the 'A' D-ring walkway, which is at an elevation of 367 ft. The mean December 1981 concentrations of ^{137}Cs and ^{90}Sr on the 305-ft elevation were, respectively, 3.6 ± 0.9 and 0.17 ± 0.04 $\mu Ci/cm^2$ and their concentrations on the 347-ft elevation floor were 2.5 ± 0.7 and 0.3 ± 0.2 $\mu Ci/cm^2$, respectively.

The sampling location having the highest mean ^{137}Cs surface activity before decontamination was floor location H7, which is beneath the northeast corner of core flood tank 'A'. The mean ^{137}Cs activity at this location was 8 $\mu Ci/cm^2$ which is only about a factor of four higher than the lowest local mean ^{137}Cs concentration measured on the 305-ft elevation. However, surface activities were found to vary by factors sometimes this large or larger over small areas of floor. Samples were collected in the same vicinity, usually from points not more than a few inches apart, at locations 50, 34, and H7 on the 305 ft elevation and at locations 54, H10, and 91 on the 347 ft elevation. Samples were collected at each of these locations to different depths in an attempt to determine if activity had migrated into the concrete. The surface activity of ^{137}Cs, prior to decontamination, varied by factors of 2.2, 2.1 and 12.9 for locations 50, 34, and H7; and 2.0, 3.8, and 3.2 for locations 54, H10, and 91. Following decontamination, surface activities varied by factors of 30, 2.1, 3.6, 6.4, 3.7, and 2.3,

respectively. This nonhomogeneity of surface activity over small areas nullifies any conclusions regarding activity penetration that might be drawn from these surface activity data.

Of the locations whose samples were analyzed for ^{90}Sr, location 149 had the highest pre-decontamination surface activity. That value was 1.0 ± 0.1 $\mu Ci/cm^2$. The mean value of the ratio of ^{90}Sr to ^{137}Cs that was calculated for each sample collected from the 305-ft elevation is 4 ± 2 E-2. Similar ratios for ^{134}Cs, ^{125}Sb, ^{60}Co, and ^{129}I for various types of Reactor Building surfaces were presented in Table 36. The ^{90}Sr to ^{137}Cs ratio for all vacuum samples collected from horizontal surfaces at all elevations is 7 ± 6 E-2 while that for all milled samples collected from the same surfaces is 5 ± 4 E-2. The same ratio for all samples collected from vertical surfaces is 4 ± 1 E-2. The values of these ratios are essentially equal to the value of the ratio of the concentrations of ^{90}Sr to ^{137}Cs that was measured in the liquid samples collected from the Reactor Building basement on May 14, 1981.[4] The value of this latter ratio, 3.7 E-2, was computed after decay correcting the concentrations in $\mu Ci/mL$ to March 26, 1982, the date to which all of the surface concentrations in this report have been decay-corrected. This equality implies that the mode of transport of the ^{90}Sr from the contaminated water in the basement to Reactor Building surfaces was in water droplets and that the majority of the ^{90}Sr was transported to the walls and floors after it had reached chemical equilibrium in the basement water.

Sufficient surface activity data was collected before decontamination to make possible calculations of the fractions of the total core inventories of certain fission products that were deposited and which remained on Reactor Building surfaces. What is needed to perform these calculations is an itemized list of Reactor Building surface areas. That list is provided in Table 55. The surface areas of the four generic surfaces[5] (i.e. horizontal and vertical concrete and steel surfaces) are given in this table. The areas of these surfaces at three different elevation intervals were calculated so that mean surface concentrations on surfaces lying within these intervals could be used directly. Since no surface samples were collected from the Reactor Building basement during the December sample collection

period, the surface activities used for that region of the building were those measured on the 305-ft elevation. Similarly the concentrations used for surfaces at 347-ft, 6-in, elevation and above were estimated as the average of the mean December 1981 surface activities measured on the 347-ft, 6-in. and 367-ft, 4-in. elevations. Using the measured December surface concentrations and the surface areas from Table 55, the total activities of ^{137}Cs, ^{90}Sr, ^{129}I, and ^{125}Sb on various Reactor Building surfaces were calculated. Those activities (measured in curies) are presented in Table 56.

Total core inventories of these nuclides and their calculated inventories on Reactor Building surfaces are given in Table 57. The total core inventories listed are those that were calculated using the ORIGEN-2 Code[6] and have been decay-corrected to March 26, 1982. It is evident that the percentages of the core inventories of these nuclides deposited on Reactor Building surfaces are all very small (see Table 58). Excluding iodine, the values range from 2.4 E-3% for ^{90}Sr to 4.7 E-2% for ^{134}Cs. This latter value is 34% higher than its true value if we assume the ^{137}Cs core inventory to be correct, since the percentage of ^{137}Cs deposited on surfaces is 3.5 E-2%. The highest percentage of the five nuclides listed is that of ^{129}I and the value for it is 5.7 E-2%. The core inventory of ^{131}I at the time of shutdown was 7.0 E+7 Ci[6]. If we assume that the same fraction of ^{129}I was on the floors and walls of the Reactor Building shortly after reactor scram we can readily estimate the initial surface concentration of ^{131}I on those surfaces. Multiplying the ^{131}I inventory by the deposition fraction for ^{129}I and dividing this result by 2.20 E+8 cm^2, the total internal Reactor Building surface area, one arrives at a March 28, 1979 average ^{131}I surface concentration of 180 $\mu Ci/cm^2$.

Several sets of surface samples were collected during December 1981 from an area of the 305-ft elevation just south of the open stairwell. Samples collected at one of the locations in this area, location 55, which is near the containment wall, were found to contain ^{144}Ce. Because Ce is usually associated with fuel, these samples were subjected to analyses for fissile material. The vacuum and milled samples identified as 55F1 and 55F2, respectively, did contain detectible amounts of ^{235}U. The surface

concentrations were measured to be 3.9 and 100 nanograms of ^{235}U per cm^2 (or 150 and 180 nanograms per sample). Other samples collected from the floor in the same general area had less-than-detectible quantities of ^{235}U. The reactor coolant drain tank (RCDT) vent line exhausts on the west side of the RCDT cubicle not too distant from the bottom of the open stairwell. It is probable that the small amount of fuel that was measured was lifted from the basement through the open stairwell during the early stages of RCDT discharge. The obvious implication is that the RCDT and areas of the basement floor in the vicinity of the RCDT cubicle are contaminated with fuel.

The hydrolasing of Reactor Building floors and walls, which was the principle method used during decontamination, reduced the mean ^{137}Cs surface activity on the 305-ft elevation floor to 0.7 ± 0.4 $\mu Ci/cm^2$. The mean ^{137}Cs surface activity on the 347-ft elevation floor was reduced to a comparable level, that being 0.3 ± 0.1 $\mu Ci/cm^2$. The mean surface concentration of ^{90}Sr following decontamination was 2 ± 2 E-2 $\mu Ci/Cm^2$ on the 305-ft elevation floor and 8 ± 3 E-3 $\mu Ci/cm^2$ on the 347-ft elevation floor. The post-decontamination surface activities of other nuclides were presented in Table 42.

Decontamination Factors

DFs for ^{137}Cs, ^{90}Sr, and ^{129}I that were calculated using pre- and post-decontamination surface activities were presented for both vacuum and milled samples in Tables 47, 48, and 49, respectively. DFs for these nuclides were given by sampling location in these tables. Table 53 presented the mean DFs for these three nuclides and for ^{60}Co, ^{125}Sb, and ^{235}U for four generic surfaces at each of three Reactor Building elevations.

The data presented in Table 53 indicate that, as might be expected, loose particulate activity was removed more efficiently than was fixed activity. The ratio of the DF for loose ^{137}Cs particulate activity to that for fixed ^{137}Cs activity is about 7 to 1 for the 305-ft elevation and is about 4 to 1 for the 347-ft elevation floor. The same ratio for ^{90}Sr is about 6 to 1 for the 305-ft elevation and is about 7 to 1 for the 347-ft elevation floor.

The decontamination operations reduced the ^{137}Cs surface activity on the 305-ft elevation by a factor of 20 and reduced that on the 347-ft elevation floor by a factor of 13. The surface activity reduction that was achieved for ^{90}Sr was the same for both floors, that being a factor of 30. The data in Tables 50, 51, and 52 make it apparent that, on the whole, decontamination of vertical surfaces was not acheived. Indeed, of 15 locations on vertical surfaces that were sampled both before and after Reactor Building decontamination, 2 had surface concentrations of ^{137}Cs that remained unchanged and 8 had surface concentrations of ^{137}Cs that were higher after decontamination than before. Apparently some activity splashed onto the walls during hydrolasing of the floors and was not subsequently removed.

The hydrolasing of the 305-ft elevation was, on the averge, equally effective in removing particulate ^{137}Cs and ^{90}Sr activities. If we ignore the results for sample location 149 (because the concentration of ^{90}Sr there was an order of magnitude higher than at any other location sampled during December), the data in Tables 47 and 48 indicate that hydrolasing was also equally effective in removing these particulate activities from the 347-ft elevation floor. However, the fractional reduction in ^{137}Cs and ^{90}Sr particulte activities on the upper floor was substantially less than on the lower floor.

The effectiveness of hydrolasing in removing ^{60}Co, ^{90}Sr, and ^{137}Cs activities fixed to Reactor Building floors was about the same but it was less than half as effective on fixed ^{125}Sb and ^{235}U. The data in Table 53 also show that particulate ^{125}Sb activity was less effectively removed than the particulate ^{90}Sr or ^{137}Cs activities. Since ^{137}Cs is soluble in warm water and ^{125}Sb and ^{235}U are not, it is likely that standing water played as important a role in removing ^{137}Cs and ^{90}Sr activity from floor surfaces as did the abrasive action of the water emitted from the hydrolaser.

Beta and Gamma Exposure Rates

Figures 6 and 7 display the beta and gamma exposure rates data that were measured during the December 1981 and March 1982 sample collection campaigns. These data for each location are displayed in a box adjacent to the location symbol; within each box the beta exposure rates are listed on the left and the gamma exposure rates are listed on the right. Figure 6 shows the exposure rates measured on the 305-ft elevation floor and Figure 7 shows similar data measured on the 347-ft elevation floor.

Gamma exposure rates measured on floor surfaces during December range from 90 mR/h at location 115 to 1,500 mR/h at location 55. Beta exposure rates measured on floor surfaces during December range from 560 mRad/h at location 47 to 7,000 mRad/h at location 34. The mean beta/gamma ratio prior to commencement of decontamination was about 6 to 1 on the 305-ft elevation floor and was about 9 to 1 on the 347-ft elevation floor. The difference is due to the higher mean gamma exposure rate on the lower floor. Of the 12 sampling locations on vertical surfaces for which we have December beta/gamma exposure rates data, only 4 exhibit beta/gamma ratios that have values greater than one. Since the ratio of the concentration of ^{90}Sr to that of ^{137}Cs was found to be statistically the same for both floors and walls (see Table 9), the gamma exposure rates measured on vertical surfaces are probably biased high because of insufficient survey instrument collimation.

Gamma exposure rates measured on floor surfaces during March range from 60 mR/h at location 33 to 2,500 mR/h at location H2. Beta exposure rates on floors at this time range from <130 mRad/h at location 50 to 8,580 mRad/h at location H2. As was the case during December, the D-ring wall above the 347-ft elevation floor exhibited the smallest exposure rates among four types of surfaces sampled.

Decontamination reduced the gamma exposure rates at sampling locations on the 305-ft elevation floor by a factor of about 2. The reduction in gamma exposure rates at sampling location on the 347-ft elevation floor was, on the average, about the same, being a factor of 2.4. Beta exposure rates

were reduced by factors of about 8 and 3, respectively, at sampling locations on the 305-ft and 347-ft elevation floors.

One of the primary motives for performing beta and gamma exposure rate measurements at sampling locations was to determine how well the beta and gamma radiation fields correlated with surface activity. If it could be shown that the fields immediately above a surface were linearly or otherwise simply related to surface activities on that surface then it would be possible to infer surface activities using the results of a quick and simple measurement. The surface activity measurement results reported in this work revealed that ^{137}Cs was the predominant radionuclide on Reactor Building surfaces both prior to and following decontamination and that the concentrations of other radionuclides were, on the average, proportional to its concentration (see Tables 36 and 43). Therefore, ^{137}Cs was chosen as the nuclide having the best potential for being simply related to both the gamma and beta radiation fields.

The mean December 1981 concentrations of ^{137}Cs measured at all sampling locations are plotted versus their corresponding measured beta and gamma exposure rates in Figures 8 and 9 respectively. Figures 10 and 11 are similar graphs of the March 1982 data. An examination of these plots indicates that the measured gamma exposure rates correlate rather poorly with ^{137}Cs surface concentrations, whereas the beta exposure rates appear to rise in a linear manner with increasing ^{137}Cs surface activity. Because a trend in these latter data was suspected, the combined December and March data were plotted in Figure 12.

Least-squares fits of the data to equations of the form $y = ax^b$, where $y = \mu Ci/cm^2$ of ^{137}Cs and x = beta (mrad/h) or gamma (mR/h) exposure rate, were performed. The power curve provides the proper form for displaying linear data on log-log paper. The coefficients of the fits were computed along with the coefficient of determination (r^2). The calculated values of these coefficients for various sets of data are given in Table 58.

Of the data sets fit with the power function, the December 1981 beta exposure rates set exhibited the least scatter. The coefficients of determination for this set is 0.915. The fit of the March 1982 beta data is much poorer, in part, because of the relatively narrower ranges of ^{137}Cs surface concentrations and beta exposure rates. Given the relatively long half-lives of the predominant nuclides (^{137}Cs, 30.17 years; ^{134}Cs, 2.062 years; and ^{90}Sr, 28.8 years), the power function and the coefficients given in Table 58 could be used to estimate ^{137}Cs (and consequently ^{134}Cs and ^{90}Sr) surface concentrations on Reactor Building surfaces at locations that were not sampled using beta exposure rate data. It would be necessary to make these measurements using the same source-detector geometry as was used in this work.

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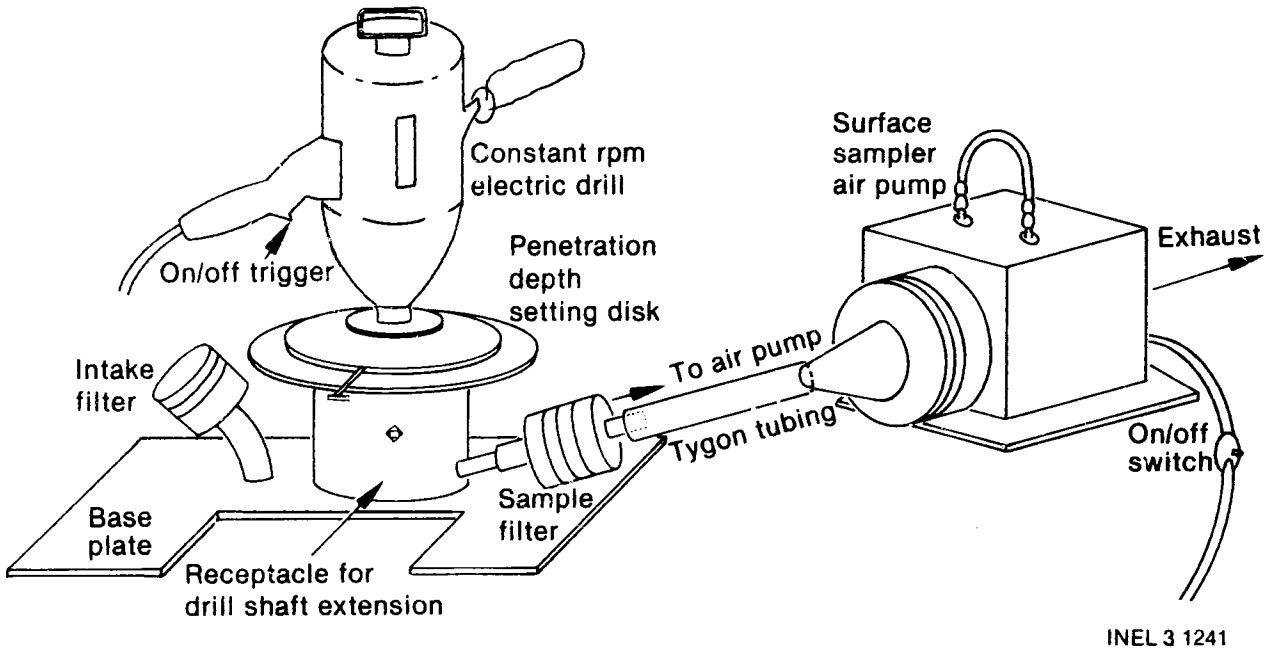

Figure 1. Surface sampler and air pump schematic.

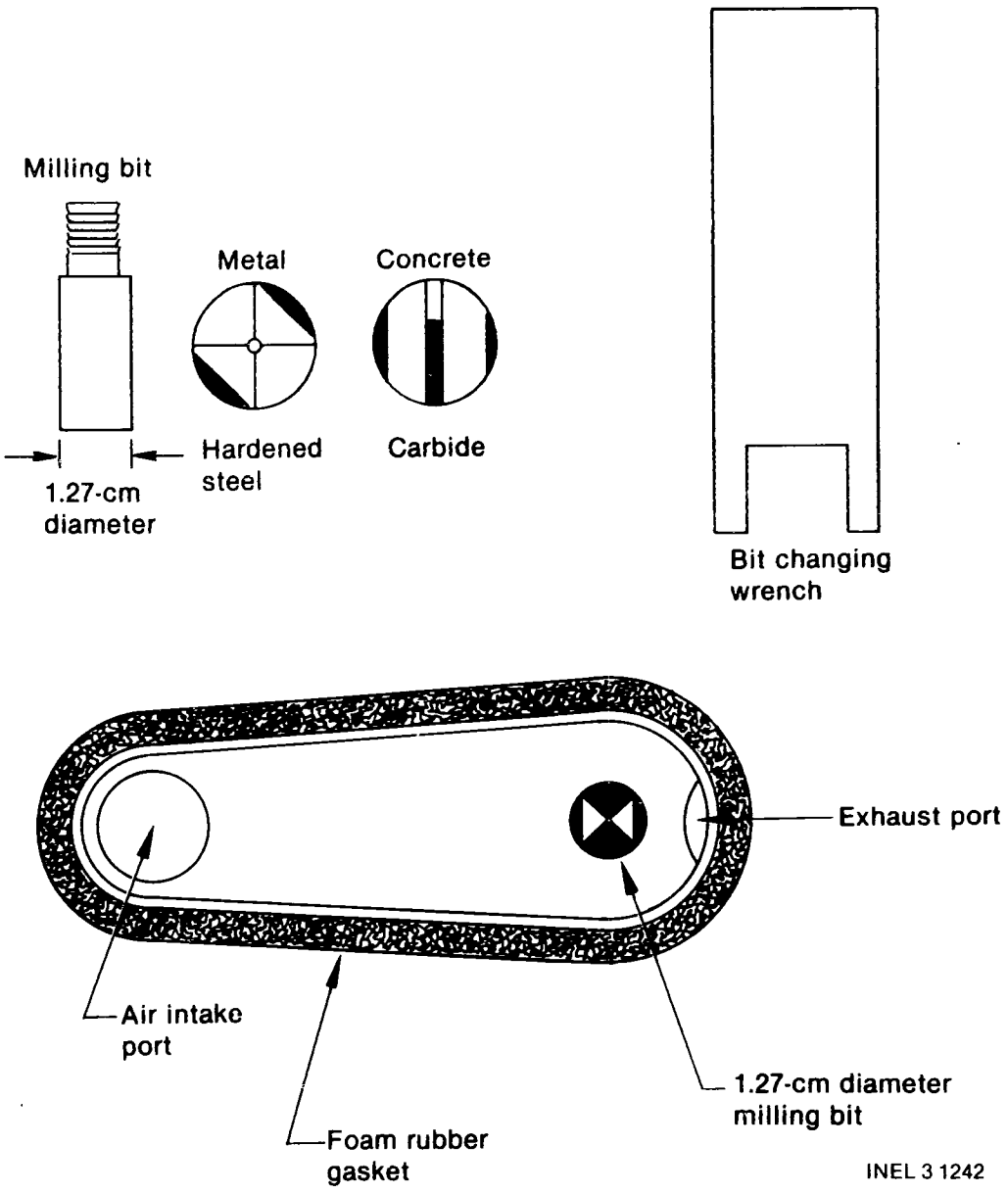

Figure 2. Surface sampler vacuum chamber and milling bits schematic.

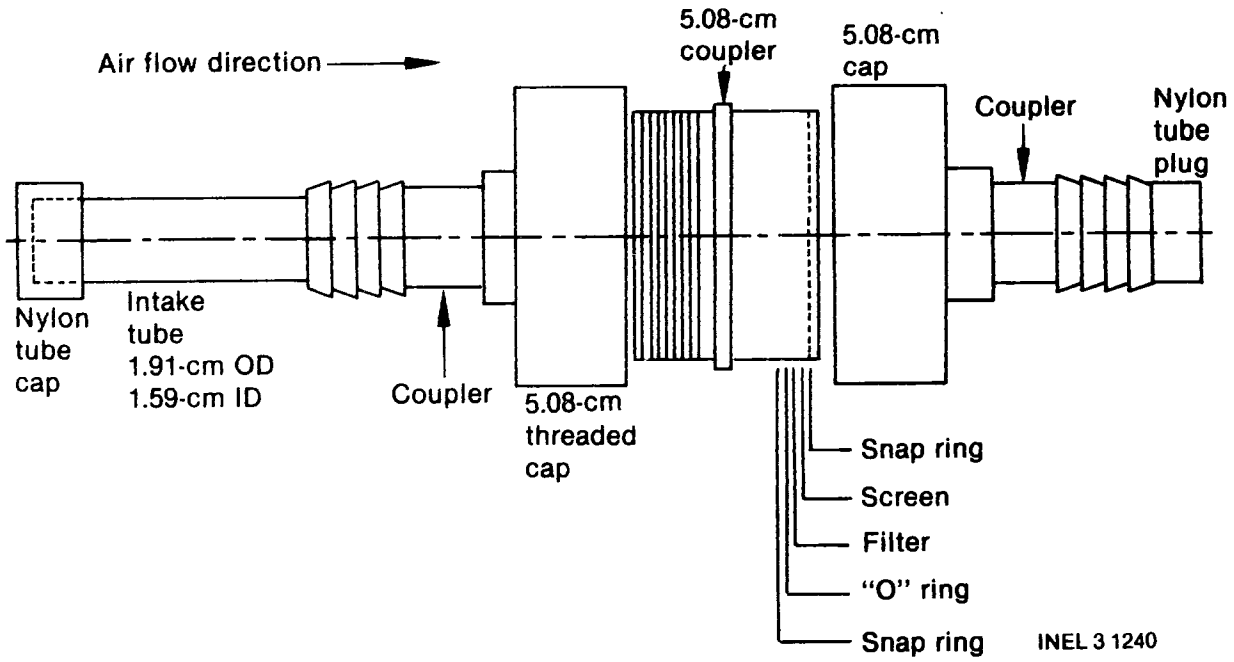

Figure 3. Surface sampler sample filter cartridge schematic.

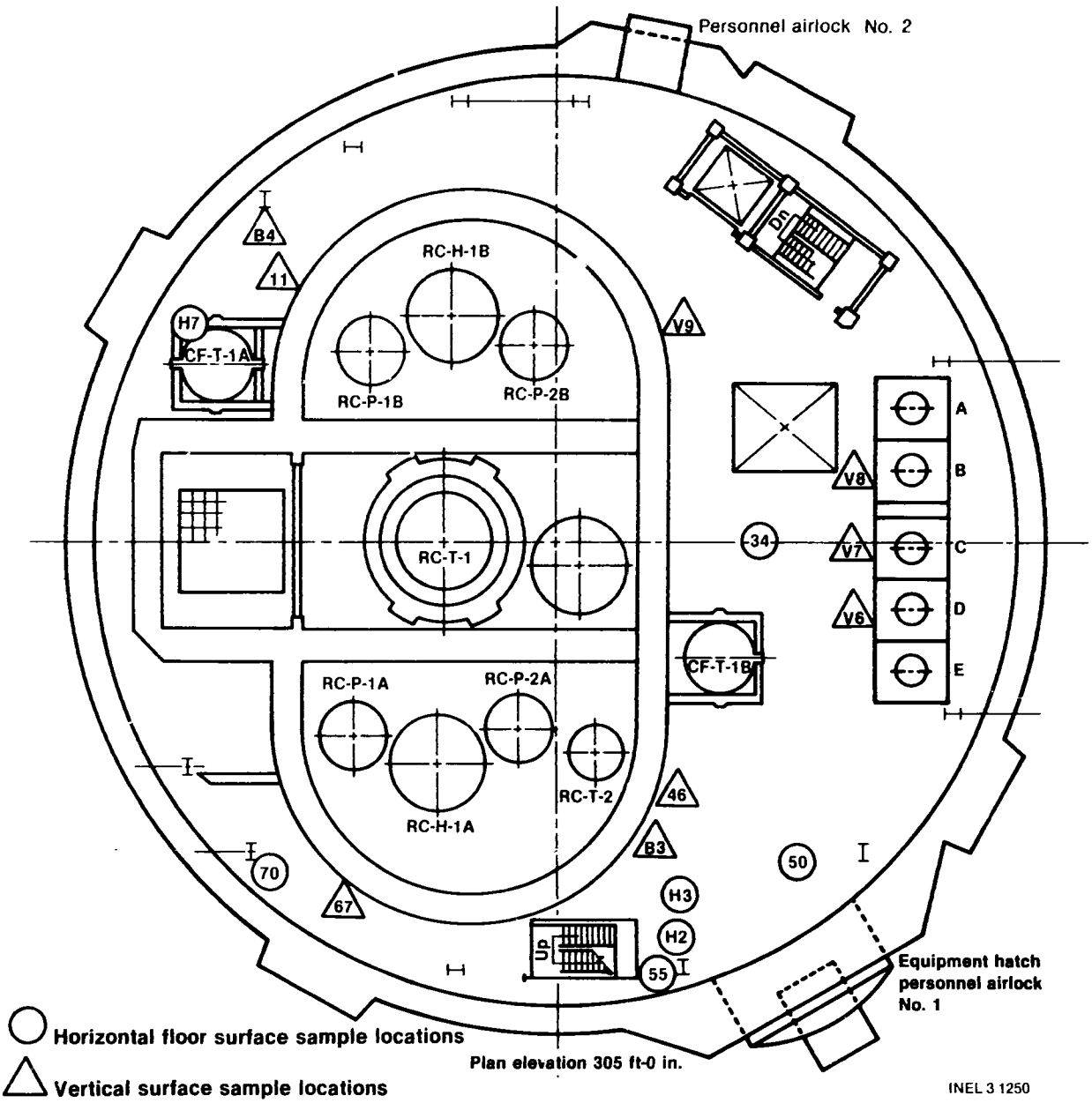

Figure 4. Sample locations at the 305-ft elevation.

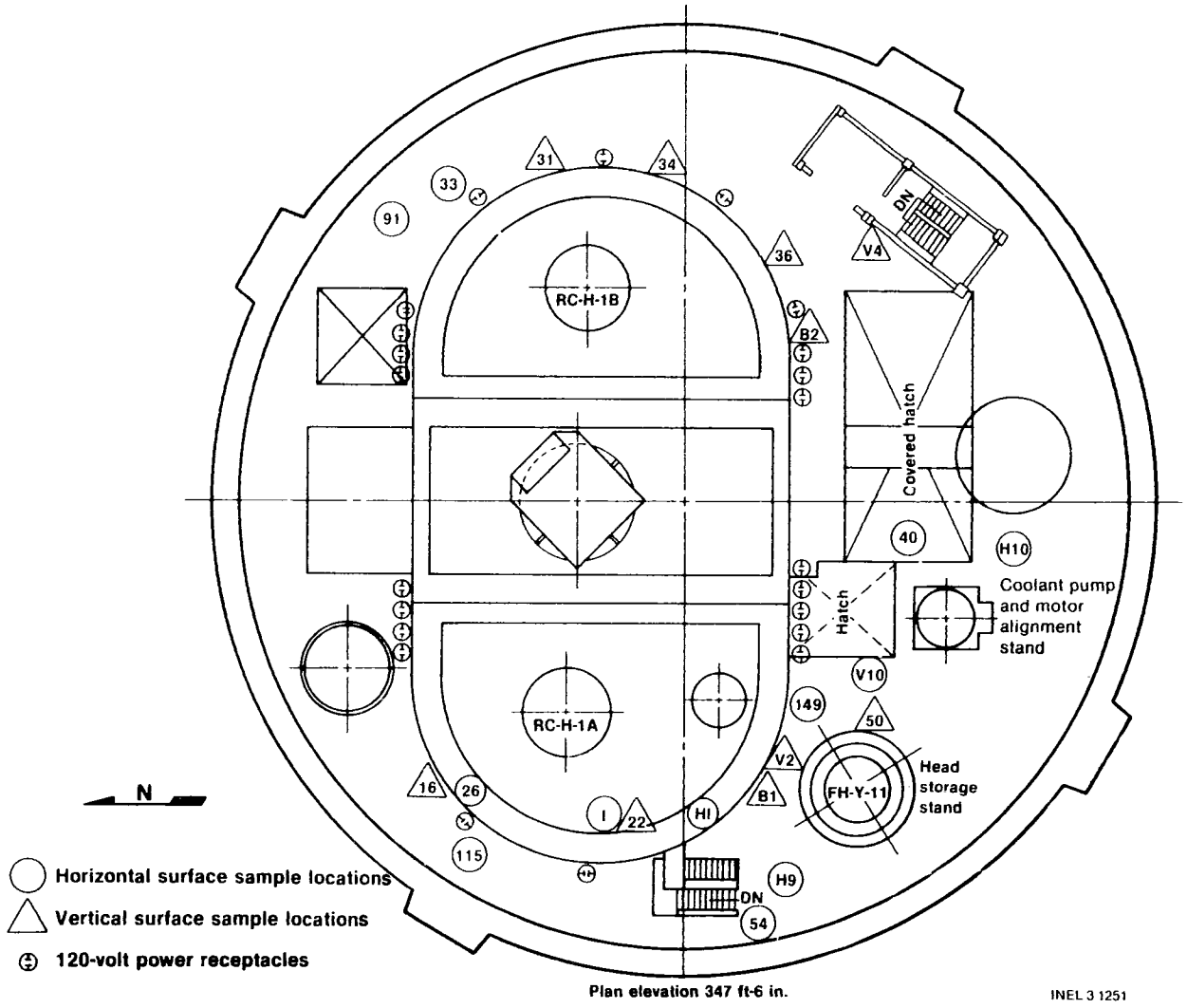

Figure 5. Sample locations at elevations 347 ft-6-in. and above.

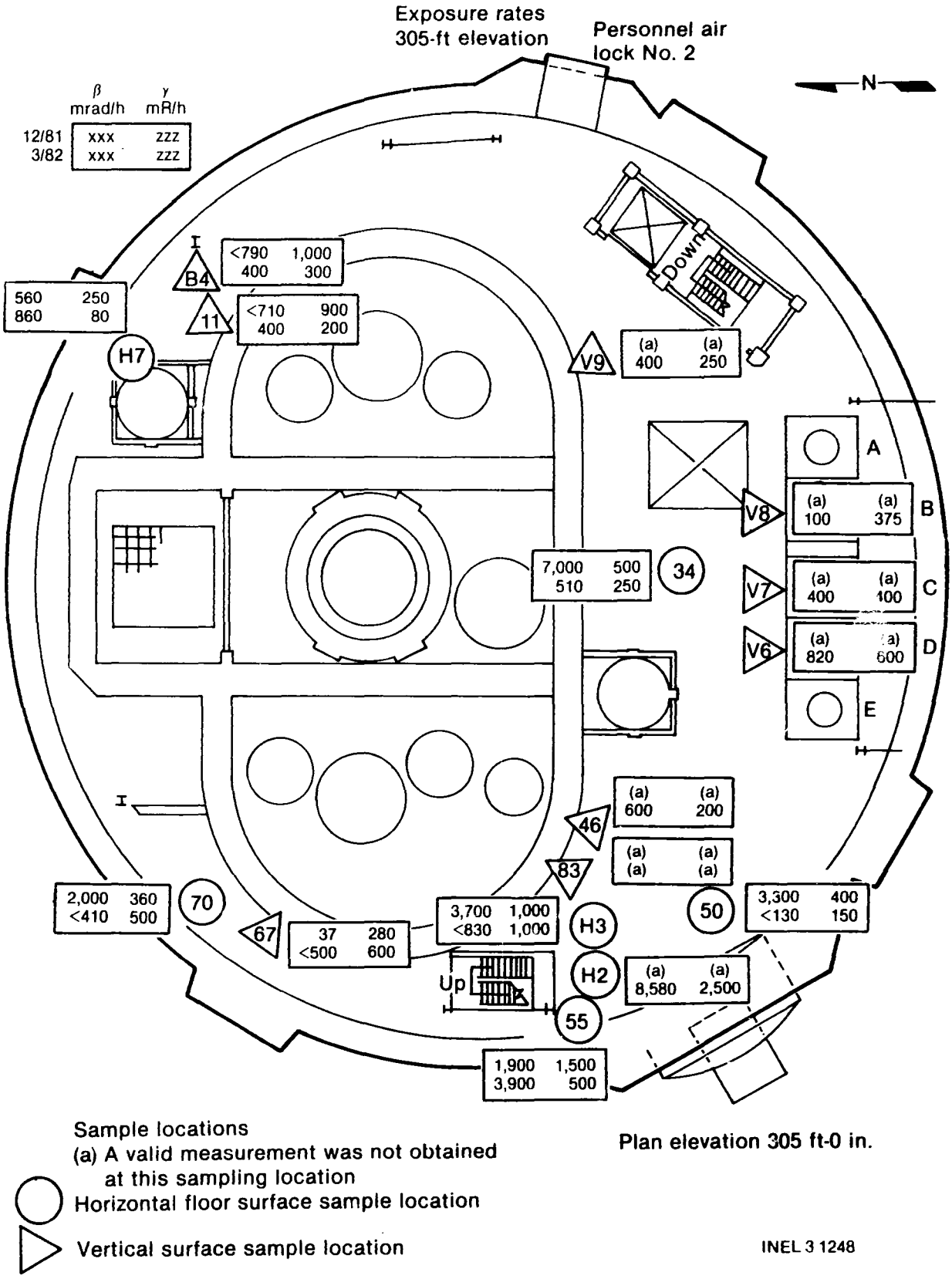

Figure 6. December 1981 and March 1982 beta and gamma exposure rates, at the 305-ft elevation (shown on the 305-ft elevation floor plan).

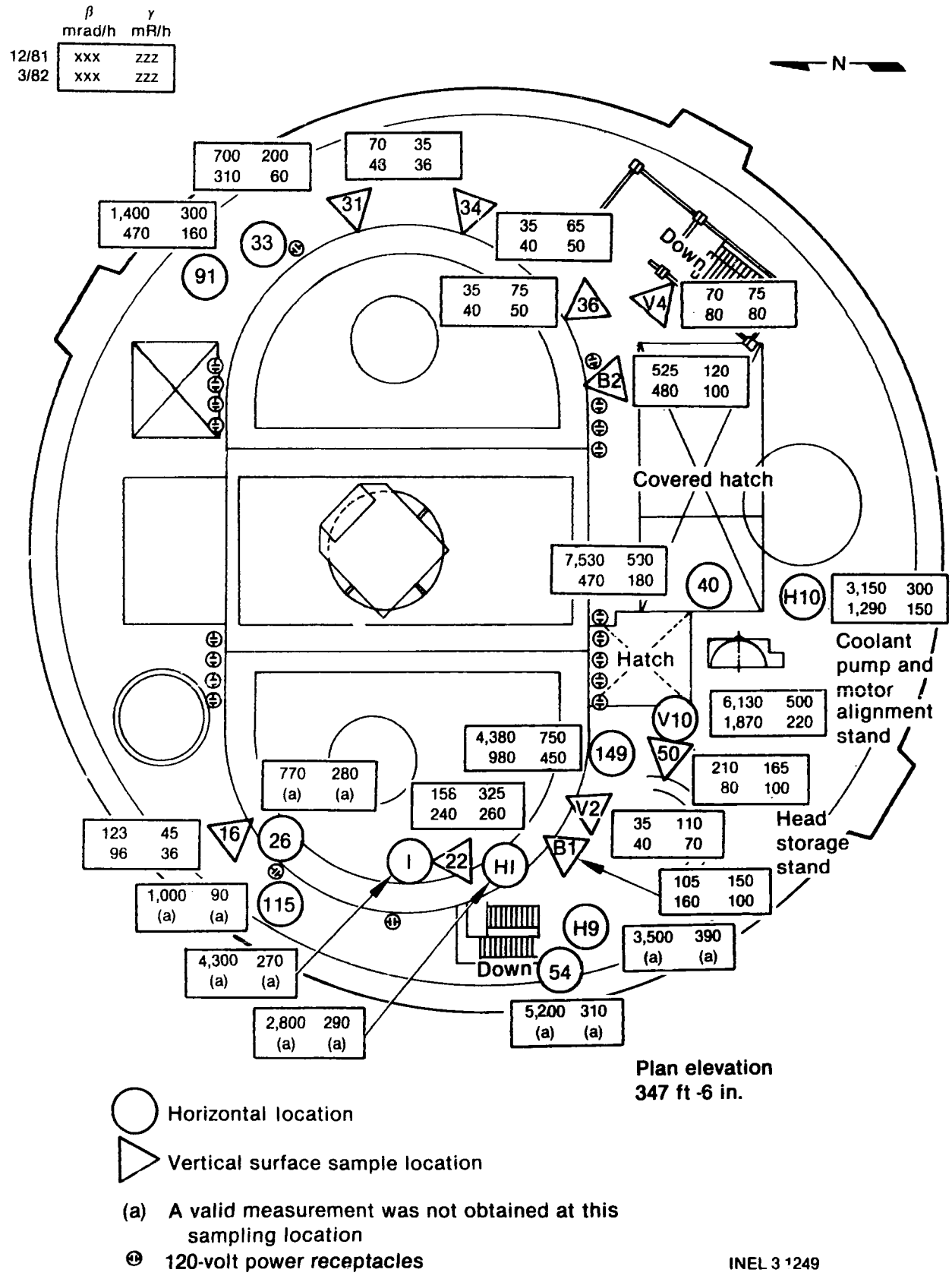

Figure 7. December 1981 and March 1982 beta and gamma exposure rates at elevations 347 ft,6 in., 367 ft,4 in., and 369 ft,6 in. (shown on the 347 ft,6 in. elevation floor plan).

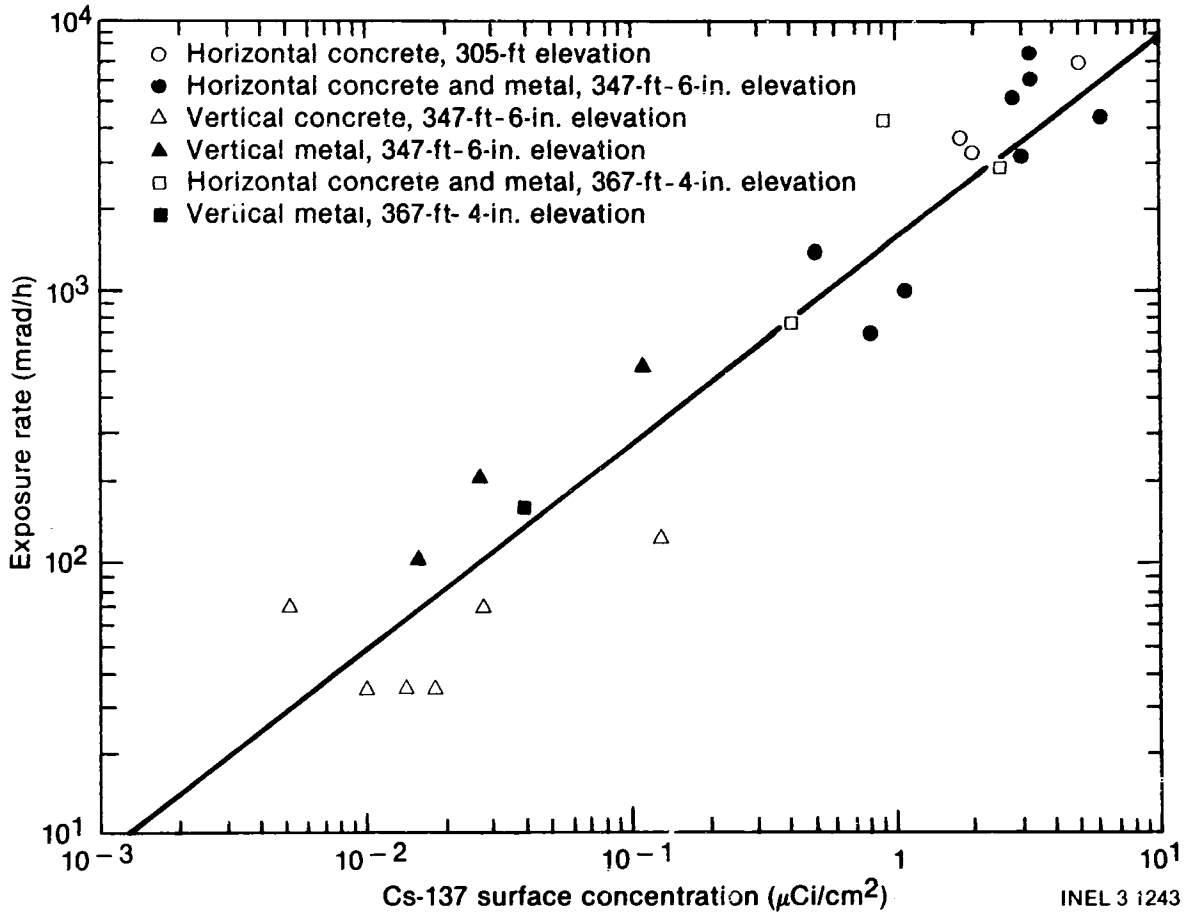

Figure 8. December 1981 Cs-137 surface concentration vs beta exposure rate.

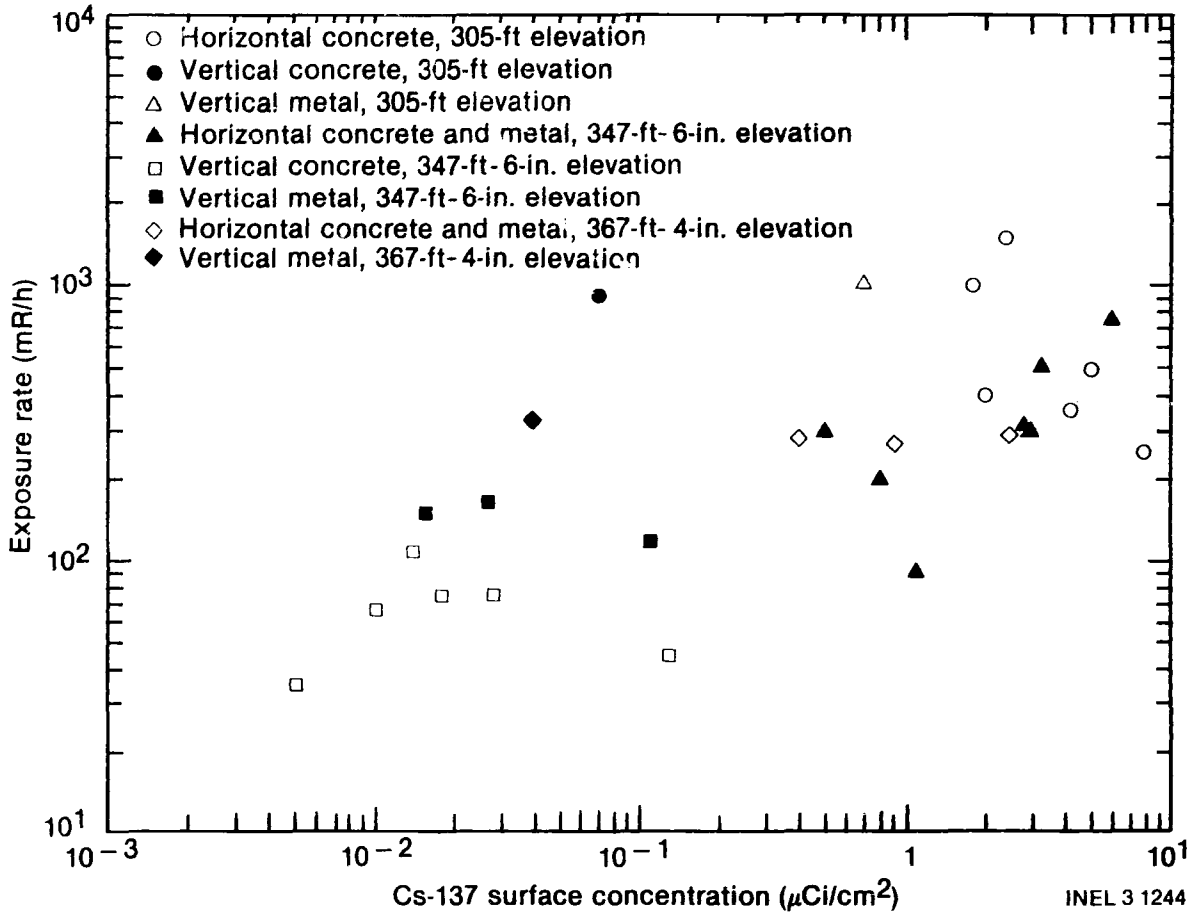

Figure 9 December 1981 Cs-137 surface concentration vs gamma exposure rate.

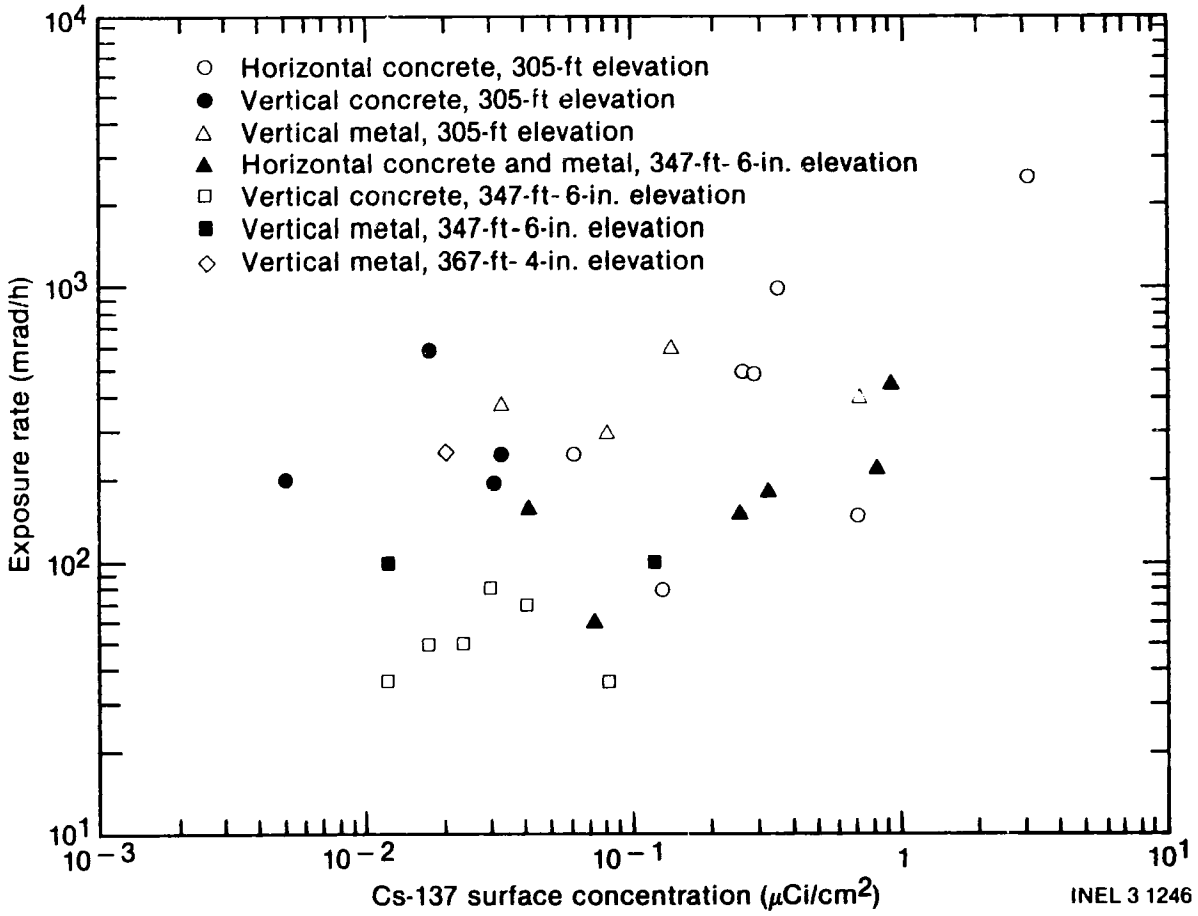

Figure 10. March 1982 Cs-137 surface concentration vs beta exposure rate.

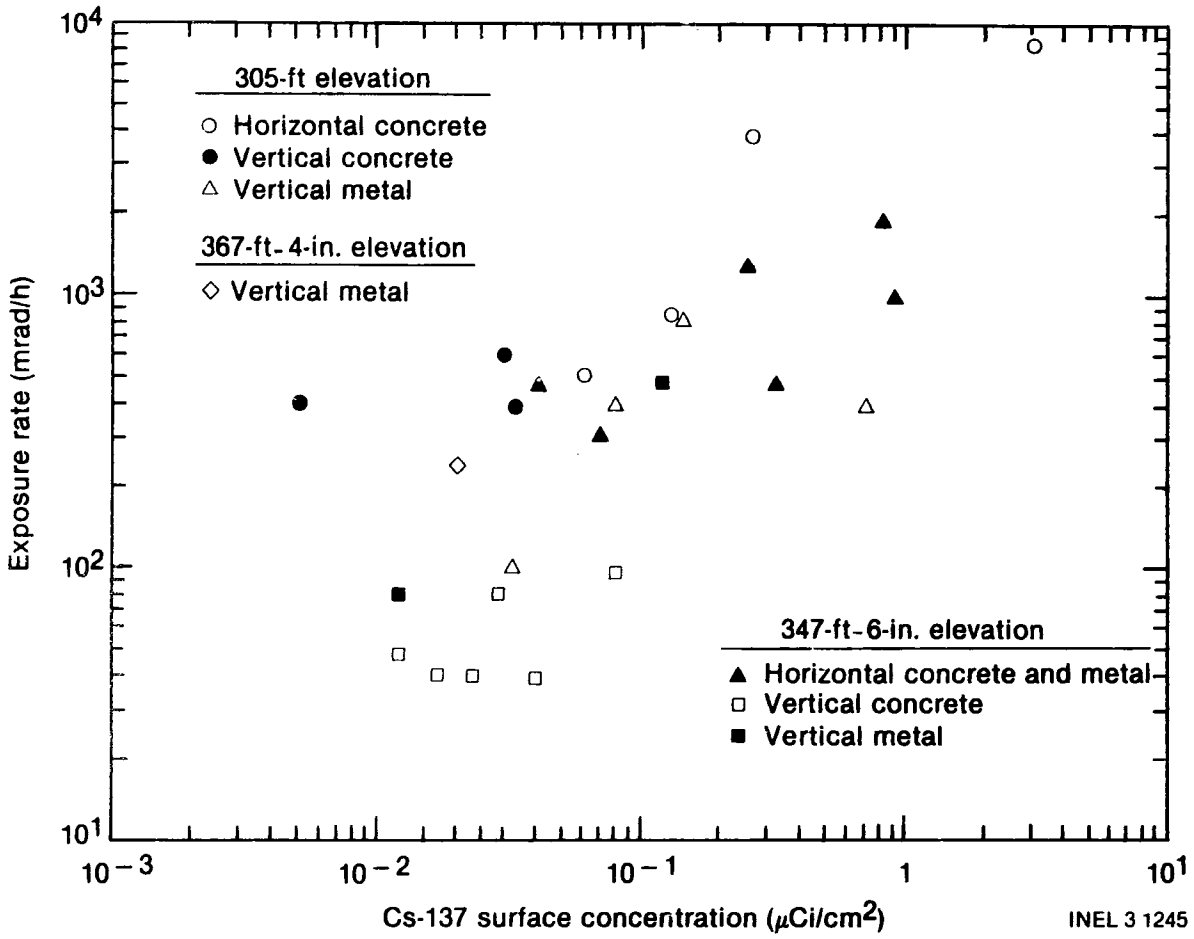

Figure 11. March 1982 Cs-137 surface concentration vs gamma exposure rate.

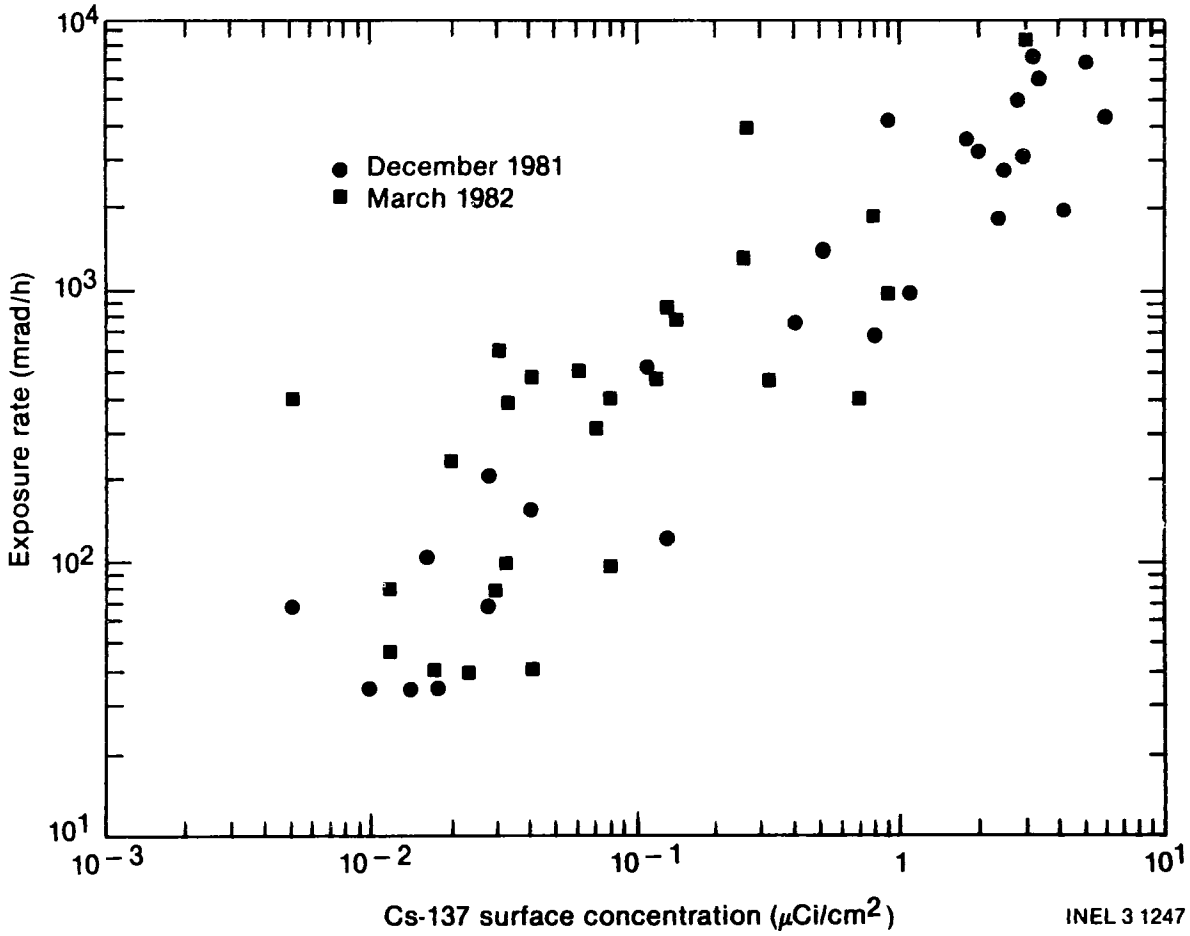

Figure 12. December 1981 and March 1982 Cs-137 surface concentration vs beta exposure rate.

TABLE 1. ACTIVITY COLLECTION EFFICIENCIES OF SURFACE SAMPLERS FOR FOUR TYPES OF SURFACES[a]

Type of Surface	Cs-137 ($\mu Ci/cm^2$) Milled Samples	Cs-137 ($\mu Ci/cm^2$) Adhesive Strips	Efficiency
Horizontal Concrete	1.39 ± 0.06 E-1	1.0 ± 0.1 E-1	1.4 ± 0.2
Vertical Concrete	2.2 ± 0.3 E-1	8.5 ± 0.2 E-2	2.6 ± 0.4
Horizontal Metal	1.1 ± 0.2 E-1	7.0 ± 0.5 E-2	1.6 ± 0.3
Vertical Metal	9 ± 2 E-2	8.0 ± 0.9 E-2	1.1 ± 0.3

a. Activity collection efficiency is defined as the ratio of the mean value of ^{137}Cs surface activity as determined by analyzing milled samples to the mean value determined by analyzing adhesive strips.

TABLE 2. NUMBER OF LOCATIONS SAMPLED AT EACH REACTOR BUILDING ELEVATION

	Elevation			
	305 ft	347 ft	367 ft	372 ft
Horizontal Surfaces				
Concrete Floor	7	8	--	--
Metal Decking	--	1	--	--
'A' D-Ring Walkway	--	--	2	--
RC-P-2A I Beam	--	--	1	--
Elevator Shaft Roof	--	--	--	1
Vertical Surfaces				
D-Ring Wall	4	5	--	--
Air Cooling Assembly Wall	3	--	--	--
Junction Boxes, Etc.	2	3	--	--
RC-P-2A I Beam	--	--	1	--
Cinder Block Wall	--	1	--	--

TABLE 3. MASSES OF COLLECTED MILLINGS[a] FOR POST DECONTAMINATION SAMPLES

Horizontal Concrete Sampling Depth						Vertical Concrete Sampling Depth		Vertical Metal Sampling Depth		Horizontal Metal Sampling Depth	
0.25 mm		1.27 mm		3.18 mm		1.27 mm		1.27 mm		1.27 mm	
Sample Number	Net Mass (g)	Sample Number	Net Mass (g)	Sample Number	Net Mass (g)	Sample Number	Net Mass (g)	Sample Number	Net Mass (g)	Sample Number	Net Mass (g)
54F2	0.42	54F4(1)	0.00	26F2	0.66	31W	0.52	B2-2	0.03	I-2(1)	0.00
149F2	0.33	54F4(2)	0.01	HIC	0.55	34W	0.43	50W	0.00	I-2(2)	0.00
149F4	0.49	H10-4	0.32	115F2	0.99	V4	0.50	B1-2(1)	0.00	40F2	0.28
H10-2	0.27	91F4	0.14	54F6	0.16	36W	0.71	B1-2(2)	0.15	--	--
91F-2	0.11	50F4	0.13	H9-2	0.21	V2	0.28	22IB	0.06	--	--
50F2	0.16	34F4	0.40	149F6	1.09	16W	1.33	B4-2	1.51	--	--
34F2	0.00	H7-5	0.50	149F8	0.79	11W	0.61	V8	0.07	--	--
H7-2	0.33	H7-8	0.40	V10-2	1.01	V9	0.90	V7	0.26	--	--
H7-4	0.20	--	--	H10-6	0.76	46W	0.98	V6	0.07	--	--
--	--	--	--	91F6	1.01	67W	0.77	B3-2	0.01	--	--
--	--	--	--	33F2	0.38	--	--	--	--	--	--
--	--	--	--	50F6	0.36	--	--	--	--	--	--
--	--	--	--	H3C	0.55	--	--	--	--	--	--
--	--	--	--	H2C	0.93	--	--	--	--	--	--
--	--	--	--	55F2	0.85	--	--	--	--	--	--
--	--	--	--	70F2	0.28	--	--	--	--	--	--
--	--	--	--	34F6	0.38	--	--	--	--	--	--
--	--	--	--	H7-10	1.11	--	--	--	--	--	--
--	--	--	--	H7-12	1.36	--	--	--	--	--	--

a. The masses given here are those reported in the EG G Internal Technical Report, RE-P-82-047, after subtraction of the mean mass of the vacuum sample filters, which was 0.23 g.

TABLE 4. CALCULATED DEPTHS OF SAMPLING[a]--HORIZONTAL CONCRETE

Intended Sampling Depths					
0.25 mm		1.27 mm		3.18 mm	
Sample Number	Calculated Depth (mm)	Sample Number	Calculated Depth (mm)	Sample Number	Calculated Depth (mm)
54F2	1.63	54F4(1)	0.00	26F2	2.57
149F2	1.28	54F4(2)	0.04	HIC	2.14
149F4	1.91	H10-4	1.25	115F2	3.85
H10-2	1.05	91F4	0.54	54F6	0.62
91F2	0.43	50F4	0.51	H9-2	0.82
50F2	0.62	34F4	1.56	149F6	4.24
34F2	0.00	H7-5	1.95	149F8	3.07
H7-2	1.28	H7-8	1.56	V10-2	3.93
H7-4	0.78	--	--	H10-6	2.96
--	--	--	--	91F6	3.93
--	--	--	--	33F2	1.48
--	--	--	--	50F6	1.40
--	--	--	--	H3C	2.14
--	--	--	--	H2C	3.62
--	--	--	--	55F2	3.31
--	--	--	--	70F2	1.09
--	--	--	--	34F6	1.48
--	--	--	--	H7-10	4.32
--	--	--	--	H7-12	5.29

a. Calculated assuming a constant sample density of 2 mg/mm^3 and a constant core radius of 6.35 mm.

$$h = \frac{m}{\pi r^2 \rho}$$

where

h = sampling depth (mm)
r = core radius (6.35 mm)
ρ = sample density (2 mg/mm^3)
m = sample mass (mg).

TABLE 5. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CONCRETE FLOOR AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 ($\mu g/cm^2$)
70F1	Surface	12/81	1.28 ± 0.01 E-2[b]	1.26 ± 0.01 E-1	--c	--c	4.0 ± 0.1 E-3	--d	--d
70F2	125	12/81	4.1 ± 0.6 E-1[e]	4.1 ± 0.6 E-0	--c	--c	1.2 ± 0.2 E-1	--d	--d
70F1	Surface	3/82	6.2 ± 0.3 E-5	5.6 ± 0.1 E-4	4.0 ± 0.5 E-5	--c	3.21 ± 0.08 E-5	--d	--d
70F2	125	3/82	2.8 ± 0.4 E-2	2.8 ± 0.4 E-1	--c	--c	1.0 ± 0.1 E-2	--d	--d
55F1[f]	Surface	12/81	8.93 ± 0.05 E-3	8.67 ± 0.01 E-2	7.4 ± 0.1 E-3	1.5 ± 0.1 E-4	6.7 ± 0.1 E-3	--d	3.9 ± 0.3 E+0
55F2[f]	125	12/81	2.3 ± 0.3 E-1	2.3 ± 0.3 E+0	2.0 ± 0.3 E-1	4.8 ± 0.7 E-3	1.8 ± 0.3 E-1	--d	1.0 ± 0.2 E+2
55F1	Surface	3/82	6.7 ± 0.1 E-4	6.54 ± 0.02 E-3	1.1 ± 0.2 E-4	--c	2.48 ± 0.06 E-4	--d	<3 E-1
55F2	125	3/82	2.6 ± 0.4 E-2	2.5 ± 0.4 E-1	1.4 ± 0.2 E-2	1.4 ± 0.3 E-4	1.1 ± 0.2 E-2	--d	1.0 ± 0.2 E+1
H2V	Surface	12/81	2.30 ± 0.02 E-3	2.23 ± 0.01 E-2	1.8 ± 0.2 E-4	4.0 ± 0.5 E-6	7.5 ± 0.2 E-4	--d	<3 E-1
H2C	125	12/81	2.1 ± 0.3 E-1	2.1 ± 0.3 E+0	3.5 ± 0.5 E-2	5 ± 1 E-4	9 ± 1 E-2	--d	<6 E-0
H2V	Surface	3/82	1.8 ± 0.1 E-5	2.20 ± 0.05 E-4	--c	--c	1.59 ± 0.04 E-6	--d	<3 E-1
H2C	125	3/82	3.1 ± 0.4 E-1	3.0 ± 0.4 E+0	9 ± 2 E-3	2.1 ± 0.5 E-4	9 ± 1 E-2	--d	<6 E-0
H3V	Surface	12/81	1.41 ± 0.02 E-3	1.39 ± 0.01 E-2	1.3 ± 0.3 E-4	--c	--d	<3 E-9	--d
H3C	125	12/81	1.9 ± 0.3 E-1	1.8 ± 0.3 E-0	1.1 ± 0.2 E-2	5 ± 1 E-4	--d	4.8 ± 0.8 E-7	--d
H3V	Surface	3/82	5.7 ± 0.1 E-4	5.66 ± 0.03 E-3	--c	--c	--d	<3 E-9	--d
H3C	125	3/82	3.5 ± 0.5 E-2	3.4 ± 0.5 E-1	--c	--c	--d	2.8 ± 0.8 E-7	--d
50F1	Surface	12/81	4.34 ± 0.04 E-3	4.25 ± 0.01 E-2	1.6 ± 0.4 E-4	--c	--d	--d	--d
50F2	10	12/81	1.9 ± 0.3 E-1	1.9 ± 0.3 E+0	--c	--c	--d	--d	--d
50F3	Surface	12/81	3.23 ± 0.03 E-3	3.19 ± 0.02 E-2	--c	--c	--d	--d	--d
50F4	50	12/81	1.2 ± 0.2 E-1	1.2 ± 0.2 E+0	4 ± 1 E-3	--c	--d	--d	--d
50F5	Surface	12/81	6.77 ± 0.05 E-3	6.63 ± 0.01 E-2	--c	--c	--d	--d	--d
50F6	125	12/81	2.6 ± 0.4 E-1	2.6 ± 0.4 E+0	4 ± 1 E-3	4.3 ± 0.9 E-4	--d	--d	--d

TABLE 5. (continued)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
50F1	Surface	3/82	1.8 ± 0.2 E-5	1.80 ± 0.05 E-4	--c	--c	--d	--d	--d
50F2	10	3/82	2.3 ± 0.3 E-2	2.3 ± 0.3 E-1	--c	--c	--d	--d	--d
50F3	Surface	3/82	6.4 ± 0.3 E-5	6.5 ± 0.1 E-4	1.5 ± 0.4 E-5	--c	--d	--d	--d
50F4	50	3/82	6.4 ± 0.9 E-3	6.3 ± 0.9 E-2	--c	--c	--d	--d	--d
50F5	Surface	3/82	4.6 ± 0.2 E-5	4.1 ± 0.1 E-4	--c	--c	--d	--d	--d
50F6	125	3/82	1.9 ± 0.3 E-1	1.9 ± 0.3 E+0	--c	--c	--d	--d	--d
34F1	Surface	12/81	1.01 ± 0.01 E-2	1.01 ± 0.01 E-1	--c	--c	4.3 ± 0.1 E-3[g]	--d	--d
34F2	10	12/81	3.8 ± 0.5 E-1	3.8 ± 0.5 E+0	8 ± 3 E-3	1.2 ± 0.3 E-4	1.3 ± 0.2 E-1[f]	--d	--d
34F3	Surface	12/81	1.93 ± 0.01 E-2	1.92 ± 0.01 E-1	--c	--c	4.3 ± 0.1 E-3[g]	--d	--d
34F4	50	12/81	4.1 ± 0.6 E-1	4.1 ± 0.6 E+0	--c	2.8 ± 0.8 E-4	1.3 ± 0.2 E-1[f]	--d	--d
34F5	Surface	12/81	1.66 ± 0.01 E-2	1.66 ± 0.01 E-1	--c	--c	4.3 ± 0.1 E-3[g]	--d	--d
34F6	125	12/81	8 ± 1 E-1	8 ± 1 E-0	--c	--c	1.3 ± 0.2 E-1[f]	--d	--d
34F1	Surface	3/82	1.9 ± 0.2 E-5	1.80 ± 0.05 E-4	--c	--c	4.1 ± 0.1 E-5[g]	--d	--d
34F2	10	3/82	4.2 ± 0.6 E-3	4.4 ± 0.6 E-2	--c	4 ± 1 E-6	1.8 ± 0.3 E-3[f]	--d	--d
34F3	Surface	3/82	1.10 ± 0.04 E-4	1.09 ± 0.01 E-3	--c	--c	4.1 ± 0.1 E-5[g]	--d	--d
34F4	50	3/82	6.1 ± 0.9 E-3	5.7 ± 0.8 E-2	--c	--c	1.8 ± 0.3 E-3[f]	--d	--d
34F5	Surface	3/82	1.56 ± 0.04 E-4	1.53 ± 0.02 E-3	--c	--c	4.1 ± 0.1 E-5[g]	--d	--d
34F6	125	3/82	9 ± 1 E-3	8 ± 1 E-2	--c	--c	1.8 ± 0.3 E-3[f]	--d	--d
H7-1	Surface	12/81	4.78 ± 0.04 E-3	4.75 ± 0.01 E-2	--c	--c	4.6 ± 0.1 E-3[g]	--d	<9 E-29
H7-2	10	12/81	3.4 ± 0.5 E-1	3.4 ± 0.5 E+0	--c	--c	1.2 ± 0.2 E-1	--d	<6 E+0
H7-3	Surface	12/81	2.56 ± 0.01 E-2	2.54 ± 0.01 E-1	--c	5 ± 1 E-6	4.6 ± 0.1 E-3[g]	--d	<9 E-29
H7-4	50	12/81	1.4 ± 0.2 E-1	1.4 ± 0.2 E+0	--c	4 ± 2 E-3	5.8 ± 0.8 E-2	--d	<6 E+0
H7-5	Surface	12/81	3.50 ± 0.04 E-3	3.47 ± 0.01 E-2	--c	1.7 ± 0.4 E-6	4.6 ± 0.1 E-3[g]	--d	<9 E-29
H7-6	125	12/81	1.8 ± 0.3 E+0	1.8 ± 0.3 E+1	2.8 ± 0.8 E-2	--c	7 ± 1 E-1	--d	<6 E+0
H7-1	Surface	3/82	1.6 ± 0.2 E-5	1.49 ± 0.04 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4 E-29
H7-2	10	3/82	7 ± 1 E-3	7 ± 1 E-2	--c	--c	--d	--d	--d
H7-3	Surface	3/82	3.0 ± 0.2 E-5	2.80 ± 0.05 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4 E-29

TABLE 5. (continued)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
H7-4	10	3/82	9 ± 1 E-3	9 ± 1 E-2	--c	--c	4.6 ± 0.7 E-3	--d	<6 E+0
H7-6	Surface	3/82	2.4 ± 0.2 E-5	2.10 ± 0.05 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4E-2[g]
H7-5	50	3/82	2.5 ± 0.4 E-2	2.4 ± 0.3 E-1	--c	--c	5.3 ± 0.8 E-3	--d	<6 E+0
H7-7	Surface	3/82	1.4 ± 0.2 E-5	1.50 ± 0.05 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4 E-2[g]
H7-8	50	3/82	1.3 ± 0.2 E-2	1.3 ± 0.2 E-1	--c	--c	--d	--d	--d
H7-9	Surface	3/82	4.8 ± 0.3 E-5	5.1 ± 0.1 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4 E-2[g]
H7-10	125	3/82	1.6 ± 0.2 E-2	1.6 ± 0.2 E-1	--c	--c	4.1 ± 0.6 E-3	--d	<6 E+0
H7-11	Surface	3/82	6.2 ± 0.3 E-5	6.2 ± 0.1 E-4	--c	--c	2.17 ± 0.05 E-5[g]	--d	<4 E-2[g]
H7-12	125	3/82	7 ± 1 E-3	7 ± 1 E-2	--c	--c	--d	--d	--d

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The surface activity concentrations given here for vacuumed samples were calculated assuming that

- The surface vacuumed in each case had an area of 39.03 cm^2.
- The activity collected during vacuuming without drill operation was considered evenly distributed over 39.03 cm^2.
- The activity collection efficiency of the sampler during vacuuming was 100 percent. The uncertainties in the concentrations determined by analysis of vacuumed samples are given at the one sigma level and are due to counting statistics only.

c. The concentration of this radionuclide was less than the detection limit.

d. The sample was not analyzed for this radionuclide.

e. The uncertainties in the concentrations determined by analysis of milled samples are given at the one sigma level and are due to counting statistics and the uncertainties in the activity collection efficiencies of the samplers.

f. The following nuclides were also measured in samples 55F1 and 55F2 ($\mu Ci/cm^2$):

			Ce-144	Ag-110M	Ru/Rh-106
55F1	Surface	12/81	1.0 ± 0.1 E-3	9 ± 1 E-5	--c
55F2	125	12/81	2.7 ± 0.4 E-2	2.1 ± 0.4 E-3	2.8 ± 0.5 E-2

g. The vacuumed samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

h. The milled samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

TABLE 6. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE D-RING WALL AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
67W	50	12/81	2.7 ± 0.4 E-3	2.7 ± 0.4 E-2	--b	5 ± 1 E-5	8 ± 1 E-4	--c	--c
67W	50	3/82	1.6 ± 0.2 E-3	1.7 ± 0.3 E-2	--b	--b	4.1 ± 0.6 E-4	--c	--c
46W	50	12/81	1.4 ± 0.2 E-3	1.4 ± 0.2 E-2	--b	--b	4.4 ± 0.7 E-4	--c	--c
46W	50	3/82	3.0 ± 0.5 E-3	3.0 ± 0.5 E-2	--b	--b	2.5 ± 0.4 E-3	--c	--c
V9	50	12/81	1.7 ± 0.3 E-3	1.7 ± 0.3 E-2	--b	3.1 ± 0.9 E-5	9 ± 1 E-4	--c	--c
V9	50	3/82	3.3 ± 0.5 E-3	3.2 ± 0.5 E-2	--b	--b	7 ± 1 E-4	--c	--c
11W-1	50	12/81	1.3 ± 0.2 E-2	1.3 ± 0.2 E-1	1.1 ± 0.4 E-3	--b	--c	<4 E-8	--c
11W-2	50	12/81	8 ± 1 E-4	7 ± 1 E-3	--b	--b	--c	<4 E-8	--c
11W	50	3/82	4.2 ± 0.7 E-4	5.0 ± 0.8 E-3	--b	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 7. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON VERTICAL METAL AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
B3-1	50	12/81	4 ± 1 E-3	4 ± 1 E-2	--b	--b	1.5 ± 0.4 E-3	--c	--c
B3-2	50	3/82	3 ± 1 E-2	3.5 ± 0.9 E-1	--b	--b	1.5 ± 0.4 E-2	--c	--c
V6	50	12/81	1.4 ± 0.4 E-2	1.4 ± 0.4 E-1	--b	--b	--c	7 ± 2 E-7	--c
V6	50	3/82	1.4 ± 0.4 E-2	1.4 ± 0.4 E-1	--b	--b	--c	3.4 ± 0.9 E-6	--c
V7	50	12/81	5 ± 1 E-3	5 ± 1 E-2	--b	--b	2.2 ± 0.6 E-3	--c	--c
V7	50	3/82	7 ± 2 E-2	7 ± 2 E-1	--b	--b	1.8 ± 0.5 E-2	--c	--c
V8	50	12/81	8 ± 2 E-3	8 ± 2 E-2	--b	--b	--c	--c	--c
V8	50	3/82	3.2 ± 0.9 E-3	3.2 ± 0.9 E-2	--b	--b	--c	--c	--c
B4-2	50	12/81	7 ± 2 E-2	7 ± 2 E-1	--b	--b	--c	--c	--c
B4-2	50	3/82	8 ± 2 E-3	8 ± 2 E-2	--b	--b	--c	5 ± 1 E-6	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 8. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CONCRETE FLOOR AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
115F1	Surface	12/81	2.26 ± 0.03 E-3	2.27 ± 0.01 E-2	--b	5 ± 1 E-6	2.27 ± 0.06 E-3	--c	--c
115F2	125	12/81	1.2 ± 0.2 E-1	1.1 ± 0.2 E+0	--b	--b	1.0 ± 0.1 E-1	--c	--c
115F1	Surface	3/82	7.4 ± 0.3 E-5	7.2 ± 0.1 E-4	--b	--b	7.0 ± 0.2 E-5	--c	--c
115F2	125	3/82	3.9 ± 0.6 E-3	3.7 ± 0.5 E-2	--b	--b	2.3 ± 0.3 E-3	--c	--c
54F1	Surface	12/81	1.15 ± 0.01 E-2	1.14 ± 0.01 E-1	--b	--b	6.4 ± 0.2 E-3[d]	--c	<9 E-2[d]
54F2	10	12/81	2.8 ± 0.4 E-1	2.8 ± 0.4 E+0	--b	--b	1.1 ± 0.2 E-1	--c	<6 E+0
54F3	Surface	12/81	1.47 ± 0.01 E-2	1.46 ± 0.01 E-1	--b	--b	6.4 ± 0.2 E-3[d]	--c	<9 E-2[d]
54F4	50	12/81	3.7 ± 0.5 E-1	3.7 ± 0.5 E-0	--b	--b	1.2 ± 0.2 E-1	--c	<6 E+0
54F5	Surface	12/81	1.82 ± 0.01 E-2	1.81 ± 0.01 E-1	--b	--b	6.4 ± 0.2 E-3[d]	--c	<9 E-2[d]
54F6	125	12/81	1.4 ± 0.2 E-1	1.4 ± 0.2 E+0	--b	--b	6.4 ± 0.9 E-2	--c	<6 E+0
54F1	Surface	3/82	2.70 ± 0.05 E-4	2.70 ± 0.02 E-3	--b	--b	1.05 ± 0.03 E-4[d]	--c	--c
54F2	10	3/82	2.3 ± 0.3 E-2	2.2 ± 0.3 E-1	--b	3.6 ± 0.9 E-5	1.4 ± 0.2 E-2	--c	--c
54F3-1	Surface	3/82	1.60 ± 0.05 E-4	1.55 ± 0.02 E-3	--b	--b	1.05 ± 0.03 E-4[d]	--c	--c
54F4-1	50	3/82	1.7 ± 0.2 E-2	1.7 ± 0.2 E-1	--b	--b	--c	--c	--c
54F3-2	Surface	3/82	1.80 ± 0.05 E-4	1.77 ± 0.02 E-3	--b	--b	1.05 ± 0.03 E-4[d]	--c	--c
54F4-2	50	3/82	1.4 ± 0.2 E-2	1.4 ± 0.2 E-1	--b	--b	1.4 ± 0.2 E-2	--c	--c
54F5	Surface	3/82	6.7 ± 0.3 E-5	7.0 ± 0.1 E-4	--b	--b	1.05 ± 0.03 E-4[d]	--c	--c
54F6	125	3/82	1.4 ± 0.2 E-2	1.4 ± 0.2 E-1	--b	--b	1.1 ± 0.2 E-2	--c	--c
H9-1	Surface	12/81	1.05 ± 0.01 E-2	1.06 ± 0.01 E-1	--b	--b	--c	1.0 ± 0.2 E-8	--c
H9-2	125	12/81	9 ± 1 E-2	9 ± 1 E-1	--b	--b	--c	4.4 ± 0.8 E-7	--c
H9-1	Surface	3/82	7.6 ± 0.3 E-5	7.4 ± 0.1 E-4	--b	--b	--c	<3 E-9	--c
H9-2	125	3/82	7 ± 1 E-3	7 ± 1 E-2	--b	--b	--c	3.9 ± 0.9 E-7	--c

TABLE 8. (continued)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235, (ng/cm^2)
149F1	Surface	12/81	1.53 ± 0.01 E-2	1.53 ± 0.01 E-1	--b	--b	3.55 ± 0.09 E-2	--c	<3 E-1
149F2	125	12/81	5.8 ± 0.8 E-1	5.8 ± 0.8 E+0	--b	--b	1.0 ± 0.1 E+0	--c	<6 E+0
149F1	Surface	3/82	4.30 ± 0.05 E-4	4.24 ± 0.03 E-3	--b	--b	6.0 ± 0.1 E-5[d]	--c	<6 E-2[d]
149F2	10	3/82	7 ± 1 E-2	6.6 ± 0.9 E-1	--b	9 ± 3 E-6	1.1 ± 0.2 E-2	--c	<6 E+0
149F3	Surface	3/82	2.10 ± 0.05 E-4	2.03 ± 0.01 E-3	--b	--b	6.0 ± 0.1 E-5[d]	--c	<6 E-2[d]
149F4	10	3/82	5.5 ± 0.8 E-2	5.5 ± 0.8 E-1	--b	--b	--c	--c	--c
149F5	Surface	3/82	5.3 ± 0.3 E-5	5.1 ± 0.1 E-4	--b	--b	6.0 ± 0.1 E-5[d]	--c	<6 E-2[d]
149F6	125	3/82	7 ± 1 E-2	7 ± 1 E-1	--b	--b	2.0 ± 0.3 E-2	--c	<6 E-0
149F7	Surface	3/82	2.10 ± 0.05 E-4	2.03 ± 0.01 E-3	--b	--b	6.0 ± 0.1 E-5[d]	--c	<6 E-2[d]
149F8	125	3/82	1.8 ± 0.3 E-1	1.7 ± 0.3 E+0	--b	--b	5.3 ± 0.8 E-3	--c	--c
V10-1	Surface	12/81	3.09 ± 0.04 E-3	3.05 ± 0.01 E-2	--b	--b	--c	--c	--c
V10-2	125	12/81	3.3 ± 0.5 E-1	3.3 ± 0.5 E+0	--b	--b	--c	--c	--c
V10-1	Surface	3/82	5.3 ± 0.2 E-5	4.8 ± 0.1 E-4	--b	--b	--c	--c	--c
V10-2	125	3/82	8 ± 1 E-2	8 ± 1 E-1	--b	--b	--c	--c	--c
H10-1	Surface	12/81	1.89 ± 0.02 E-3	1.87 ± 0.01 E-2	--b	--b	--c	5.9 ± 0.9 E-9[d]	--c
H10-2	10	12/81	5.0 ± 0.7 E-1	4.9 ± 0.7 E+0	--b	5 ± 2 E-5	--c	4.7 ± 0.7 E-7[e]	--c
H10-3	Surface	12/81	1.65 ± 0.02 E-3	1.63 ± 0.01 E-2	--b	--b	--c	5.9 ± 0.9 E-9[d]	--c
H10-4	50	12/81	2.8 ± 0.4 E-1	2.8 ± 0.4 E+0	9 ± 2 E-3	1.6 ± 0.4 E-4	--c	4.7 ± 0.7 E-7[e]	--c
H10-5	Surface	12/81	7.0 ± 0.2 E-4	7.02 ± 0.04 E-3	--b	--b	--c	5.9 ± 0.9 E-9[d]	--c
H10-6	125	12/81	1.3 ± 0.2 E-1	1.3 ± 0.2 E+0	--b	--b	--c	4.7 ± 0.7 E-7[e]	--c
H10-1	Surface	3/82	3.5 ± 0.2 E-5	3.30 ± 0.05 E-4	--b	--b	--c	<2 E-9[d]	--c
H10-2	10	3/82	4.4 ± 0.6 E-2	4.3 ± 0.6 E-1	--b	--b	--c	3.5 ± 0.7 E-7[e]	--c
H10-3	Surface	3/82	5.1 ± 0.2 E-5	5.1 ± 0.1 E-4	--b	--b	--c	<2 E-9[d]	--c
H10-4	50	3/82	1.2 ± 0.2 E-2	1.2 ± 0.2 E-1	--b	--b	--c	3.5 ± 0.7 E-7[e]	--c
H10-5	Surface	3/82	8.7 ± 0.3 E-5	8.8 ± 0.1 E-4	--b	--b	--c	<2 E-9[d]	--c
H10-6	125	3/82	2.0 ± 0.3 E-2	2.0 ± 0.3 E-1	--b	--b	--c	3.5 ± 0.7 E-7[e]	--c

TABLE 8. (continued)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	$U\text{-}235_2$ (ng/cm^2)
33F1	Surface	12/81	2.45 ± 0.05 E-4	2.34 ± 0.02 E-3	--b	1.2 ± 0.2 E-6	1.82 ± 0.05 E-4	--c	--c
33F2	125	12/81	8 ± 1 E-2	8 ± 1 E-1	--b	6 ± 2 E-5	2.1 ± 0.3 E-2	--c	--c
33F1	Surface	3/82	7.5 ± 0.3 E-5	7.2 ± 0.1 E-4	--b	--b	6.2 ± 0.2 E-5	--c	--c
33F2	125	3/82	7 ± 1 E-3	7 ± 1 E-2	--b	--b	4.8 ± 0.7 E-3	--c	--c
91F1	Surface	12/81	3.4 ± 0.2 E-4	3.47 ± 0.04 E-3	--b	--b	--c	<2 E-9[d]	--c
91F2	10	12/81	7 ± 1 E-2	7 ± 1 E-1	--b	--b	--c	4.2 ± 0.7 E-7[e]	--c
91F5	Surface	12/81	1.28 ± 0.05 E-4	1.22 ± 0.02 E-3	--b	--b	--c	<2 E-9[d]	--c
91F6	50	12/81	5.5 ± 0.8 E-2	5.4 ± 0.8 E-1	2.1 ± 0.8 E-3	--b	--c	4.2 ± 0.7 E-7[e]	--c
91F3	Surface	12/81	2.4 ± 0.1 E-4	2.09 ± 0.03 E-3	--b	--b	--c	<2 E-9[d]	--c
91F4	125	12/81	2.2 ± 0.3 E-2	2.2 ± 0.3 E-1	--b	--b	--c	4.2 ± 0.7 E-7[e]	--c
91F1	Surface	3/82	2.50 ± 0.05 E-4	2.53 ± 0.02 E-3	--b	--b	--c	6 ± 1 E-9[d]	--c
91F2	10	3/82	2.6 ± 0.4 E-3	2.5 ± 0.4 E-2	--b	--b	--c	3.0 ± 0.5 E-7[e]	--c
91F3	Surface	3/82	1.90 ± 0.05 E-4	1.99 ± 0.02 E-3	--b	--b	--c	6 ± 1 E-9[d]	--c
91F4	50	3/82	4.1 ± 0.6 E-3	4.0 ± 0.6 E-2	--b	--b	--c	3.0 ± 0.5 E-7[e]	--c
91F5	Surface	3/82	7.1 ± 0.3 E-5	7.7 ± 0.1 E-4	--b	--b	--c	6 ± 1 E-9[d]	--c
91F6	125	3/82	6.1 ± 0.9 E-3	6.1 ± 0.9 E-2	--b	--b	--c	3.0 ± 0.5 E-7[e]	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

d. The vacuumed samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

e. The milled samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

TABLE 9. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON METAL DECKING AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
40F1	Surface	12/81	1.28 ± 0.02 E-3	1.25 ± 0.01 E-2	--b	--b	--c	<3 E-9	--c
40F2	50	12/81	3.2 ± 0.6 E-1	3.2 ± 0.6 E-0	--b	5 ± 2 E-5	--c	9 ± 2 E-7	--c
40F1	Surface	3/82	1.80 ± 0.054	1.77 ± 0.01 E-3	--b	--b	--c	6 ± 2 E-9	--c
40F2	50	3/82	3.2 ± 0.6 E-2	3.2 ± 0.6 E-1	6 ± 3 E-4	--b	--c	3.6 ± 0.9 E-7	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 10. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE D-RING WALL AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLE (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
16W	50	12/81	1.2 ± 0.2 E-2	1.3 ± 0.2 E-1	--b	--b	3.3 ± 0.5 E-3	--c	--c
16W	50	3/82	8 ± 1 E-3	8 ± 1 E-2	--b	--b	2.4 ± 0.4 E-3	--c	--c
V2	50	12/81	1.4 ± 0.2 E-3	1.4 ± 0.2 E-2	--b	--b	--c	1.1 ± 0.3 E-7	--c
V2	50	3/82	4.0 ± 0.6 E-3	4.0 ± 0.6 E-2	--b	--b	--c	<4 E-8	--c
36W	50	12/81	2.0 ± 0.3 E-3	1.8 ± 0.3 E-2	--b	--b	1.1 ± 0.2 E-3	--c	--c
36W	50	3/82	2.4 ± 0.4 E-3	2.3 ± 0.4 E-2	--b	--b	1.4 ± 0.2 E-3	--c	--c
34W	50	12/81	9 ± 1 E-4	1.0 ± 0.1 E-2	--b	--b	--c	--c	--c
34W	50	3/82	1.8 ± 0.3 E-3	1.7 ± 0.3 E-2	--b	--b	--c	--c	--c
31W	50	12/81	4.5 ± 0.9 E-4	5.1 ± 0.8 E-3	--b	--b	--c	--c	--c
31W	50	3/82	1.2 ± 0.2 E-3	1.2 ± 0.2 E-2	--b	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 11. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CINDERBLOCK WALL AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
V4	50	12/81	2.9 ± 0.5 E-3	2.8 ± 0.4 E-2	--b	--b	1.3 ± 0.2 E-3	--c	--c
V4	50	3/82	2.8 ± 0.4 E-3	2.9 ± 0.5 E-2	--b	4 ± 1 E-6	9 ± 1 E-4	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 12. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON VERTICAL METAL SURFACES AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
B1-1	50	12/82	1.6 ± 0.4 E-3	1.6 ± 0.4 E-2	--b	--b	--c	9 ± 2 E-7	--c
B1-1-1	50	3/82	4 ± 1 E-3	5 ± 1 E-2	--b	--b	--c	--c	--c
B1-1-2	50	3/82	1.6 ± 0.4 E-2	1.5 ± 0.4 E-1	--b	--b	--c	--c	--c
50W	50	12/81	2.4 ± 0.7 E-3	2.7 ± 0.7 E-2	--b	--b	--c	--c	--c
50W	50	3/82	1.1 ± 0.3 E-3	1.2 ± 0.3 E-2	--b	--b	--c	--c	--c
B2-2	50	12/81	1.2 ± 0.3 E-2	1.1 ± 0.3 E-1	--b	--b	2.0 ± 0.5 E-3	--c	--c
B2-2	50	3/82	1.2 ± 0.3 E-2	1.2 ± 0.3 E-1	--b	--b	2.2 ± 0.6 E-3	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 13. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE "A" D-RING WALL WALKWAY AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
26F1	Surface	12/81	5.9 ± 0.1 E-4	5.69 ± 0.05 E-3	--b	--b	--c	--c	--c
26F2	125	12/81	3.9 ± 0.6 E-2	3.9 ± 0.6 E-1	--b	--b	--c	--c	--c
26F1	Surface	3/82	1.28 ± 0.01 E-3	1.27 ± 0.01 E-2	--b	--b	--c	--c	--c
26F2	125	3/82	4.5 ± 0.6 E-2	4.5 ± 0.6 E-1	--b	--b	--c	--c	--c
HIV	Surface	12/81	4.51 ± 0.04 E-3	4.47 ± 0.01 E-2	--b	--b	1.65 ± 0.08 E-3	--c	--c
HIC	125	12/81	2.5 ± 0.4 E-1	2.5 ± 0.4 E+0	--b	--b	1.1 ± 0.2 E-1	--c	--c
HIV	Surface	3/82	2.15 ± 0.01 E-3	2.13 ± 0.01 E-2	--b	--b	1.15 ± 0.03 E-3	--c	--c
HIC	125	3/82	9 ± 1 E-2	9 ± 1 E-1	--b	--b	3.6 ± 0.5 E-2	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 14. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE RC-P-2A I BEAM, (HORIZONTAL) AT THE 369-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
I-1	Surface	12/81	1.49 ± 0.02 E-3	1.50 ± 0.01 E-2	--b	--b	--c	--c	--c
I-2	50	12/81	9 ± 2 E-2	9 ± 2 E-1	--b	--b	--c	--c	--c
I-1	Surface	3/82	5.5 ± 0.1 E-4	5.35 ± 0.02 E-3	--b	--b	--c	--c	--c
I-2-1	50	3/82	2.1 ± 0.4 E-3	2.1 ± 0.4 E-2	--b	--b	--c	--c	--c
I-2-2	50	3/82	6 ± 1 E-3	5 ± 1 E-2	1.3 ± 0.3 E-3	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 15. MEASURED SURFACE ACTIVITY CONCENTRATIONS AT THE RC-P-2A I BEAM (VERTICAL) ON THE 369-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
22IB	50	12/81	3 ± 1 E-3	4 ± 1 E-2	--b	--b	--c	--c	--c
22IB	50	3/82	2.2 ± 0.6 E-3	2.0 ± 0.6 E-2	--b	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 16. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE ELEVATOR SHAFT ROOF AT THE 372-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sample Number	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235, (ng/cm^2)
H8-1	Surface	12/81	4.2 ± 0.1 E-4	4.08 ± 0.04 E-3	--b	--b	--c	--c	--c
H8-2	125	12/81	3.0 ± 0.4 E-2	3.0 ± 0.4 E-1	2.1 ± 0.8 E-3	1.3 ± 0.3 E-4	--c	--c	--c
H8-1	Surface	--d	--	--	--	--	--	--	--
H8-2	125	--d	--	--	--	--	--	--	--

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than the detection limit.

c. The sample was not analyzed for this radionuclide.

d. March 1982 sample was not collected.

TABLE 17. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CONCRETE FLOOR AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING LISTED BY SAMPLING LOCATION (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235, (ng/cm^2)
70	Surface	12/81	1.28 ± 0.02 E-2[b]	1.26 ± 0.01 E-1	--c	--c	4.0 ± 0.1 E-3	--d	--d
70	125	12/81	4.1 ± 0.6 E-1[e]	4.1 ± 0.6 E+0	--c	--c	1.2 ± 0.2 E-1	--d	--d
70	Surface	3/82	6.2 ± 0.3 E-5	5.6 ± 0.1 E-4	4.0 ± 0.5 E-5	--c	3.21 ± 0.08 E-5	--d	--d
70	125	3/82	2.8 ± 0.4 E-2	2.8 ± 0.4 E-1	--c	--c	1.0 ± 0.1 E-2	--d	--d
55[f]	Surface	12/81	8.93 ± 0.05 E-3	8.67 ± 0.01 E-2	7.4 ± 0.1 E-3	1.5 ± 0.1 E-4	6.7 ± 0.1 E-3	--d	3.9 ± 0.3 E+0
55[f]	125	12/81	2.3 ± 0.3 E-1	2.3 ± 0.3 E+0	2.0 ± 0.3 E-1	4.8 ± 0.7 E-3	1.8 ± 0.3 E-1	--d	1.0 ± 0.2 E+2
55	Surface	3/82	6.7 ± 0.1 E-4	6.54 ± 0.02 E-3	1.1 ± 0.2 E-4	--c	2.48 ± 0.06 E-4	--d	<3 E-1
55	125	3/82	2.6 ± 0.4 E-2	2.5 ± 0.4 E-1	1.4 ± 0.2 E-2	1.4 ± 0.3 E-4	1.1 ± 0.2 E-2	--d	1.0 ± 0.2 E+1
H2	Surface	12/81	2.30 ± 0.02 E-3	2.23 ± 0.01 E-2	1.8 ± 0.2 E-4	4.0 ± 0.5 E-6	7.5 ± 0.2 E-4	--d	<3 E-1
H2	125	12/81	2.1 ± 0.3 E-1	2.1 ± 0.3 E+0	3.5 ± 0.5 E-2	5 ± 1 E-4	9 ± 1 E-2	--d	<6 E+0
H2	Surface	3/82	1.8 ± 0.1 E-5	2.20 ± 0.05 E-4	--c	--c	1.59 ± 0.04 E-6	--d	<3 E-1
H2	125	3/82	3.1 ± 0.4 E-1	3.0 ± 0.4 E+0	9 ± 2 E-3	2.1 ± 0.5 E-4	9 ± 1 E-2	--d	<6 E+0
H3	Surface	12/81	1.41 ± 0.02 E-3	1.39 ± 0.01 E-2	1.3 ± 0.3 E-4	--c	--d	<3 E-9	--d
H3	125	12/81	1.9 ± 0.3 E-1	1.8 ± 0.3 E+0	1.1 ± 0.2 E-2	5 ± 1 E-4	--d	4.8 ± 0.8 E-7	--d
H3	Surface	3/82	5.7 ± 0.1 E-4	5.66 ± 0.03 E-3	--c	--c	--d	<3 E-9	--d
H3	125	3/82	3.5 ± 0.5 E-2	3.4 ± 0.5 E-1	--c	--c	--d	2.8 ± 0.8 E-7	--d
50	Surface	12/81	5 ± 1 E-3	5 ± 1 E-2	1.6 ± 0.4 E-4	--c	--d	--d	--d
50	10, 50 125	12/81	1.9 ± 0.4 E-1	1.9 ± 0.4 E+0	4 ± 1 E-3	4.3 ± 0.9 E-4	--d	--d	--d
50	Surface	3/82	4 ± 1 E-5	4 ± 1 E-4	1.5 ± 0.4 E-5	--c	--d	--d	--d
50	10, 50, 125	3/82	7 ± 6 E-2	7 ± 6 E-1	--c	--c	--d	--d	--d

TABLE 17. (continued)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
34	Surface	12/81	1.5 ± 0.3 E-2	1.5 ± 0.3 E-1	--c	--c	4.3 ± 0.1 E-3[e]	--d	--d
34	10, 50, 125	12/81	5 ± 1 E-1	5 ± 1 E+0	8 ± 3 E-3	2.0 ± 0.8 E-4	1.3 ± 0.2 E-1[f]	--d	--d
34	Surface	3/82	1.0 ± 0.4 E-4	9 ± 4 E-4	--c	--c	4.1 ± 0.1 E-5[e]	--d	--d
34	10, 50, 125	3/82	6 ± 1 E-3	6 ± 1 E-2	--c	4 ± 1 E-6	1.8 ± 0.3 E-3[f]	--d	--d
H7	Surface	12/81	1.1 ± 0.7 E-2	1.1 ± 0.7 E-1	--c	3 ± 2 E-6	4.6 ± 0.1 E-3[e]	--d	<9 E-2[e]
H7	10, 50, 125	12/81	8 ± 5 E-1	8 ± 5 E+0	2.8 ± 0.8 E-2	4 ± 2 E-3	3 ± 2 E-1	--d	<6 E+0
H7	Surface	3/82	3.2 ± 0.8 E-5	3.2 ± 0.8 E-4	--c	--c	2.17 ± 0.05 E-5[e]	--d	<4 E-2[e]
H7	10, 50, 125	3/82	1.3 ± 0.3 E-2	1.3 ± 0.3 E-1	--c	--c	4.7 ± 0.3 E-3	--d	<6 E+0

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The surface activity concentrations given here for vacuumed samples were calculated assuming that

- The surface vacuumed in each case had an area of 39.03 cm^2.
- The activity collected during vacuuming without drill operation was considered evenly distributed over 39.03 cm^2.
- The activity collection efficiency of the sampler during vacuuming was 100 percent. The uncertainties in the concentrations determined by analysis of vacuumed samples are given at the one sigma level and are due to counting statistics only.

c. The concentration of this radionuclide was less than detection limit.

d. The sample was not analyzed for this radionuclide.

e. The vacuumed samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

f. The milled samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

TABLE 18. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE D-RING WALL AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235, 2 (ng/cm^2)
67	50	12/81	--b	--b	--b	--b	--b	--b	--b
67	50	3/82	1.6 ± 0.2 E-3	1.7 ± 0.3 E-2	--c	--c	4.1 ± 0.6 E-4	--b	--d
46	50	12/81	--b	--b	--b	--b	--b	--b	--b
46	50	3/82	3.0 ± 0.5 E-3	3.0 ± 0.5 E-2	--c	--c	2.5 ± 0.4 E-3	--b	--d
V9	50	12/81	1.7 ± 0.3 E-3	1.7 ± 0.3 E-2	--c	3.1 ± 0.9 E-5	9 ± 1 E-4	--b	--d
V9	50	3/82	3.3 ± 0.5 E-3	3.2 ± 0.5 E-2	--c	--c	7 ± 1 E-4	--b	--d
11	50	12/81	7 ± 6 E-3	7 ± 6 E-2	1.1 ± 0.4 E-3	--c	--d	<4 E-8	--d
11	50	3/82	4.2 ± 0.7 E-4	5.0 ± 0.8 E-3	--c	--c	--d	--b	--d

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. These data were rejected because of confirmed sample collection problems.

c. The concentration of this radionuclide was less than detection limit.

d. The sample was not analyzed for this radionuclide.

TABLE 19. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON VERTICAL METAL SURFACES AT THE 305-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
B3	50	12/81	4 ± 1 E-3	4 ± 1 E-2	--b	--b	1.5 ± 0.4 E-3	--c	--c
B3	50	3/82	3 ± 1 E-2	3.5 ± 0.9 E-1	--b	--b	1.5 ± 0.4 E-2	--c	--c
V6	50	12/81	1.4 ± 0.4 E-2	1.4 ± 0.4 E-1	--b	--b	--c	7 ± 2 E-7	--c
V6	50	3/82	1.4 ± 0.4 E-2	1.4 ± 0.4 E-1	--b	--b	--c	3.4 ± 0.9 E-6	--c
V7	50	12/81	5 ± 1 E-3	5 ± 1 E-2	--b	--b	2.2 ± 0.6 E-3	--c	--c
V7	50	3/82	7 ± 2 E-2	7 ± 2 E-1	--b	--b	1.8 ± 0.5 E-2	--c	--c
V8	50	12/81	8 ± 2 E-3	8 ± 2 E-2	--b	--b	--c	--c	--c
V8	50	3/82	3.2 ± 0.9 E-3	3.2 ± 0.9 E-2	--b	--b	--c	--c	--c
B4	50	12/81	7 ± 2 E-2	7 ± 2 E-1	--b	--b	--c	--c	--c
B4	50	3/82	8 ± 2 E-3	8 ± 2 E-2	--b	--b	--c	5 ± 1 E-6	

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 20. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CONCRETE FLOOR AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
115	Surface	12/81	2.26 ± 0.03 E-3	2.27 ± 0.01 E-2	--b	5 ± 1 E-6	2.27 ± 0.06 E-3	--c	--c
115	125	12/81	1.2 ± 0.3 E-1	1.1 ± 0.2 E+0	--b	--b	1.0 ± 0.1 E-1	--c	--c
115	Surface	3/82	7.4 ± 0.3 E-5	7.2 ± 0.1 E-4	--b	--b	7.0 ± 0.2 E-5	--c	--c
115	125	3/82	3.9 ± 0.6 E-3	3.7 ± 0.5 E-2	--b	--b	2.3 ± 0.3 E-3	--c	--c
54	Surface	12/81	1.5 ± 0.2 E-2	1.5 ± 0.2 E-1	--b	--b	6.4 ± 0.2 E-3[d]	--c	<9 E-2[d]
54	10, 50, 125	12/81	2.6 ± 0.7 E-1	2.6 ± 0.7 E-0	--b	--b	1.0 ± 0.2 E-1	--c	<6 E+0
54	Surface	3/82	1.7 ± 0.4 E-4	1.7 ± 0.4 E-3	--b	--b	1.05 ± 0.03 E-4[d]	--c	--c
54	10, 50, 125	3/82	1.7 ± 0.2 E-2	1.7 ± 0.2 E-1	--b	3.6 ± 0.9 E-5	1.3 ± 0.1 E-2	--c	--c
H9	Surface	12/81	1.05 ± 0.01 E-2	1.06 ± 0.01 E-1	--b	--b	--e	1.0 ± 0.2 E-8	--c
H9	125	12/81	--e	--e	--e	--e	--e	--e	--e

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

d. The vacuumed samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

e. These data were rejected because of confirmed sample collection problems.

TABLE 21. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CONCRETE FLOOR AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235, (ng/cm^2)
H9	Surface	3/82	7.6 ± 0.3 E-5	7.4 ± 0.1 E-4	--b	--b	--c	<3 E-9	--c
H9	125	3/82	7 ± 1 E-3	7 ± 1 E-2	--b	--b	--c	3.9 ± 0.9 E-7	--c
149	Surface	12/81	1.53 ± 0.01 E-2	1.53 ± 0.01 E-1	--b	--b	3.55 ± 0.09 E-2	--c	<3 E-1
149	125	12/81	5.8 ± 0.8 E-1	5.8 ± 0.8 E+0	--b	--b	1.0 ± 0.1 E+0	--c	<6 E+0
149	Surface	3/82	2.3 ± 0.8 E-4	2.2 ± 0.8 E-3	--b	--b	6.0 ± 0.1 E-5[d]	--c	<6 E-2[d]
149	10, 125	3/82	9 ± 3 E-2	9 ± 3 E-1	--b	9 ± 3 E-6	1.2 ± 0.4 E-2	--c	<6 E+0
V10	Surface	12/81	3.09 ± 0.04 E-3	3.05 ± 0.01 E-2	--b	--b	--c	--c	--c
V10	125	12/81	3.3 ± 0.5 E-1	3.3 ± 0.5 E+0	--b	--b	--c	--c	--c
V10	Surface	3/82	5.3 ± 0.2 E-5	4.8 ± 0.1 E-4	--b	--b	--c	--c	--c
V10	125	3/82	8 ± 1 E-2	8 ± 1 E-1	--b	--b	--c	--c	
H10	Surface	12/81	1.4 ± 0.4 E-3	1.4 ± 0.4 E-2	--b	--b	--c	5.9 ± 0.9 E-9[d]	--c
H10	10, 50, 150	12/81	3 ± 1 E-1	3 ± 1 E+0	9 ± 2 E-3	1.1 ± 0.6 E-4	--c	4.7 ± 0.7 E-7[e]	--c
H10	Surface	3/82	6 ± 2 E-5	6 ± 2 E-4	--b	--b	--c	<2 E-9[d]	--c
H10	10, 50, 125	3/82	3 ± 1 E-2	2.5 ± 0.9 E-1	--b	--b	--c	3.5 ± 0.7 E-7[e]	--c
33	Surface	12/81	2.45 ± 0.05 E-4	2.34 ± 0.02 E-3	--b	1.2 ± 0.2 E-6	1.82 ± 0.05 E-4	--c	--c
33	125	12/81	8 ± 1 E-2	8 ± 1 E-1	--b	6 ± 2 E-5	2.1 ± 0.3 E-2	--c	--c
33	Surface	3/82	7.5 ± 0.3 E-5	7.2 ± 0.1 E-4	--b	--b	6.2 ± 0.2 E-5	--c	--c
33	125	3/82	7 ± 1 E-3	7 ± 1 E-2	--b	--b	4.8 ± 0.7 E-3	--c	--c
91	Surface	12/81	2.4 ± 0.6 E-4	2.3 ± 0.7 E-3	--b	--b	--c	<2 E-9[d]	--c
91	10, 50, 125	12/81	5 ± 1 E-2	5 ± 1 E-1	2.1 ± 0.8 E-3	--b	--c	4.2 ± 0.7 E-7[e]	--c
91	Surface	3/82	1.7 ± 0.5 E-4	1.8 ± 0.5 E-3	--b	--b	--c	6 ± 1 E-9[d]	--c
91	10, 50, 125	3/82	4 ± 1 E-3	4 ± 1 E-2	--b	--b	--c	3.0 ± 0.5 E-7[e]	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

d. The vacuumed samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

e. The milled samples collected at this sampling location were consolidated prior to analysis for Sr-90, I-129, and/or U-235.

TABLE 22. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON METAL DECKING AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
40	Surface	12/81	1.28 ± 0.02 E-3	1.25 ± 0.01 E-2	--b	--b	--c	<3 E-9	--c
40	50	12/81	3.2 ± 0.6 E-1	3.2 ± 0.6 E+0	--b	5 ± 2 E-5	--c	9 ± 2 E-7	--c
40	Surface	3/82	1.80 ± 0.05 E-4	1.77 ± 0.01 E-3	--b	--b	--c	6 ± 2 E-9	--c
40	50	3/82	3.2 ± 0.6 E-2	3.2 ± 0.6 E-1	6 ± 3 E-4	--b	--c	3.6 ± 0.9 E-7	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 23. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE D-RING WALL AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
16	50	12/81	1.2 ± 0.2 E-2	1.3 ± 0.2 E-1	--b	~b	3.3 ± 0.5 E-3	--c	--c
16	50	3/82	8 ± 1 E-3	8 ± 1 E-2	--b	~b	2.4 ± 0.4 E-3	--c	--c
V2	50	12/81	1.4 ± 0.2 E-3	1.4 ± 0.2 E-2	--b	~b	--c	1.1 ± 0.3 E-7	--c
V2	50	3/82	4.0 ± 0.6 E-3	4.0 ± 0.6 E-2	--b	~b	--c	<4 E-8	--c
36	50	12/81	2.0 ± 0.3 E-3	1.8 ± 0.3 E-2	--b	~b	1.1 ± 0.2 E-3	--c	--c
36	50	3/82	2.4 ± 0.4 E-3	2.3 ± 0.4 E-2	--b	~b	1.4 ± 0.2 E-3	--c	--c
34	50	12/81	9 ± 1 E-4	1.0 ± 0.1 E-2	--b	~b	--c	--c	--c
34	50	3/82	1.8 ± 0.3 E-3	1.7 ± 0.3 E-2	--b	~b	--c	--c	--c
31	50	12/81	4.5 ± 0.9 E-4	5.1 ± 0.8 E-3	--b	~b	--c	--c	--c
31	50	3/82	1.2 ± 0.2 E-3	1.2 ± 0.2 E-2	--b	~b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 24. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE CINDERBLOCK WALL AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
V4	50	12/81	2.9 ± 0.5 E-3	2.8 ± 0.4 E-2	--b	--b	1.3 ± 0.2 E-3	--c	--c
V4	50	3/82	2.8 ± 0.4 E-3	2.9 ± 0.5 E-2	--b	4 ± 1 E-6	9 ± 1 E-4	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 25. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON VERTICAL METAL SURFACES AT THE 347-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
B1	50	12/81	1.6 ± 0.4 E-3	1.6 ± 0.4 E-2	--b	--b	--c	9 ± 2 E-7	--c
B1	50	3/82	--d	--d	--d	--d	--d	--d	--d
50	50	12/81	2.4 ± 0.7 E-3	2.7 ± 0.7 E-2	--b	--b	--c	--c	--c
50	50	3/82	1.1 ± 0.3 E-3	1.2 ± 0.3 E-2	--b	--b	--c	--c	--c
B2	50	12/81	1.2 ± 0.3 E-2	1.1 ± 0.3 E-1	--b	--b	2.0 ± 0.5 E-3	--c	--c
B2	50	3/82	1.2 ± 0.3 E-2	1.2 ± 0.3 E-1	--b	--b	2.2 ± 0.6 E-3	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

d. These data were rejected because of confirmed sample collection problems.

TABLE 26. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE "A" D-RING WALKWAY AT THE 367-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$) Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
26	Surface	12/81	5.9 ± 0.1 E-4	5.69 ± 0.05 E-3	--b	--b	--c	--c	--c
26	125	12/8i	3.9 ± 0.6 E-2	3.9 ± 0.6 E-1	--b	--b	--c	--c	--c
26	Surface	3/82	1.28 ± 0.01 E-3	1.27 ± 0.01 E-2	--b	--b	--c	--c	--c
26	125	3/82	4.5 ± 0.6 E-2	4.5 ± 0.6 E-1	--b	--b	--c	--c	--c
HI	Surface	12/81	--d	--d	--d	--d	--d	--d	--d
HI	125	12/81	2.5 ± 0.4 E-1	2.5 ± 0.4 E+0	--b	--b	1.1 ± 0.2 E-1	--c	--c
HI	Surface	3/82	2.15 ± 0.01 E-3	2.13 ± 0.01 E-2	--b	--b	1.15 ± 0.03 E-3	--c	--c
HI	125	3/82	9 ± 1 E-2	9 ± 1 E-1	--b	--b	3.6 ± 0.5 E-2	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

d. These data were rejected because of confirmed sample collection problems.

TABLE 27. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE RC-P-2A I BEAM (HORIZONTAL) AT THE 367-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
I	Surface	12/81	1.49 ± 0.02 E-3	1.50 ± 0.01 E-2	--b	--b	--c	--c	--c
I	50	12/81	9 ± 2 E-2	9 ± 2 E-1	--b	--b	--c	--c	--c
I	Surface	3/82	5.5 ± 0.1 E-4	5.35 ± 0.02 E-3	--b	--b	--c	--c	--c
I	50	3/82	6 ± 1 E-3	5 ± 1 E-2	1.3 ± 0.3 E-3	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 28. MEASURED SURFACE ACTIVITY CONCENTRATIONS ON THE RC-P-2A I BEAM (VERTICAL) ON THE 369-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
22	50	12/81	3 ± 1 E-3	4 ± 1 E-2	--b	--b	--c	--c	--c
22	50	3/82	2.2 ± 0.6 E-3	2.0 ± 0.6 E-2	--b	--b	--c	--c	--c

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. The sample was not analyzed for this radionuclide.

TABLE 29. MEASURED SURFACE ACTIVITY CONCENTRATIONS AT THE ELEVATOR SHAFT ROOF ON THE 372-FT ELEVATION WITHIN THE TMI-2 REACTOR BUILDING (DECAY-CORRECTED TO MARCH 26, 1982)

Sampling Location	Sampling Depth (mil)	Sampling Date (M/Y)	Mean Surface Activity Concentrations[a] ($\mu Ci/cm^2$)						
			Cs-134	Cs-137	Sb-125	Co-60	Sr-90	I-129	U-235 (ng/cm^2)
H8	Surface	12/81	4.2 ± 0.1 E-4	4.08 ± 0.04 E-3	--b	--b	--c	--c	--c
H8	125	12/81	--d	--d	--d	--d	--d	--d	--d
H8	Surface	3/82	--e	--	--	--	--	--	--
H8	125	3/82	--e	--	--	--	--	--	--

a. The surface activity concentrations given here for milled samples have been corrected for the activity collection efficiencies of the surface samplers.

b. The concentration of this radionuclide was less than detection limit.

c. These data were rejected because of confirmed sample collection problems.

d. The sample was not analyzed for this radionuclide.

e. A sample was not collected during March 1982.

TABLE 30. DECEMBER 1981 MEAN Cs-137 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	^{137}Cs ($\mu Ci/cm^2$)	Sampling Location	^{137}Cs ($\mu Ci/cm^2$)	Sampling Location	^{137}Cs ($\mu Ci/cm^2$)
Horizontal Concrete					
70	4.2 ± 0.6 E+0	115	1.1 ± 0.2 E+0	26	4.0 ± 0.6 E-1
55	2.4 ± 0.3 E+0	54	2.8 ± 0.7 E+0	HI	2.5 ± 0.4 E+0
H2	2.1 ± 0.3 E+0	H9	--b	--	--
H3	1.8 ± 0.3 E+0	149	6.0 ± 0.8 E+0	--	--
50	2.0 ± 0.4 E+0	V10	3.3 ± 0.5 E+0	--	--
34	5 ± 1 E+0	H10	3. ± 1.0 E+0	--	--
H7	8 ± 5 E+0	33	8. ± 1 E-1	--	--
--	--	91	5. ± 1 E-1	--	--
Mean	3.6 ± 0.9 E+0	Mean	2.5 ± 0.7 E+0	Mean	1 ± 1 E+0
Vertical Concrete					
67	--b	16	1.3 ± 0.2 E-1	--	--
46	--b	V2	1.4 ± 0.2 E-2	--	--
V9	1.7 ± 0.3 E-2	V4	2.8 ± 0.4 E-2	--	--
11	7 ± 6 E-2	36	1.8 ± 0.3 E-2	--	--
--	--	34	1.0 ± 0.1 E-2	--	--
--	--	31	5.1 ± 0.8 E-3	--	--
Mean	4 ± 3 E-2	Mean	3 ± 2 E-2	--	--
Horizontal Metal					
--	--	40	3.2 ± 0.6 E+0	I	9 ± 2 E-1
Vertical Metal					
B3	4 ± 1 E-2	B1	1.6 ± 0.4 E-2	22	4 ± 1 E-2
V6	1.4 ± 0.4 E-1	50	2.7 ± 0.7 E-2	--	--
V7	5 ± 1 E-2	B2	1.1 ± 0.3 E-1	--	--
V8	8 ± 2 E-2	--	--	--	--
B4	7 ± 2 E-1	--	--	--	--
Mean	2 ± 1 E-1	Mean	5 ± 3 E-2	Mean	4 ± 1 E-2

a. Activities given here have been decay-corrected to March 26, 1982.

b. Sample was rejected because of sample collection problems.

TABLE 31. DECEMBER 1981 MEAN Cs-134 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	Cs-134 ($\mu Ci/cm^2$)	Sampling Location	Cs-134 ($\mu Ci/cm^2$)	Sampling Location	Cs-134 ($\mu Ci/cm^2$)
Horizontal Concrete					
70	4.2 ± 0.6 E-1	115	1.2 ± 0.2 E-1	26	4.0 ± 0.6 E-2
55	2.5 ± 0.3 E-1	54	2.8 ± 0.7 E-1	HI	2.5 ± 0.4 E-1
H2	2.1 ± 0.3 E-1	H9	--b	--	--
H3	1.9 ± 0.3 E-1	149	6.0 ± 0.8 E-1	--	--
50	2.0 ± 0.4 E-1	V10	3.3 ± 0.5 E-1	--	--
34	5 ± 1 E-1	H10	3 ± 1 E-1	--	--
H7	8 ± 5 E-1	33	8 ± 1 E-2	--	--
--	--	91	5 ± 1 E-2	--	--
Mean	3.7 ± 0.9 E-1	Mean	2.5 ± 0.7 E-1	Mean	1 ± 1 E-1
Vertical Concrete					
67	--b	16	1.2 ± 0.2 E-2	--	--
46	--b	V2	1.4 ± 0.2 E-3	--	--
V9	1.7 ± 0.3 E-3	V4	2.9 ± 0.5 E-3	--	--
11	7 ± 6 E-3	36	2.0 ± 0.3 E-3	--	--
--	--	34	9 ± 1 E-4	--	-
--	--	31	4.5 ± 0.9 E-4	--	--
Mean	4 ± 3 E-3	Mean	3 ± 2 E-3	--	--
Horizontal Metal					
--	--	40	3.2 ± 0.6 E-1	I	9 ± 2 E-2
Vertical Metal					
B3	4 ± 1 E-3	B1	1.6 ± 0.4 E-3	22	3 ± 1 E-3
V6	1.4 ± 0.4 E-2	50	2.4 ± 0.7 E-3	--	--
V7	5 ± 1 E-3	B2	1.2 ± 0.3 E-2	--	--
V8	8 ± 2 E-3	--	--	--	--
B4	7 ± 2 E-2	--	--	--	--
Mean	2 ± 1 E-2	Mean	5 ± 3 E-3	Mean	3 ± 1 E-3

a. Activities given here have been decay-corrected to March 26, 1982.

b. Sample was rejected because of sample collection problems.

TABLE 32. DECEMBER 1981 MEAN Sr-90 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)
Horizontal Concrete					
70	1.2 ± 0.2 E-1	115	1.0 ± 0.1 E-1	HI	1.1 ± 0.2 E-1
55	1.9 ± 0.3 E-1	54	1.1 ± 0.2 E-1	--	--
H2	9 ± 1 E-2	149	1.0 ± 0.1 E+0	--	--
34	1.3 ± 0.2 E-1	33	2.1 ± 0.3 E-2	--	--
H7	3 ± 2 E-1	--	--	--	--
Mean	1.7 ± 0.4 E-1	Mean	3 ± 2 E-1	Mean	1.1 ± 0.2 E-1
Vertical Concrete					
67	--[b]	16	3.3 ± 0.5 E-3	--	--
46	--[b]	V4	1.3 ± 0.2 E-3	--	--
V9	9 ± 1 E-4	36	1.1 ± 0.2 E-3	--	--
Mean	9 ± 1 E-4	Mean	1.9 ± 0.7 E-3	--	--
Vertical Metal					
B3	1.5 ± 0.4 E-3	B2	2.0 ± 0.5 E-3	--	--
V7	2.2 ± 0.6 E-3	--	--	--	--
Mean	1.9 ± 0.4 E-3	Mean	2.0 ± 0.5 E-3	--	--

a. Activities given here have been decay-corrected to March 26, 1982.

b. Sample was rejected because of sample collection problems.

TABLE 33. DECEMBER 1981 MEAN I-129 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION

Elevation 305 ft		Elevation 347 ft, 6 in.	
Sampling Location	$I\text{-}129_2$ ($\mu Ci/cm^2$)	Sampling Location	$I\text{-}129_2$ ($\mu Ci/cm^2$)
Horizontal Concrete			
H3	4.8 ± 0.8E-7	H-10	4.8 ± 0.7E-7
--	--	91	4.2 ± 0.7E-7
Mean	4.8 ± 0.8E-7	Mean	4.5 ± 0.3E-7
Vertical Concrete			
11	<4E-8	V2	1.1 ± 0.3E-7
Horizontal Metal			
--	--	40	9 ± 2E-7
Vertical Metal			
V6	7 ± 2E-7	B1	9 ± 2E-7

TABLE 34. DECEMBER 1981 MEAN Sb-125 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.	
Sampling Location	Sb-125 ($\mu Ci/cm^2$)	Sampling Location	Sb-125 ($\mu Ci/cm^2$)
Horizontal Concrete			
55	2.1 ± 0.3 E-1	H10	9 ± 2 E-3
H2	3.5 ± 0.5 E-2	91	2.1 ± 0.8 E-3
H3	1.1 ± 0.2 E-2	--	--
50	4 ± 1 E-3	--	--
34	8 ± 3 E-3	--	--
H7	2.8 ± 0.8 E-2	--	--
Mean	5 ± 3 E-2	Mean	6 ± 3 E-3
Vertical Concrete			
11	1.1 ± 0.4 E-3	--	--

a. Activities given here have been decay-corrected to March 26, 1982.

TABLE 35. DECEMBER 1981 MEAN SURFACE CONCENTRATIONS OF SEVERAL NUCLIDES LISTED BY TYPE OF SURFACE AND ELEVATION[a]

	Mean Surface Concentration ($\mu Ci/cm^2$)				
	Sr-90	Sb-125	I-129	Cs-134	Cs-137
Elevation 305 ft					
Horizontal Concrete	1.7 ± 0.4 E-1	5 ± 3 E-2	4.8 ± 0.8 E-7	3.7 ± 0.9 E-1	3.6 ± 0.9 E-0
Vertical Concrete	9 ± 1 E-4	1.1 ± 0.4 E-3	<4 E-8	4 ± 3 E-3	4 ± 3 E-2
Horizontal Metal	--	--	--	--	--
Vertical Metal	1.9 ± 0.4 E-3	--	7 ± 2 E-7	2 ± 1 E-2	2 ± 1 E-1
Elevation 347 ft					
Horizontal Concrete	3 ± 2 E-1	6 ± 3 E-3	4.5 ± 0.3 E-7	2.5 ± 0.7 E-1	2.5 ± 0.7 E+0
Vertical Concrete	1.9 ± 0.7 E-3	--	1.1 ± 0.3 E-7	3 ± 2 E-3	3 ± 2 E-?
Horizontal Metal	--	--	9 ± 2 E-7	3.2 ± 0.6 E-1	3.2 ± 0.6 E+0
Vertical Metal	2.0 ± 0.5 E-3	--	9 ± 2. E-7	5 ± 3 E-3	5 ± 3 E-2
Elevation 367 ft					
Horizontal Concrete	1.1 ± 0.2 E-1	--	--	1 ± 1 E-1	1 ± 1 E+0
Vertical Concrete	--	--	--	--	--
Horizontal Metal	--	--	--	9 ± 2 E-2	9 ± 2 E-1
Vertical Metal	--	--	--	3 ± 1 E-3	4 ± 1 E-2

a. Activities given here have been decay-corrected to March 26, 1982.

TABLE 36. MEAN VALUES FOR EACH TYPE OF SURFACE OF THE RATIOS OF THE DECEMBER 1981 SURFACE CONCENTRATIONS OF SEVERAL RADIONUCLIDES TO THE CONCENTRATION OF CS-137 MEASURED IN EACH SURFACE SAMPLE[a]

	Ratios of Concentrations				
	Cs-134	Sb-125	Co-60	Sr-90	I-129
Elevation 305 ft					
Concrete Floor					
Vacuum	1.01 ± 0.01 E-1	3 ± 4 E-2	5 ± 8 E-4	4 ± 2 E-2	<2.2 E-7[b]
Milled	1.00 ± 0.02 E-1	2 ± 3 E-2	8 ± 12 E-4	4 ± 2 E-2	2.7 ± 0.6 E-7[b]
D-Ring Wall					
Milled	1.05 ± 0.08 E-1	8 ± 3 E-3[b]	1.8 ± 0.6 E-3[b]	5 ± 1 E-2[b]	<3.0 E-6[b]
Vertical Metal					
Milled	1.00 ± 0.01 E-1	--[c]	--[c]	4.1 ± 0.5 E-2	5 ± 2 E-6[b]
Elevation 347 ft, 6 in.					
Concrete Floor					
Vacuum	1.02 ± 0.04 E-1	--	4 ± 2 E-4	1.1 ± 0.8 E-1	3 ± 2 E-7
Milled	1.01 ± 0.02 E-1	3.6 ± 0.5 E-3	5 ± 3 E-5	7 ± 6 E-2	5 ± 5 E-7
D-Ring Wall					
Milled	9.6 ± 0.9 E-2	--	--	4 ± 3 E-2	8 ± 2 E-6[b]
Vertical Metal					
Milled	1.0 ± 0.1 E-1	--	--	1.8 ± 0.7 E-2[b]	6 ± 2 E-5[b]
All Horizontal Surfaces					
Vacuum	1.02 ± 0.03 E-1	3 ± 4 E-2	5 ± 7 E-4	7 ± 6 E-2	3 ± 2 E-7
Milled	1.01 ± 0.02 E-1	1 ± 3 E-2	5 ± 10 E-4	5 ± 4 E-2	4 ± 3 E-7

TABLE 36. (Continued)

	Ratios of Concentrations				
	Cs-134	Sb-125	Co-60	Sr-90	I-129
All Vertical Surfaces					
Milled	9.9 ± 0.9 E-2	8 ± 3 E-3[b]	1.8 ± 0.6 E-3[b]	4 ± 1 E-2	2 ± 3 E-5

a. Activities were decay-corrected to March 26, 1982, prior to computation of ratios.

b. Ratio for a single sample.

c. Concentration of radionuclide was less than detection limit.

TABLE 37. MARCH 1982 MEAN Cs-137 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	^{137}Cs ($\mu Ci/cm^2$)	Sampling Location	^{137}Cs ($\mu Ci/cm^2$)	Sampling Location	^{137}Cs ($\mu Ci/cm^2$)
Horizontal Concrete					
70	2.8 ± 0.4 E-1	115	3.8 ± 0.5 E-2	26	4.6 ± 0.6 E-1
55	2.6 ± 0.4 E-1	54	1.7 ± 0.2 E-1	HI	9 ± 1 E-1
H2	3.0 ± 0.4 E+0	H9	7 ± 1 E-2	--	--
H3	3.5 ± 0.5 E-1	149	9 ± 3 E-1	--	--
50	7 ± 6 E-1	V10	8 ± 1 E-1	--	--
34	6 ± 1 E-2	H10	2.5 ± 0.9 E-1	--	--
H7	1.3 ± 0.3 E-1	33	7 ± 1 E-2	--	--
--	--	91	4 ± 1 E-2	--	--
Mean	7 ± 4 E-1	Mean	3 ± 1 E-1	Mean	7 ± 2 E-1
Vertical Concrete					
67	1.7 ± 0.3 E-2	16	8 ± 1 E-2	--	--
46	3.0 ± 0.5 E-2	V2	4.0 ± 0.6 E-2	--	--
V9	3.2 ± 0.5 E-2	V4	2.9 ± 0.5 E-2	--	--
11	5.0 ± 0.8 E-3	36	2.3 ± 0.4 E-2	--	--
--	--	34	1.7 ± 0.3 E-2	--	--
--	--	31	1.2 ± 0.2 E-2	--	--
Mean	2.1 ± 0.6 E-2	Mean	3 ± 1 E-2	--	--
Horizontal Metal					
--	--	40	3.2 ± 0.6 E-1	I	6 ± 1 E-2
Vertical Metal					
B3	3.5 ± 0.9 E-1	B1	--[b]	22	2.0 ± 0.6 E-2
V6	1.4 ± 0.4 E-1	50	1.2 ± 0.3 E-2	--	--
V7	7 ± 2 E-1	B2	1.2 ± 0.3 E-1	--	--
V8	3.2 ± 0.9 E-2	--	--	--	--
B4	8 ± 2 E-2	--	--	--	--
Mean	3 ± 1 E-1	Mean	7 ± 5 E-2	Mean	2.0 ± 0.6 E-2

a. Activities given here have been decay-corrected to March 26, 1982.

b. Sample was rejected because of sample collection problems.

TABLE 38. MARCH 1982 MEAN Cs-134 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	$Cs\text{-}134_2$ ($\mu Ci/cm^2$)	Sampling Location	$Cs\text{-}134_2$ ($\mu Ci/cm^2$)	Sampling Location	$Cs\text{-}134_2$ ($\mu Ci/cm^2$)
Horizontal Concrete					
70	2.8 ± 0.4 E-2	115	4.0 ± 0.6 E-3	26	4.6 ± 0.6 E-2
55	2.7 ± 0.4 E-2	54	1.7 ± 0.2 E-2	HI	9 ± 1 E-2
H2	3.1 ± 0.4 E-1	H9	7 ± 1 E-3	--	--
H3	3.6 ± 0.5 E-2	149	9 ± 3 E-2	--	--
50	7 ± 6 E-2	V10	8 ± 1 E-2	--	--
34	6 ± 1 E-3	H10	3 ± 1 E-2	--	--
H7	1.3 ± 0.3 E-2	33	7 ± 1 E-3	--	--
--	--	91	4 ± 1 E-3	--	--
Mean	7 ± 4 E-2	Mean	3 ± 1 E-2	Mean	7 ± 2 E-2
Vertical Concrete					
67	1.6 ± 0.2 E-3	16	8 ± 1 E-3	--	--
46	3.0 ± 0.5 E-3	V2	4.0 ± 0.6 E-3	--	--
V9	3.3 ± 0.5 E-3	V4	2.8 ± 0.4 E-3	--	--
11	4.2 ± 0.7 E-4	36	2.4 ± 0.4 E-3	--	--
--	--	34	1.8 ± 0.3 E-3	--	--
--	--	31	1.2 ± 0.2 E-3	--	--
Mean	2.1 ± 0.7 E-3	Mean	3 ± 1 E-3	--	--
Horizontal Metal					
--	--	40	3.2 ± 0.6 E-2	I	7 ± 1 E-3
Vertical Metal					
B3	3 ± 1 E-2	B1	--b	22	2.2 ± 0.6 E-3
V6	1.4 ± 0.4 E-2	50	1.1 ± 0.3 E-3	--	--
V7	7 ± 2 E-2	B2	1.2 ± 0.3 E-2	--	--
V8	3.2 ± 0.9 E-3	--	--	--	--
B4	8 ± 2 E-3	--	--	--	--
Mean	3 ± 1 E-2	Mean	7 ± 5 E-3	Mean	2.2 ± 0.6 E-3

a. Activities given here have been decay-corrected to March 26, 1982.

b. Sample was rejected because of sample collection problems.

TABLE 39. MARCH 1982 MEAN Sr-90 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sr\text{-}90_2$ ($\mu Ci/cm^2$)
Horizontal Concrete					
70	1.0 ± 0.1 E-2	115	2.4 ± 0.3 E-3	HI	3.6 ± 0.5 E-2
55	1.1 ± 0.2 E-2	54	1.3 ± 0.1 E-2	--	--
H2	9 ± 1 E-2	149	1.2 ± 0.4 E-2	--	--
34	1.8 ± 0.3 E-3	33	4.9 ± 0.7 E-3	--	--
H7	4.7 ± 0.3 E-3	--	--	--	--
Mean	2 ± 2 E-2	Mean	8 ± 3 E-3	Mean	3.6 ± 0.5 E-2
Vertical Concrete					
67	4.1 ± 0.6 E-4	16	2.4 ± 0.4 E-3	--	--
46	2.5 ± 0.4 E-3	V2	9 ± 1 E-4	--	--
V9	7 ± 1 E-4	36	1.4 ± 0.2 E-3	--	--
Mean	1.2 ± 0.7 E-3	Mean	1.6 ± 0.4 E-3	--	--
Vertical Metal					
B3	1.5 ± 0.4 E-2	B2	2.2 ± 0.6 E-3	--	--
V7	1.8 ± 0.5 E-2	--	--	--	--
Mean	1.7 ± 0.2 E-2	Mean	2.2 ± 0.6 E-3	--	--

a. Activities given here have been decay-corrected to March 26, 1982.

TABLE 40. MARCH 1982 MEAN I-129 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION

Elevation 305 ft		Elevation 347 ft, 6 in.	
Sampling Location	$I\text{-}129_2$ ($\mu Ci/cm^2$)	Sampling Location	$I\text{-}129_2$ ($\mu Ci/cm^2$)
Horizontal Concrete			
H3	2.8 ± 0.8 E-7	H-9	3.9 ± 0.9 E-7
--	--	H10	3.5 ± 0.7 E-7
--	--	91	3.1 ± 0.5 E-7
Mean	2.8 ± 0.8 E-7	Mean	3.5 ± 0.2 E-7
Vertical Concrete			
--	--	V2	<4 E-8
Horizontal Metal			
--	--	40	3.7 ± 0.9 E-7
Vertical Metal			
V6	3.4 ± 0.9 E-6	B2	5 ± 1 E-6
Mean	3.4 ± 0.9 E-6	Mean	5 ± 1 E-6

TABLE 41. MARCH 1982 MEAN Sb-125 SURFACE CONCENTRATIONS LISTED BY TYPE OF SURFACE AND ELEVATION[a]

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	$Sb\text{-}125_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sb\text{-}125_2$ ($\mu Ci/cm^2$)	Sampling Location	$Sb\text{-}125_2$ ($\mu Ci/cm^2$)
Horizontal Concrete					
70	4.0 ± 0.5 E-5	--	--	--	--
55	1.4 ± 0.2 E-2	--	--	--	--
H2	9 ± 2 E-3	--	--	--	--
50	1.5 ± 0.4 E-5	--	--	--	--
Mean	6 ± 3 E-3	--	--	--	--
Horizontal Metal					
--	--	40	6 ± 3 E-4	I	1.3 ± 0.3 E-3

a. Activities given here have been decay-corrected to March 26, 1982.

TABLE 42. MARCH 1982 MEAN SURFACE CONCENTRATIONS OF SEVERAL NUCLIDES LISTED BY TYPE OF SURFACE AND ELEVATION[a]

	Mean Surface Concentration ($\mu Ci/cm^2$)				
	Sr-90	Sb-125	I-129	Cs-134	Cs-137
Elevation 305 ft					
Horizontal Concrete	2 ± 2 E-2	6 ± 3 E-3	2.8 ± 0.8 E-7	7 ± 4 E-2	7 ± 4 E-1
Vertical Concrete	1.2 ± 0.7 E-3	--	--	2.1 ± 0.7 E-3	2.1 ± 0.6 E-2
Horizontal Metal	--	--	--	--	--
Vertical Metal	1.7 ± 0.2 E-2	--	4.2 ± 0.8 E-6	3 ± 1 E-2	3 ± 1 E-1
Elevation 347 ft					
Horizontal Concrete	8 ± 3 E-3	--	3.5 ± 0.2 E-7	3 ± 1 E-2	3 ± 1 E-1
Vertical Concrete	1.6 ± 0.4 E-3	--	<4 E-8	3 ± 1 E-3	3 ± 1 E-2
Horizontal Metal	--	6 ± 3 E-4	3.7 ± 0.9 E-7	3.2 ± 0.6 E-2	3.2 ± 0.6 E-1
Vertical Metal	2.2 ± 0.6 E-3	--	--	7 ± 5 E-3	7 ± 5 E-2
Elevation 367 ft					
Horizontal Concrete	3.6 ± 0.5 E-2	--	--	7 ± 2 E-2	7 ± 2 E-1
Vertical Concrete	--	--	--	--	--
Horizontal Metal	--	1.3 ± 0.3 E-3	--	7 ± 1 E-3	6 ± 1 E-2
Vertical Metal	--	--	--	2.2 ± 0.6 E-3	2.0 ± 0.6 E-2

a. Activities given here have been decay-corrected to March 26, 1982.

TABLE 43. MEAN VALUES FOR EACH TYPE OF SURFACE OF THE RATIOS OF THE MARCH 1982 SURFACE CONCENTRATIONS OF SEVERAL RADIONUCLIDES TO THE CONCENTRATION OF CS-137 MEASURED IN EACH SURFACE SAMPLE[a]

	Ratios of Concentrations				
	Cs-134	Sb-125	Co-60	Sr-90	I-129
Elevation 305 ft					
Concrete Floor					
Vacuum	1.02 ± 0.08 E-1	4 ± 3 E-2	--[b]	4 ± 2 E-2	<5.3E-7[c]
Milled	1.02 ± 0.04 E-1	3 ± 4 E-2	2 ± 3 E-4	3 ± 1 E-2	8 ± 3E-7[b]
D-Ring Wall					
Milled	9.5 ± 0.8 E-2	--	--	4 ± 3 E-2	--
Vertical Metal					
Milled	9.7 ± 0.6 E-2	--	--	3 ± 1 E-2	4 ± 3 E-5
Elevation 347 ft, 6 in.					
Concrete Floor					
Vacuum	1.02 ± 0.04 E-1	--	--	7 ± 3 E-2	3 ± 1E-6[b]
Milled	1.02 ± 0.02 E-1	--	9 ± 11 E-5	5 ± 3 E-2	4 ± 3 E-6
D-Ring Wall					
Milled	1.02 ± 0.03 E-1	--	--	5 ± 2E-2	<1.0 E-6[b]
Vertical Metal					
Milled	9.6 ± 0.6 E-2	--	--	1.8 ± 0.7E-2[b]	--
All Horizontal Surfaces					
Vacuum	1.02 ± 0.06 E-1	4 ± 3 E-2	--	5 ± 3 E-2	3.40 ± 0.01E-6
Milled	1.02 ± 0.04 E-1	2 ± 3 E-2	2 ± 2 E-4	4 ± 3 E-2	3 ± 3 E-6

TABLE 43. (Continued)

	Ratios of Concentration				
	Cs-134	Sb-125	Co-60	Sr-90	I-129
All Vertical Surfaces:					
Milled	9.9 ± 0.6 E-2	--	1.4 ± 0.4 E-4[b]	4 ± 2 E-2	4 ± 3 E-5

a. Activities were decay-corrected to March 26, 1982 prior to computation of ratios.

b. Concentration of radionuclide was less than detection limit.

c. Ratio for a single sample.

TABLE 44. DECEMBER 15 and 17, 1981, BETA AND GAMMA EXPOSURE RATES MEASURED AT SURFACE SAMPLING LOCATIONS INSIDE THE TMI-2 REACTOR BUILDING

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)
Horizontal Concrete								
70	2000	360	115	1000	90	26	770	280
55	1900	1500	54	5200	310	HI	2800	290
H2	--a	--a	H9	3500	390	--	--	--
H3	3700	1000	149	4380	750	--	--	--
50	3300	400	V10	6130	500	--	--	--
34	7000	500	H10	3150	300	--	--	--
H7	560	250	33	700	200	--	--	--
--	--	--	91	1400	300	--	--	--
Mean	3100	670	Mean	3200	360	Mean	1800	290
Vertical Concrete								
67	37	280	16	123	45	--	--	--
46	--a	--a	V2	35	110	--	--	--
V9	--a	--a	V4	70	75	--	--	--
11	<710	900	36	35	75	--	--	--
--	--	--	34	35	65	--	--	--
--	--	--	31	70	35	--	--	--
Mean	<370	590	Mean	61	68	--	--	--

TABLE 44. (Continued)

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)
Horizontal Metal								
--	--	--	40	7530	500	I	4300	270
Vertical Metal								
B3	--a	--a	B1	105	150	22	158	325
V6	--a	--a	50	210	165	--	--	--
V7	--a	--a	B2	525	120	--	--	--
V8	--a	--a	--	--	--	--	--	--
B4	<790	1000	--	--	--	--	--	--
Mean	<790	1000	Mean	280	145	Mean	158	325

a. A measurement was not made at this location.

TABLE 45. MARCH 25 AND 26, 1982, BETA AND GAMMA EXPOSURE RATES MEASURED AT SURFACE SAMPLING LOCATIONS INSIDE THE TMI-2 REACTOR BUILDING

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)
Horizontal Concrete								
70	<410	500	115	--a	--a	26	--a	--a
55	3900	500	54	--a	--a	HI	--a	--a
H2	8580	2500	H9	--a	--a	--	--	--
H3	<830	1000	149	980	450	--	--	--
50	<130	150	V10	1870	220	--	--	--
34	510	250	H10	1290	150	--	--	--
H7	860	80	33	310	60	--	--	--
--	--	--	91	470	160	--	--	--
Mean	<2170	710	Mean	980	210	--	--	--
Vertical Concrete								
67	<500	600	16	96	36	--	--	--
46	600	200	V2	40	70	--	--	--
V9	400	250	V4	80	80	--	--	--
11	400	200	36	40	50	--	--	--
--	--	--	34	40	50	--	--	--
--	--	--	31	48	36	--	--	--
Mean	<480	310	Mean	57	54	--	--	--

TABLE 45. (Continued)

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)	Location	Beta (mrad/h)	Gamma (mR/h)
Horizontal Metal								
--	--	--	40	470	180	I	--a	--a
Vertical Metal								
B3	--a	--a	B1	160	100	22	240	260
V6	820	600	50	80	100	--	--	--
V7	400	400	B2	480	100	--	--	--
V8	100	375	--	--	--	--	--	--
B4	400	300	--	--	--	--	--	--
Mean	430	420	Mean	240	100	Mean	240	260

a. A valid measurement was not made at this location.

TABLE 46. MEAN DECEMBER 1981 and MARCH 1982 BETA AND GAMMA EXPOSURE RATES LISTED BY SURFACE TYPE AND ELEVATION

Date (M/Y)	Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
	Beta (mrad/h)	Gamma (mR/h)	Beta (mrad/h)	Gamma (mR/h)	Beta (mrad/h)	Gamma (mR/h)
Horizontal Concrete						
12/81	3100	670	3200	360	1800	290
3/82	<2170	710	980	210	--a	--a
Vertical Concrete						
12/81	<370	590	61	68	--	--
3/82	<480	310	57	54	--	--
Horizontal Metal						
12/81	--	--	7530	500	4300	270
3/82	--	--	470	180	--a	--a
Vertical Metal						
12/81	<790	1000	280	145	158	325
3/82	430	420	240	100	240	260

a. Exposure rate data that were obtained for this elevation were rejected because of measurement problems.

TABLE 47. MEASURED DECONTAMINATION FACTORS FOR LOOSE AND FIXED Cs-137 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
	Decontamination Factor			Decontamination Factor			Decontamination Factor	
Sampling Location	Vacuum Samples	Milled Samples	Sampling Location	Vacuum Samples	Milled Samples	Sampling Location	Vacuum Samples	Milled Samples
Horizontal Concrete								
70	2.25 ± 0.04 E+2	1.5 ± 0.3 E+1	115	3.15 ± 0.05 E+1	3.0 ± 0.7 E+1	26	4.48 ± 0.05 E-1	9 ± 2 E-1
55	1.33 ± 0.01 E+1	9 ± 2 E+0	54	9 ± 2 E+1	1.5 ± 0.4 E+1	HI	--a	2.8 ± 0.5 E+0
H2	1.01 ± 0.02 E+2	7 ± 1 E-1	H9	1.43 ± 0.02 E+2	--a	--	--	--
H3	2.46 ± 0.02 E+0	5 ± 1 E+0	149	7 ± 3 E+1	6 ± 2 E+0	--	--	--
50	1.3 ± 0.4 E+2	3 ± 2 E+0	V10	6.4 ± 0.1 E+1	4.1 ± 0.8 E+0	--	--	--
34	1.7 ± 0.8 E+2	8 ± 2 E+1	H10	2 ± 1 E+1	1.2 ± 0.6 E+1	--	--	--
H7	3 ± 2 E+2	6 ± 4 E+1	33	3.25 ± 0.05 E+0	1.1 ± 0.2 E+1	--	--	--
--	--	--	91	1.3 ± 0.5 E+0	1.3 ± 0.4 E+1	--	--	--
Vertical Concrete								
67	NA	--a	16	NA	1.6 ± 0.3 E+0	--	--	--
46	NA	--a	V2	NA	3.5 ± 0.7 E-1	--	--	--
V9	NA	5 ± 1 E-1	V4	NA	1.0 ± 0.2 E+0	--	--	--
11	NA	1 ± 1 E+1	36	NA	8 ± 2 E-1	--	--	--
--	--	--	34	NA	6 ± 1 E-1	--	--	--
--	--	--	31	NA	4 ± 1 E-1	--	--	--
Horizontal Metal								
--	--	--	40	7.06 ± 0.07 E+0	1.0 ± 0.3 E+1	1	2.80 ± 0.02 E+0	1.8 ± 0.5 E+1
Vertical Metal								
B3	NA	1.1 ± 0.4 E-1	B1	NA	--a	22	NA	2.0 ± 0.8 E+0
V6	NA	1.0 ± 0.4 E+0	50	NA	2.3 ± 0.8 E+0	--	--	--
V7	NA	7 ± 2 E-2	B2	NA	9 ± 3 E-1	--	--	--
V8	NA	2.5 ± 0.9 E+0	--	--	--	--	--	--
B4	NA	9 ± 3 E+0	--	--	--	--	--	--

a. December or March data was rejected because of sample collection problems.

b. Not applicable.

TABLE 48. MEASURED DECONTAMINATION FACTORS FOR LOOSE AND FIXED Sr-90 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
	Decontamination Factor			Decontamination Factor			Decontamination Factor	
Sampling Location	Vacuum Samples	Milled Samples	Sampling Location	Vacuum Samples	Milled Samples	Sampling Location	Vacuum Samples	Milled Samples
Horizontal Concrete								
70	1.25 ± 0.04 E+2	1.2 ± 0.2 E+1	115	3.2 ± 0.1 E+1	4.3 ± 0.7 E+1	HI	--a	3.1 ± 0.7 E+0
55	2.70 ± 0.08 E+1	1.6 ± 0.4 E+1	54	6.1 ± 0.3 E+1	8 ± 2 E+0	--	--	--
H2	4.7 ± 0.2 E+2	1.0 ± 0.2 E+0	149	5.9 ± 0.2 E+2	8 ± 3 E+1	--	--	--
34	1.05 ± 0.04 E+2	7 ± 2 E+1	33	2.9 ± 0.1 E+0	4.4 ± 0.9 E+0	--	--	--
H7	2.12 ± 0.07 E+2	6 ± 4 E+1	--	--	--	--	--	--
Vertical Concrete								
V9	NA	1.3 ± 0.2 E+0	16	NA	1.4 ± 0.3 E+0	--	--	--
--	--	--	V4	NA	1.4 ± 0.3 E+0	--	--	--
--	--	--	36	NA	8 ± 2 E-1	--	--	--
Vertical Metal								
B3	NA	1.0 ± 0.4 E-1	B2	NA	9 ± 3 E-1	--	--	--
V7	NA	1.2 ± 0.5 E-1	--	--	--	--	--	--

a. December or March data were rejected because of sample collection problems.

b. Not applicable.

TABLE 49. MEASURED DECONTAMINATION FACTORS FOR LOOSE AND FIXED I-129 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft			Elevation 347 ft, 6 in.		
	Decontamination Factor			Decontamination Factor	
Sampling Location	Vacuum Samples	Milled Samples	Sampling Location	Vacuum Samples	Milled Samples
Horizontal Concrete					
H3	--[a]	>1.6 E+2	H9	>3.3 E+0	--[b]
--	--	--	H10	>3.0 E+0	1.3 ± 0.3 E+0
--	--	--	91	<3.3 E-1	1.4 ± 0.3 E+0
Vertical Concrete					
--	--	--	V2	NA[c]	>2.8 E+0
Horizontal Metal					
--	--	--	40	<5.0 E-1	2.5 ± 0.8 E+0
Vertical Metal					
V6	NA	2.1 ± 0.8 E-1	H9	--	--

a. December and March concentrations were lower than detection limit.

b. December sample was rejected because of sample collection problems.

c. Not applicable.

TABLE 50. MEASURED DECONTAMINATION FACTORS FOR TOTAL Cs-137 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	Decontamination Factor	Sampling Location	Decontamination Factor	Sampling Location	Decontamination Factor
Horizontal Concrete					
70	1.5 ± 0.3 E+1	115	2.9 ± 0.6 E+1	26	9 ± 2 E-1
55	9 ± 2 E+0	54	1.6 ± 0.5 E+1	HI	2.8 ± 0.5 E+0
H2	7 ± 1 E-1	H9	--a	--	--
H3	5 ± 1 E+0	149	7 ± 2 E+0	--	--
50	3 ± 3 E+0	V10	4.1 ± 0.8 E+0	--	--
34	8 ± 2 E+1	H10	1.2 ± 0.6 E+1	--	--
H7	6 ± 4 E+1	33	1.1 ± 0.2 E+1	--	--
--	--	91	1.3 ± 0.4 E+1	--	--
Mean	2 ± 1 E+1	Mean	1.3 ± 0.3 E+1	Mean	2 ± 1 E+0
Vertical Concrete					
67	--a	16	1.6 ± 0.3 E+0	--	--
46	--a	V2	3.5 ± 0.7 E-1	--	--
V9	5 ± 1 E-1	V4	1.0 ± 0.2 E+0	--	--
11	1 ± 1 E+1	36	8 ± 2 E-1	--	--
--	--	34	6 ± 1 E-1	--	--
--	--	31	4 ± 1 E-1	--	--
Mean	5 ± 5 E+0	Mean	8 ± 2 E-1	--	--
Horizontal Metal					
--	--	40	1.0 ± 0.3 E+1	I	1.5 ± 0.4 E+1
Vertical Metal					
B3	1.1 ± 0.4 E-1	B1	--a	22	2.0 ± 0.8 E+0
V6	1.0 ± 0.4 E+0	50	2.3 ± 0.8 E+0	--	--
V7	7 ± 2 E-2	B2	9 ± 3 E-1	--	--
V8	2.5 ± 0.9 E+0	--	--	--	--
B4	9 ± 3 E+0	--	--	--	--
Mean	3 ± 2 E+0	Mean	1.6 ± 0.7 E+0	Mean	2.0 ± 0.8 E+0

a. Surface activity data was rejected because of sample collection problems.

TABLE 51. MEASURED DECONTAMINATION FACTORS FOR TOTAL Sr-90 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
Sampling Location	Decontamination Factor	Sampling Location	Decontamination Factor	Sampling Location	Decontamination Factor
Horizontal Concrete					
70	1.2 ± 0.2 E+1	115	4.2 ± 0.7 E+1	HI	3.1 ± 0.7 E+0
55	1.7 ± 0.4 E+1	54	8 ± 2 E+0	--	--
H2	1.0 ± 0.2 E+0	149	8 ± 3 E+1	--	--
34	7 ± 2 E+1	33	4.3 ± 0.9 E+0	--	--
H7	6 ± 4 E+1	--	--	--	--
Mean	3 ± 1 E+1	Mean	3 ± 2 E+1	Mean	3.1 ± 0.7 E+0
Vertical Concrete					
67	--[a]	16	1.4 ± 0.3 E+0	--	--
46	--[a]	V4	1.4 ± 0.3 E+0	--	--
V9	1.3 ± 0.2 E+0	36	8 ± 2 E-1	--	--
Mean	1.3 ± 0.2 E+0	Mean	1.2 ± 0.2 E+0	--	--
Vertical Metal					
B3	1.0 ± 0.4 E-1	B2	9 ± 3 E-1	--	--
V7	1.2 ± 0.5 E-1	--	--	--	--
Mean	1.1 ± 0.1 E-1	Mean	9 ± 3 E-1	--	--

a. Surface activity data were rejected because of sample collection problems.

TABLE 52. MEASURED DECONTAMINATION FACTORS FOR TOTAL I-129 SURFACE ACTIVITY LISTED BY REACTOR BUILDING ELEVATION AND SAMPLING LOCATION

Elevation 305 ft		Elevation 347 ft, 6 in.	
Sampling Location	Decontamination Factor	Sampling Location	Decontamination Factor
Horizontal Concrete			
H3	1.7 ± 0.6 E+0	H10	1.4 ± 0.3 E+0
--	--	91	1.4 ± 0.3 E+0
Mean	1.7 ± 0.6 E+0	Mean	1.4 ± 0.3 E+0
Vertical Concrete			
--	--	V2	>2.8 E+0
Horizontal Metal			
--	--	40	2.4 ± 0.8 E+0
Vertical Metal			
V6	2.1 ± 0.8 E-1	--	--

TABLE 53. MEAN DECONTAMINATION FACTORS FOR SEVERAL NUCLIDES LISTED BY TYPE OF SURFACE AND ELEVATION

Nuclide	Elevation 305 ft		Elevation 347 ft, 6 in.		Elevation 367 ft, 4 in.	
	Vacuum Samples	Milled Samples	Vacuum Samples	Milled Samples	Vacuum Samples	Milled Samples
Horizontal Concrete						
Co-60	--[a]	3 ± 1 E+1	--	--	--	--
Sr-90	1.9 ± 0.8 E+2	3 ± 1 E+1	2 ± 1 E+2	3 ± 2 E+1	--	3.1 ± 0.7 E+0
Sb-125	4 ± 3 E+1	9 ± 5 E+0	--	--	--	--
I-129	--	>1.6 E+2	--	1.35 ± 0.05 E+0	--	--
Cs-137	1.3 ± 0.4 E+2	2 ± 1 E+1	5 ± 2E+1	1.3 ± 0.3 E+1	4.48 ± 0.05 E-1	2 ± 1 E+0
U-235	>1.3 E+1	1.0 ± 0.3 E+1	--	--	--	--
Vertical Concrete						
Sr-90	NA[b]	1.3 ± 0.2 E+0	NA	1.2 ± 0.2 E+0	--	--
I-129	NA	--	NA	>2.8 E+0	--	--
Cs-137	NA	5 ± 5 E+0	NA	8 ± 2 E-1	--	--
Horizontal Metal						
Sr-90	--	--	--	--	--	--
I-129	--	--	<5 E-1	2.5 ± 0.8 E+0	--	--
Cs-137	--	--	7.06 ± 0.07 E+0	1.0 ± 0.3 E+1	2.80 ± 0.02 E+0	1.8 ± 0.5 E+1
Vertical Metal						
Sr-90	NA	1.1 ± 0.1 E-1	NA	9 ± 3 E-1	NA	--
I-129	NA	2.1 ± 0.8 E-1	NA	--	NA	--
Cs-137	NA	3 ± 2 E+0	NA	1.6 ± 0.7 E+0	NA	2.0 ± 0.8 E+0

a. Nuclide was not detected or measured.

b. Not applicable

TABLE 54. DECONTAMINATION FACTORS CALCULATED USING PRE- AND POST-DECONTAMINATION BETA AND GAMMA EXPOSURE RATES DATA

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
	Decontamination Factor			Decontamination Factor			Decontamination Factor	
Sampling Location	Beta	Gamma	Sampling Location	Beta	Gamma	Sampling Location	Beta	Gamma
Horizontal Concrete								
70	>4.9 E-0	7.2 E-1	115	--a	--a	26	--a	--a
55	4.9 E-1	3.0 E+0	54	--a	--a	HI	--a	--a
H2	--a	--a	H9	--a	--a	--	--	--
H3	>4.5 E+0	1.0 E+0	149	4.5 E+0	1.7 E+0	--	--	--
50	>2.5 E+1	2.7 E+0	V10	3.3 E+0	2.3 E+0	--	--	--
34	1.4 E+1	2.0 E+0	H10	2.4 E+0	2.0 E+0	--	--	--
H7	6.5 E-1	3.1 E+0	33	2.3 E+0	3.3 E+0	--	--	--
			91	3.0 E+0	1.9 E+0	--	--	--
Mean	>8.3 E+0	2.1 E+0	Mean	3.1 E+0	2.2 E+0	--	--	--
Vertical Concrete								
67	>7.4 E-2	4.7 E-1	16	1.3 E+0	1.3 E+0	--	--	--
46	--a	--a	V2	8.8 E-1	1.6 E+0	--	--	--
V9	--a	--a	V4	8.8 E-1	9.4 E-1	--	--	--
11	<1.8 E+0	4.5 E+0	36	8.8 E-1	1.5 E+0	--	--	--
--	--	--	34	8.8 E-1	1.3 E+0	--	--	--
--	--	--	31	1.5 E+0	9.7 E-1	--	--	--
Mean	--	2.5 E+0	Mean	1.1 E+0	1.3 E+0	--	--	--

TABLE 54. (continued)

Elevation 305 ft			Elevation 347 ft, 6 in.			Elevation 367 ft, 4 in.		
	Decontamination Factor			Decontamination Factor			Decontamination Factor	
Sampling Location	Beta	Gamma	Sampling Location	Beta	Gamma	Sampling Location	Beta	Gamma
Horizontal Metal								
--	--	--	40	1.6 E+1	2.8 E+0	I	--a	--a
Vertical Metal								
B3	--a	--a	B1	6.6 E-1	1.5 E+0	22	6.6E-1	1.3E+0
V6	--a	--a	50	2.6 E+0	1.7 E+0	--	--	--
V7	--a	--a	B2	1.1 E+0	1.2 E+0	--	--	--
V8	--a	--a	--	--	--	--	--	--
B4	>2.0 E+0	3.3 E+0	--	--	--	--	--	--
Mean	>2.0 E+0	3.3 E+0	Mean	1 5 E+0	1.5 E+0	Mean	6.6E-1	1.3E+0

a. Exposure rate data were rejected because of measurement problems.

TABLE 55. REACTOR BUILDING SURFACE AREAS

	Area (cm^2)	Percent of Total[a]
Elevation 347 ft, 6 in. and above		
Vertical Steel	4.709 E+7	21.4
Veritical Concrete	1.997 E+6	0.9
Horizontal Steel	2.601 E+7	11.8
Horizontal Concrete	9.400 E+6	4.3
Elevation 305 ft to 347 ft, 6 in.		
Vertical Steel	2.373 E+7	10.8
Veritical Concrete	2.452 E+7	11.2
Horizontal Steel	2.640 E+7	12.0
Horizontal Concrete	9.908 E+6	4.5
Elevation 282 ft, 6 in. to 305 ft		
Vertical Steel	1.659 E+7	7.6
Veritical Concrete	1.659 E+7	7.6
Horizontal Steel	8.332 E+6	3.8
Horizontal Concrete	9.107 E+6	4.1

a. Based on total internal Reactor Building surface area of 2.20 E+8 cm^2.

TABLE 56. TOTAL SURFACE ACTIVITIES IN CURIES ON REACTOR BUILDING SURFACES[a]

Elevation	Surface Activity (Ci)			
	Cs-137	Sr-90	I-129	Sb-125
282 ft, 6 in. to 305 ft				
Horizontal Concrete	3.28 ± 0.82 E+1[b]	1.55 ± 0.36 E+0	4.37 ± 0.73 E-6	4.6 ± 2.7 E-1
Vertical Concrete	6.6 ± 5.0 E-1	1.49 ± 0.17 E-2	<6.6 E-7	1.99 ± 0.66 E-2
Horizontal Metal	3.00 ± 0.75 E+1	1.42 ± 0.33 E+0	4.00 ± 0.67 E-6	4.2 ± 2.5 E-1
Vertical Metal	3.3 ± 1.7 E+0	3.15 ± 0.66 E-2	1.16 ± 0.33 E-5	--[c]
305 ft to 347 ft, 6 in.				
Horizontal Concrete	3.57 ± 0.89 E+1[b]	1.68 ± 0.40 E+0	4.76 ± 0.79 E-6	5.0 ± 3.0 E-1
Vertical Concrete	9.8 ± 7.4 E-1	2.21 ± 0.25 E-2	<9.8 E-7	2.94 ± 0.98 E-2
Horizontal Metal	9.5 ± 2.4 E+1	4.5 ± 1.1 E+0	1.27 ± 0.21 E-5	1.32 ± 0.79 E+0
Vertical Metal	4.8 ± 2.4 E+0	4.51 ± 0.95 E-2	1.66 ± 0.47 E-5	--
347 ft, 6 in. and Above				
Horizontal Concrete	1.7 ± 1.2 E+1[d]	1.93 ± 0.27 E+0	4.23 ± 0.28 E-6	1.13 ± 0.38 E-2
Vertical Concrete	6.0 ± 4.0 E-2	3.8 ± 1.4 E-3	2.20 ± 0.60 E-7	2.40 ± 0.80 E-3
Horizontal Metal	5.3 ± 1.7 E+1	5.3 ± 5.2 E+0	2.34 ± 0.52 E-5	1.56 ± 0.78 E-1
Vertical Metal	2.1 ± 1.5 E+0	9.4 ± 2.4 E-2	4.24 ± 0.94 E-5	--

a. Activities were delay-corrected to March 26, 1982

b. The mean December 1981 surface activities measured on the 305-ft elevation were used to compute total activities in this column.

c. The surface concentration of this nuclide was not measured.

d. The average of the mean December 1981 surface activities measured on the 347-ft, 6-in. and 367-ft, 4-in. elevations were used to compute total activities in this column.

TABLE 57. PERCENT OF TMI-2 FISSION PRODUCT CORE INVENTORY MEASURED ON REACTOR BUILDING SURFACES

Nuclide	Total Surface Activity (Ci)	Total Core Inventory[a] (Ci)	Percent of Core Inventory
^{134}Cs	2.75 ± 0.35 E+1[b]	5.8 E+4[b]	4.7 ± 0.6 E-2
^{137}Cs	2.75 ± 0.35 E+2	7.9 E+5	3.5 ± 0.4 E-2
^{90}Sr	1.66 ± 0.54 E+1	7.0 E+5	2.4 ± 0.8 E-3
^{129}I	1.25 ± 0.12 E-4	2.2 E-1	5.7 ± 0.5 E-2
^{125}Sb	2.92 ± 0.93 E+0	5.7 E-4	5 ± 2 E-3

a. Based on inventory reported in NSAC EPRI ORIGEN Code Calculation of TMI-2 Fission Product Inventory, Technology for Energy Corporation Report No. R-80-012, Knoxville, Tennessee (May 1980).

b. Activities are decay-corrected to March 26, 1982.

TABLE 58. COEFFICIENTS OF POWER FUNCTION FITS OF Cs-137 SURFACE CONCENTRATIONS ($\mu Ci/cm^2$) AND BETA (mrad/h) OR GAMMA (mR/h) EXPOSURE RATES[a]

Data Set	Number of Points	Coefficients of Power Function Fit		Coefficient of Determination
		a	b	r^2
December 1981 Beta	25	1.20 E-4	1.22	0.915
March 1982 Beta	24	5.85 E-4	0.866	0.643
December and March Beta	49	1.60 E-4	1.14	0.827
December 1981 Gamma				
All data (305 ft)	8	6.26 E+3	-1.274	0.286
All data (347 ft)	17	2.41 E-6	2.23	0.652
March 1982 Gamma				
Horizontal Concrete (305 ft)	7	5.18 E-3	0.691	0.414
All data, excluding 91 and 50 (347 ft)	12	4.81 E-5	1.67	0.799

a. ^{137}Cs surface concentration ($\mu Ci/cm^2$) = y, Beta (mrad/h) or gamma (mR/h) exposure rate = x, and a and b = coefficients of power function $y = ax^b$.

APPENDIX A
SAMPLING PROCEDURE

APPENDIX A
SAMPLING PROCEDURE

The procedure that was followed to collect samples using the surface samplers is as follows:

1. Install an unused milling bit that is correct for the type of surface to be sampled. Concrete surfaces require a carbide bit and metal surfaces require a hardened steel bit. Install the bit as follows:

    1.1 Turn the penetration depth setting disk counterclockwise until about 0.2 cm of thread remains above it. Press down on the drill. Turn the sampler on its side.

    1.2 Obtain either a hardened steel or carbide bit. The cutting end of each bit is inserted into a short piece of tygon tubing. Handle the bit by grasping only the tubing.

    1.3 Insert the bit into the receptacle located on the bottom of the sampler's base plate and turn it clockwise until seated finger tight.

    1.4 Remove the tygon tubing and put aside for later use.

    1.5 Tighten the bit using a clean open-end wrench.

    1.6 While the sampler is still on its side, pull the drill away from its base plate.

2. Install an unused sample filter cartridge as follows: Remove the nylon cap from the filter cartridge's intake tube and insert the tube into the exhaust port of the sampler until it is firmly seated.

3. Place the base plate of the sampler against the surface to be sampled. The gasket on the bottom of the base plate must be entirely in contact with the surface.

4. Remove the nylon plug from the filter cartridge's exhaust tube and insert the tube into the tygon tube that is connected to the air pump.

5. If the surface being sampled is horizontal surface, proceed to Step 5.1, otherwise proceed to Step 6.

5.1 Obtain a vacuum sample by turning only the air pump on while pressing the base plate against the surface. Turn the air pump off after fifteen seconds of operation.

5.2 Remove the sample filter cartridge while leaving the sampler base plate stationary. Install the nylon cap and plug on the filter cartridge.

5.3 Install an unused sample filter cartridge as described in Steps 2 and 4. Then proceed to Step 6.

6. Rezero the sampler as follows:

6.1 While pressing on the handle of the drill, turn the depth setting disk counterclockwise until it turns freely. The bit is now in contact with the surface.

6.2 Rotate the penetration depth setting disk clockwise until it comes into contact with the top of the chuck receptacle.

6.3 Note the number of the sector that is below the 'T' handle that is attached to the depth setting disk. That number is the reference zero.

7. Set the desired sampling depth by rotating the depth setting disk counterclockwise the proper number of revolutions. A sampling depth of 0.25 mm corresponds to a rotation of 6.4 sectors while depths of 1.27 and 3.18 mm are achieved by turning the disk two and five complete revolutions, respectively.

8. Push firmly on the sampler to seal the vacuum chamber gasket against the surface to be sampled.

9. Turn the air pump and drill on.

10. Push firmly on the drill until the depth setting disk comes into contact with the top of the chuck receptacle. This will require 15 seconds of drill operation for the 0.25 and 1.27 mm depths and 20 seconds for the 3.18 mm depth. Then turn the drill off.

11. While still pushing firmly on the sampler's base plate, pull the drill away from the base plate. Allow the pump to operate an additional 15 seconds after the drill is turned off.

12. Remove the sample filter cartridge from the exhaust port and install the nylon cap. If the sample was collected from a horizontal surface, turn the sampler base plate upright so that the cartridge is on the side that is down before attempting to remove the cartridge. This orientation will already exist if the surface sampled was a vertical surface.

13. Inspect the milled hole for shape and presence of residual millings. If millings remain, uncap the filter cartridge, turn the air pump on, and vacuum the hole. Turn the pump off when finished.

14. Install the nylon cap, gently disengage the filter cartridge from the tygon tube while holding the cartridge so that its intake tube is slightly inclined towards the floor. Install the nylon plug.

15. Remove the milling bit as follows:

    15.1 Turn the sampler on its side.

    15.2 Press the drill handle towards the base plate.

15.3 Using a clean, bit changing wrench loosen the bit by turning it counterclockwise.

15.4 Slip the short tygon tube that had been used to install the bit over the bit and turn it counterclockwise until free.

15.5 Remove the nylon plug from the exhaust tube of the sample filter cartridge and insert the bit into the exhaust tube discarding the tygon tube.

15.6 Install the nylon plug.

16. Label the sample filter cartridge indicating number, type of surface sampled, surface orientation, and sampling depth.

17. Return to Step 1 to collect the next sample.

APPENDIX B
ANALYSIS METHODS

APPENDIX B
ANALYSIS METHODS

The methods used to analyze surface samples are described below.

Gamma Spectroscopy

Samples were analyzed via gamma spectroscopy using the Ge(Li) spectrometer systems at the Radiation Measurements Laboratory. The absolute counting efficiencies of the detectors were determined by gamma counting a 110 mL liquid standard at a distance of 5 cm, which was the counting geometry used for sample analysis. Because the standard was liquid only and each sample contained in addition to liquid a filter and millings, a sample was centrifuged and the liquid and solid components were analyzed separately. The activities were summed and compared with the activity that was measured when the sample was in its original configuration. The difference between the two values was less than five%.

Pre-decontamination samples were counted for 20 minutes and post-decontamination samples were counted for one hour. Sample count results were software-corrected for ambient background and detector counting efficiency. Isotopes were identified by computer reference to an isotope library, and quantitative results were calculated in μCi/sample.

Strontium-90

A chemical separation technique was used to segregate and purify ^{90}Sr in each sample prior to gross beta counting. Nonradioactive strontium was initially added to each sample as a tracer to determine the chemical yield of the separation procedure. The procedure was to: (a) add phosphoric acid (H_3PO_4) to the 110 mL sample solution to form strontium phosphate [$Sr_3(PO_4)_2$], (b) add ammonium hydroxide (NH_4OH) to precipitate $Sr_3(PO_4)_2$, (c) dissolve the precipitate in nitric acid (HNO_3), (d) precipitate strontium nitrate [$Sr(NO_3)_2$] with fuming HNO_3, (e) dissolve the precipitate in 5 mL H_2O, (f) repeat steps d and e three times, (g) add 5 mg of iron and NH_4OH to precipitate iron hydroxide [$Fe(OH)_3$] (^{90}Y is also precipitated

as $Y(OH)_3$) and record time, (h) filter the solution and discard the precipitate, and (i) add sodium carbonate (Na_2CO_3) to precipitate strontium carbonate ($SrCO_3$). The $SrCO_3$ precipitate was then gross beta counted using an end-window gas flow proportional counter that had been calibrated using traceable standards of the National Bureau of Standards (NBS). The chemical yield of the separation procedure was determined by weighing the $SrCO_3$ precipitate.

Iodine-129 by Neutron Activation Analysis

The Neutron Activation Analysis (NAA) technique used to measure ^{129}I began with an oxidation-reduction-oxidation treatment to separate the ^{129}I from the sample. The separated ^{129}I solution was passed through an anion exchange column to collect the iodine, and the resin from this column was then activated. The determination of ^{129}I by NAA is based on the neutron-capture reaction $^{129}I\ (n,\gamma)\ ^{130}I$, with measurement of the induced ^{130}I activity using gamma spectroscopy.

Nonradioactive iodide carrier and ^{125}I were both added to each 110 mL sample before starting the iodine separation procedure. The former was added to ensure that the ^{129}I behaved well chemically, and the latter was added to determine the chemical yield of the sample preparation and ion exchange. Iodine was then chemically separated from each sample solution by oxidizing the iodide to iodate (IO_3), reducing IO_3 to I^- with sulfite (SO_3), oxidizing the I^- to I^0 with nitrite (NO_2), and extracting the I^0 in carbon tetrachloride (CCL_4). The I^0 was next converted to I^-, the proper form for ion exchange, by adding one drop of NH_4OH and two drops of sodium sulfate (Na_2SO_3). The CCL_4 was then discarded, and the solution was passed through a small volume of Dowex-1 (NO_3 form), an anion exchange resin. The resin was then dried and transferred to an activation capsule for irradiation.

Prior to activation, each sample capsule was analyzed for ^{125}I using a high-resolution Ge(Li) spectrometer system to determine the chemical recovery of the sample preparation procedure. The capsule was then irradiated in the Advanced Test Reactor (ATR) for 60 minutes. The ATR provides

a flux of about 7 x 10^{12} n/s/cm^2. During each irradiation an ^{129}I standard was concurrently irradiated to measure the neutron flux exactly. The sample and standard were allowed to decay six to eight hours before they were analyzed for ^{130}I using a Ge(Li) spectrometer system that had been calibrated using NBS traceable standards.

Uranium-235 by the Neutron Activation Analysis/ Delayed Fission Neutron Technique

The principle of the NAA/Delayed Fission Neutron (DFN) technique is that a fissile nuclide, upon neutron capture, can produce fission products that decay by emitting a neutron. These fission products decay with half-lives ranging from about 0.2 to 55 seconds. These decay times are long enough to count neutrons after prompt-fission neutrons and interfering delayed neutrons from nuclides such as ^{17}N have decayed away.

Sample irradiations for this work were performed using the rabbit pneumatic transfer system installed at the Coupled Fast Reactivity Measurement Facility (CFRMF) located at the Test Reactor Area (TRA). The thermal flux at the irradiation location in the CFRMF core is about 5.8 x 10^{11} n/cm^2/sec and is held constant and reproducible to within ± 0.5% by a power level servomechanism. Samples were irradiated for 60 seconds and then automatically transferred to a neutron detector. In each case the samples were allowed to decay for 40 seconds before delayed neutron counting was initiated. The neutron detector is a circular array of six Harshaw neutron proportional counter tubes embedded in a cast beeswax moderator. Samples were counted for 60 seconds and then automatically transferred to a drop-out terminus.

This system was calibrated by irradiating and then counting standards containing measured quantities of ^{235}U in water. The volume of the standards was 3 mL, which is the same as the volume of sample that was irradiated in each case. Volumetric samples for fissile material assay were collected from the 110 mL surface sample solutions immediately after they

had been shaken vigorously enough to thoroughly fractionate the filter paper. Surface concentrations of fissile material are reported in this work as ^{235}U concentrations in ng/cm^2.