COPY

FINAL STATUS SURVEY REPORT FOR DECOMMISSIONING

PRATT & WHITNEY
Pine Street Facility
15 Hall Court
Manchester, Connecticut

Performed by
Radiation Safety Associates, Inc.
19 Pendleton Drive
Hebron, Connecticut 06248

E-86

EXECUTIVE SUMMARY (Non-Technical)

Pratt & Whitney leased the building at 15 Hall Court in Manchester, Connecticut, from April 1, 1956 to August 31, 1988, during which time it was listed on its radioactive materials license No. SMB151. This license is specifically for the possession of sheets of a nickel-thorium alloy, the radioactive thorium (Th-232) comprising no more than 4% by weight. Nothing available in the written record suggests that this licensed material was ever used or stored at this facility.

It is known, however, that casting of metal parts (metals other than nickel-thorium) was accomplished at this facility, and that certain materials used in the investment casting process do contain naturally occurring radioactive materials such as uranium-238, uranium-235 and thorium-232 along with all the decay daughter products from these three. Purchase, possession and use of these materials requires no permit or license, and the containers are not required to be labeled or otherwise identified as containing radioactive material. No precautionary measures need to be taken during the use of these materials, and no special precautions need to be taken regarding its disposal.

During the license termination survey at this former Pratt & Whitney facility, certain small quantities of slightly radioactive material were found at several locations in the basement, on the first floor, and under one loading dock.

First, the yellowish ceramic-faced brick which was used to construct the interior walls on the north and west sides of the basement are slightly radioactive. It is common to find these small quantities of radioactive material in many types of ceramic materials such as floor and wall tile, colored bathroom fixtures, pottery and the like. A series of wipe tests confirmed that the material was firmly fixed in the structure of the bricks and was not removable. A complete gamma spectrum analysis of a sample of this material verified that this material contains a mix of uranium and thorium daughter products typical of this type of material. The presence of this material is certainly not the result of any use of licensed radioactive material by Pratt & Whitney.

Second, approximately 15 square meters (m^2) of the floor on the main level, and approximately 2 m^2 of floor in the basement were located on which there were low but detectable levels of radioactive material. This material appeared to have once been a thick liquid which had been spilled onto the floor and had hardened. This material could have been paint or a thin clay-like material, but a more precise identification based on visible physical characteristics could not be made. The material is firmly fixed to the concrete floor and wipe surveys confirmed that it is not removable. A complete gamma spectrum analysis showed the presence of only two decay daughter products of uranium-238. This material, therefore, could not have come from the thorium-232 which Pratt & Whitney was licensed to possess. The volume of material present is estimated to be between one and two cubic feet.

Finally, material was found under the south loading dock which had a chalky/powdery appearance with larger pieces of material mixed in. These larger pieces appeared to have come from a sheet of brittle material which had been broken up into small pieces. This larger material has the same appearance as the paint-like or clay-like material found inside the building on the floor. It is likely that this material had dried on flat surfaces, been scaled up, then put under the loading dock as fill. A complete gamma spectrum analysis showed the presence of decay daughter products from all three

major natural decay series—uranium-238, uranium-235 and thorium-232. A mix of isotopes such as this is clearly indicative of naturally occurring radioactivity, and does not suggest the presence of nickel-thorium which Pratt & Whitney was licensed to possess. It is estimated that there are 40-50 ft^3 of this material under the loading dock.

Based on a thorough examination of all the evidence, and on a knowledge of the nickel-thorium manufacturing process which Pratt & Whitney uses, we conclude that the slightly radioactive material found in and around this building did not originate in licensed material. We further conclude that the small quantity of residual radioactive material at this facility originated in material that is generally available on the open market. The fact that possession and use of this material does not require a license from any government agency indicates that such possession and use poses no significant health risk to future occupants of this building or to the general public.

1.0 BACKGROUND INFORMATION

Pratt & Whitney leased the factory building at 15 Hall Court, Manchester, Connecticut (generally referred to as "the Pine Street facility") from April 1, 1956 to August 31, 1988, during which time it was listed on their radioactive materials license No. SMB151 as a location where licensed radioactive material could be used or stored. This license is specifically for the possession of sheets of a nickel-thorium alloy, the radioactive thorium (Th-232) comprising no more than 4% by weight. Nothing available in the written record suggests that this licensed material was ever used or stored at this facility.

It is known, however, that casting of metal parts (metals other than nickel-thorium) was accomplished at the Pine Street facility, and that certain materials (e.g., sand and clay) used in this casting process do contain naturally occurring radioactive materials such as uranium-238, uranium-235 and thorium-232, along with all the decay daughter products from these three. Appendix A provides information on these three natural decay series. Purchase, possession and use of these materials requires no permit or license and the containers are not required to be labeled or otherwise identified as containing radioactive material. No precautionary measures need to be taken during the use of these materials, and no special precautions need to be taken regarding their disposal.

However, since the record of the use or non-use of radioactive material at this facility (whether or not such possession or use required a license) is unclear, the prudent and responsible course of action was to have a full license-termination survey performed at this facility.

2.0 SITE INFORMATION

2.1 Site Description

This property consists of approximately 2.44 acres of flat land in the south end of Manchester, Connecticut, and is bounded by Pine Street on the west, Hall Court on the south and Elm Street on the east. The property is one block north of Hartford Road. The building occupying the site is a single-story factory of brick construction and covers approximately 56,000 ft^2 (180 ft x 312 ft) with windows along virtually all of the approximately 30-foot-high walls. Roughly 20% of the main floor of the building's interior has been partitioned into office areas, lavatories, and special-purpose rooms. The flat space above many of these rooms contains auxiliary equipment. Ventilation ducts run throughout the interior of the structure and six main vent stacks penetrate the sheet metal roof. There are several other ventilation-related roof penetrations. There is a basement under approximately 25% (the northwest quarter) of the structure's main floor. Relatively few floor drains are present in the manufacturing areas of the building. The bulk of the remainder of the land area is covered by an asphalt-paved parking lot. There is a strip of grass on the Elm Street side and in the rear of the building. The building was probably constructed in the 1940s. Floor plans of the facility are attached as Appendix B.

2.2 Site Conditions at Time of Final Survey

The Pine Street facility has not been occupied since Pratt & Whitney vacated the premises in

August of 1988. Time, weather, and vandalism have taken their toll. The facility is in an advanced state of disrepair.

2.3 Identity of Potential Contaminants and Release Guidelines

Although the Pine Street facility was listed on Pratt & Whitney's radioactive materials license, which is for the possession and use of relatively thin (approximately ⅛ in) sheets of thorium-232 (4% maximum) in nickel, no record exists as to whether or not licensed radioactive materials were ever present or used there. In Pratt & Whitney's application, parts are stamped out of these metal sheets, edges are de-burred, and holes are drilled in the parts. If radioactive material remained at this site which resulted from the use of licensed material, it would have been in the form of slivers, granules or pieces of the sheet stock.

Since it was known that the facility was used for the casting of metal components, it was also understood that the possibility existed of finding residual clay-like material which contained natural radioactivity, but which was not required to be licensed or controlled in any way. The fact that possession and use of this material does not require a license from any government agency indicates that such possession and use poses no significant health risk to future occupants of this building or to the general public.

The applicable release criteria are stated in Regulatory Guide 1.86 "Guidelines for Decontamination of Facilities and Equipment Prior To Release For Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material" published by the U.S. Nuclear Regulatory Commission, Division of Fuel Cycle, Medical, Academic, and Commercial Use Safety, and dated May 1987. These criteria are presented in table 1 below.

3.0 FINAL STATUS SURVEY OVERVIEW

3.1 Survey Objectives

The purpose of the final status survey was to determine whether or not the radiological conditions at the Pine Street facility satisfy the NRC guidelines for unrestricted release.

3.2 Organization and Responsibilities

The survey was performed by a team composed of qualified health physicists from Radiation Safety Associates, Inc. and senior health physics technicians from Applied Radiological Control, Inc. Résumés of these individuals are included as Appendix C to this report.

Samples of soil, and other special samples, requiring gamma spectrometry or wet chemistry analysis, were conducted by RSA Laboratories, Inc. (NRC License No. 06-30007-01; Connecticut Public Health Lab No. PH-0111).

Table 1. Acceptable surface contamination guidelines from Regulatory Guide 1.86.

ACCEPTABLE SURFACE CONTAMINATION LEVELS

NUCLIDES[a]	AVERAGE[b,c,f] (dpm/100 cm²)	MAXIMUM[b,d,f] (dpm/100 cm²)	REMOVABLE[b,e,f] (dpm/100 cm²)
U-nat, U-235, U-238, and associated decay products	5,000 α	15,000 α	1,000 α
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	100	300	20
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	1,000	3,000	200
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above.	5,000 $\beta\gamma$	15,000 $\beta\gamma$	1,000 $\beta\gamma$

[a] Where surface contamination by both alpha- and beta-gamma-emitting nuclides exists, the limits established for alpha- and beta-gamma-emitting nuclides should apply independently.

[b] As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation.

[c] Measurements of average contaminant should not be averaged over more than 1 square meter. For objects of less surface area, the average should be derived for each object.

[d] The maximum contamination level applies to an area of not more than 100 cm².

[e] The amount of removable radioactive material per 100 cm² of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. When removable contamination on objects of less surface area is determined, the pertinent levels should be reduced proportionally and the entire surface should be wiped.

[f] The average and maximum radiation levels associated with surface contamination resulting from beta-gamma emitters should not exceed 0.2 mrad/hr at 1 cm and 1.0 mrad/hr at 1 cm, respectively, measured through not more than 7 milligrams per square centimeter of total absorber.

3.3 Instrumentation

Table 2 lists the instrumentation used in performing the surveys, along with other parameters and detection sensitivities for the instrumentation and survey techniques. All instruments used are calibrated every six months at a minimum, using NIST-traceable standards. The calibration isotope used for this survey was Th-230. Operational and background checks were performed at least once each four hours of instrument use.

Table 2. Instrumentation For Radiological Surveys

Type of Measurement	Instrumentation		Bkgd.[1]	2π[1] Eff (%)	Detection Sensitivity
	Detector	Meter			
Surface scans - alpha	scintillation, Ludlum, Model 43-1	Count-rate meter[2] Ludlum, Model 18	1 cpm	28	14 dpm/100 cm^2
Surface scans - beta	large area (425 cm^2) gas proportional, Ludlum, Model 43-37	Count-rate meter[2] Ludlum, Model 12	1200 cpm	9 †	9412 dpm/100 cm^2
Surface activity - alpha	scintillation, Ludlum, Model 43-1	Count-rate Meter[3] Ludlum, Model 18	1 cpm	28	45 dpm/100 cm^2
Surface activity - beta-gamma	pancake GM, Ludlum, Model 44-9	Count-rate meter[3] Ludlum, Model 3	40 cpm	9	2302 dpm/100 cm^2
Exposure rates	scintillation, Ludlum, Model 19	(same as detector)	12 μR/h	NA	1 μR/h
Gross α/β on smears	pancake GM, Ludlum, Model 44-9	Digital scaler[3] Bicron, frisk-tech	40 cpm	9	276 dpm/100 cm^2

[1]Nominal Values
[2]Monitoring audible signal
[3]1 minute integrated count
† Efficiency for ^{137}Cs is ~25%

3.4 Survey Procedures

Survey planning and procedures were in accordance with *Manual for Conducting Radiological Surveys in Support of License Termination, NUREG/CR-5849.* Procedures are described below.

3.4.1 Area Classification

Due to the difficulty in proving that licensed material was not used at this facility by Pratt & Whitney, the entire factory area was considered to be an affected area, and the office areas were considered to comprise the unaffected area. The loading docks and environs were included in the affected area. The building exterior and grounds were assumed to be part of the unaffected area.

3.4.2 Reference Grids

A one-meter-square grid system was established in the affected area. Each office and special-purpose room was assigned the name of a color (main floor) or a state (basement) to avoid confusion and redundancy. These rooms were also divided into one-meter-square grids. No

attempt was made to correlate the alpha-numeric designation of the grids on the large factory floor areas with the alpha-numeric designators used in the much smaller rooms. On the survey forms, the alpha-numeric system in each room is independent of the system used on the main factory floors.

3.4.3 Surface Scans

Scanning is an evaluation technique performed by moving the detection device over a surface at a constant speed and a fixed distance above the surface to identify areas having elevated radiation levels. Areas thus identified are followed up on with quantitative assessments.

Scanning of surfaces to identify locations of residual surface and near-surface activity was performed according to the following schedule:

Affected Area Surfaces—100% of lower surfaces (all floors, and walls up to 2 meters above the floor);

Non-contaminated upper surfaces (>2 meters above the floor) in affected areas—only in the immediate vicinity of any elevated measurement found on the lower surfaces;

Unaffected Area Surfaces—10% of lower surfaces (floors, and walls up to 2 meters above the floor).

Building interior surface scans were conducted for alpha, beta, and gamma radiations. Scans of exterior building and paved surfaces were for beta and gamma only. Soil surfaces were scanned for gamma radiation only.

Instrumentation for scanning is listed in table 2. The instruments having the lowest (best) detection sensitivity were used for the scans, wherever physical surface conditions and survey locations permitted.

Scanning speeds did not exceed 1 detector-width per second for alpha and beta detection instruments, and 0.5 m per second for gamma instruments. Audible indicators were used to help identify locations having elevated (> 1.5 times ambient) levels of direct radiation.

Locations with radiation levels in excess of background levels were marked for further investigation as described in the Surface Activity Measurement section below.

3.4.4 Surface Activity Measurements

Direct Measurements

Direct measurements of alpha, beta, and/or beta-gamma surface activity were performed at selected locations using instrumentation described in table 2. Unless precluded by physical surface conditions, the most sensitive of the instruments listed for surface measurements were used. Measurements were conducted by integrating counts over a one minute period.

Data were recorded at the spacings/frequencies as follows:

Floors and lower walls
  Affected areas - 2 m intervals
  Unaffected areas - 1 per 50 m^2 of surface

Other surfaces
  Affected areas - 2 m intervals
  Unaffected areas - 1 per 50 m^2 of surface

Removable Contamination Measurements

A 100 cm^2 smear for removable contamination was performed at each direct measurement recording location.

3.4.5 Exposure Rate Measurements

Gamma exposure rates were measured at 1 m above ground or floor surfaces using a gamma scintillation instrument. Recorded measurements were uniformly spaced according to the following pattern:

Building Interior

  Affected Areas: 1 measurement per 4 m^2
  Unaffected Areas: 1 measurement per 200 m^2

Grounds

  Affected Areas: 5 measurements per 100 m^2 grid block
  Unaffected areas: 25 measurements at randomly selected locations

3.4.6 Special Measurements and Samples

Samples from areas of elevated direct readings were obtained and analyzed. There were three such areas.

a. On 13 areas of the interior floor a material was found which appeared to have once been

a thick liquid which had been spilled onto the floor and had hardened. This material could have been paint or a thin clay-like material, but a more precise identification based on visible physical characteristics could not be made. Samples were obtained for analysis. This appeared to be the same material in all 13 locations identified.

b. Ceramic-faced brick had been used in the construction of the interior basement walls, and radiation levels were uniformly higher than background over the entire surface. A sample of this material was obtained for gamma spectrum analysis.

c. Material was found under the south loading dock which had a chalky/powdery appearance with larger pieces of material mixed in. These larger pieces appeared to have come from a sheet of brittle material which had been broken up into small pieces. This larger material has the same appearance as the paint or clay-like material found inside the building on the floor. It is likely that this material had dried on flat surfaces, been scaled up, then put under the loading dock. It is estimated that there are 40-50 ft^3 of this material under the loading dock.

The insides of ventilation ducts, drains and piping in affected areas were assessed by performing direct alpha and beta-gamma scans at all access points. Remaining ducts, electrical boxes, conduit, or other interior surfaces in affected areas were accessed at random and measurements of direct and removable activity performed. Wipes were also obtained from inside wall and floor penetrations, and from floor cracks or expansion joints.

3.5 Background Level Determinations

Background exposure rates were determined for the building interior by taking 5 measurements at locations of similar construction, but where it was unlikely that licensed radioactive material had ever been used. Several of the old factory buildings in this area have been converted to condominiums and shops, so background readings were taken at several locations in three of these buildings, and in their parking lots. Exposure rate measurements were performed using a micro-R meter. Two background soil samples were also obtained from the grassy areas along the rear and Elm Street side of the building.

3.6 Sample Analysis

Smears for removable contamination were analyzed for gross alpha, and beta/gamma activity. Soil, and materials found to have elevated readings were analyzed by gamma spectrometry to determine the isotopes and activity present.

3.7 Data Interpretation

Data conversions and evaluations were performed, following guidance in NUREG/CR-5849. Measurement data were converted to units of dpm/100 cm^2 (surface activity), μR/h (exposure rates) and pCi/g (soil concentrations) for comparison with guidelines. Values were adjusted for contributions from natural background. Individual measurements and soil radionuclide concentration levels were compared to "hot-spot" criteria. Average values for survey levels were

determined and compared with guideline levels. Data for each survey unit were tested against the confidence level objective.

3.8 Records

All samples and original survey data have been archived in the Radiation Safety Associates, Inc. main offices and will be held until such time as authorized by the NRC for disposal.

4.0 SURVEY FINDINGS AND RESULTS

4.1 Background Levels

Background exposure rates for interior areas ranged from 8.5 to 18 μR/h and averaged 13.6 μR/h. Background exposure rates for exterior areas ranged from 8 to 9 μR/h and averaged 8.6 μR/h. Concentrations of radioactivity in the soil averaged 14.82 pCi/gm. Table 3 provides information about these background soil samples. The complete gamma spectrum analysis is included as Appendix D. The small quantity of cesium-137 in sample #1 is attributable to residual fallout from past atmospheric weapons testing. The remaining mix of naturally occurring radioisotopes is within the range of what would normally be expected in soil in New England.

Table 3. Gamma spectrum analysis results of background soil samples.

Isotope	Sample #1 (pCi/g)	Sample #2 (pCi/g)	Source
Cs-137	0.47	<0.09	fallout
Pb-212	1.09	0.67	Th-232
Pb-214	0.69	0.72	U-238
Bi-214	0.66	0.77	U-238
Ac-228	0.92	1.08	Th-232
K-40	9.36	11.3	--
U-234	0.92	0.75	U-238
Total	14.12	15.52	

4.2 Building Interior Surveys

Scans

Scans of surfaces identified 12 small isolated areas of residual fixed radioactivity on both the first

floor and in the basement. One larger area was also located on the first floor, in the approximate location where dipping/casting operations had been performed by Pratt & Whitney. An old floor plan showed that a "dip tank" was located in this area. "Dipping" implies a liquid, and the contaminants on the floor look very much like the residue from spillage of a thick liquid. The locations of these elevated areas are shown in Appendix E. All other areas identified by scans were determined to be within the specified guideline values.

Surface Activity Measurements

Table E-1 of Appendix E presents the results of surface activity measurements taken at the 13 areas noted to exceed guideline values for unrestricted release. All other individual measurements that were taken were within the release guidelines.

Sampling

The radioanalysis of the ceramic-faced brick sample confirmed the presence of naturally occurring radioactive material which is commonly found in this type of material. A summary of the results are given in table 4 below. There was no detectable removable radioactive material on these bricks. The radioactivity in this material is not the result of any Pratt & Whitney operations.

Swipe surveys showed no detectable removable contamination on the dried clay-like material found on areas of both the first floor and basement of the building. A radioanalysis of this material shows that it contains a mix of radioisotopes, half of which are daughter products of uranium-235 or uranium-238. A sample of this material was also pulverized with mortar and pestle and observed under a magnifying glass. Close visual inspection of this material shows no evidence of metallic slivers or granules which would be the expected forms of residue from the Pratt & Whitney nickel-thorium activities. This material is naturally occurring and is not residual licensed material.

Exposure Rates

The exposure rates inside the building ranged from 8-15 μR/h. A few isolated areas (near the interior basement wall which was constructed of the ceramic-faced brick described earlier) had readings as high as 28 μR/h. This was determined to be due to the natural radioactivity in the building's structural material and is not related to the use of licensed radioactive material.

Exposure rate readings 1 cm above the 13 areas on the floor identified during the surface scan ranged from 8 to 9 μR/h. This shows no measurable increase over normal gamma background levels.

Table 4 contains a summary of the radioanalysis results for the ceramic brick and the clay-like material on the floors. Complete analytical results are contained in Appendix F.

Table 4. Gamma spectrum analysis of various bulk samples.

Isotope	Loading Dock (pCi/g)	Material on Floor (pCi/g)	Ceramic Brick (pCi/g)	Nickel-Thorium (pCi/g)	Source
Th-234	15.4	--	--	--	U-238
Ra-226	24.0	--	--	--	U-238
Pb-214	20.8	72.80	3.03	--	U-238
Bi-214	20.6	70.27	--	--	U-238
U-235	1.01	--	--	--	U-235
Ac-228	5.25	--	--	890.7	Th-232
Ra-224	19.3	--	--	980.6	Th-232
Pb-212	4.6	--	3.05	930.5	Th-232
Bi-212	3.33	--	--	670.6	Th-232
Tl-208	1.52	--	3.17	269.2	Th-232
K-40	--	--	45.52	--	*
Total	115.8	143.06	54.77	4,670.1	--
Gross Alpha	161.12	426.72	27.49	49.24	--
Gross Beta	140.37	440.29	60.07	212.74	--

* Potassium-40 (K-40) is a naturally occurring radionuclide with a 1.3 billion year half life. It decays directly in one step to calcium-40 which is stable.

4.3 Grounds Surveys

Scans

Scans identified one location of elevated radiation levels. This area is located under the south loading dock and is illustrated in Appendix G. The source of the radiation is material similar to that which was found on the 13 floor areas inside the building.

Sampling

Table 4 contains a summary of the radioanalytical results of the material found under the south loading dock. For comparison purposes, the radioanalytical results of the material found on the floor inside the building, the sample of ceramic brick from the basement, and of a piece of Pratt & Whitney nickel-thorium stock are included in table 4. Because of the *presence* of uranium daughter products in the loading dock, floor, and ceramic brick samples; the *absence* of metallic slivers or granules in any samples from the building; and the *total absence* of uranium daughter products in the nickel-thorium sample, it is obvious that the radioactive components of the licensed material is markedly different from those of the material found in and around this building. Complete analytical results are contained in Appendix F.

Exposure Rates

A maximum reading of 40 μR/h was obtained from the area under the south loading dock. All other outside exposure rate measurements ranged from 10-13 μR/h. These readings are all within the specified guideline values for unconditional release.

4.4 Residual Activity

Thirteen floor areas inside the building and one area outside the building (under the south loading dock) were found to be in excess of the alpha activity per 100 cm^2 release guidelines. This residual radioactivity, however, is without doubt attributable not to licensed material, but to the naturally occurring radioactivity present in the clay casting materials described above.

5.0 SUMMARY AND CONCLUSIONS

Between July 26, 1993 and August 3, 1993, radiological surveys of the Pratt & Whitney Manchester Facility were conducted. Results of the survey demonstrate that radioactive material is present at this facility, the quantities present exceed the free-release limits specified in Regulatory Guide 1.86, and that the presence of this material is likely the result of Pratt & Whitney operations. The material is not, however, licensed material. Rather, it is naturally occurring radioactive material which was probably a component part of clays and other minerals used in investment casting operations such as Pratt & Whitney was engaged in at this facility. No license is required for the possession and/or use of these materials. A close examination of this radioactive residue showed no sign of metal chips, turnings or fines such as might have resulted from licensed activities involving thorium-nickel.

K. Paul Steinmeyer
Health Physicist, RPT

David J. Durkee
Health Physicist

APPENDIX A

NATURAL DECAY SERIES

Thorium Series (4n)[a]

(Personal communication L. Slaback after Kocher 1981 and ICRP Report No. 38, 1983. In case of discrepancy, ICRP value given)

Nuclide	Historical Name	Half-life	Major Radiation Energies (MeV) and Intensities[b]					
			α		β		γ	
			MeV	%	MeV	%	MeV	%
$^{232}_{90}Th$	Thorium	1.405×10^{10} y	3.83	0.2			.059	.19
↓			3.95	23			.126	.04
			4.01	76.8				
$^{228}_{88}Ra$	Mesothorium I	5.75 y			.0389	100	.0067	6×10^{-5}
↓								
$^{228}_{89}Ac$	Mesothorium II	6.13 h			.983	7	.338	11.4
↓					1.014	6.6	.911	27.7
					1.115	3.4	.969	16.6
					1.17	32	1.588	3.5
					1.74	12		
					2.08	8		
					(+33 more βs)			
$^{228}_{90}Th$	Radiothorium	1.913 y	5.34	26.7			0.84	1.19
↓			5.42	72.4			.132	.11
							.166	.08
							.216	.27
$^{224}_{88}Ra$	Thorium X	3.66 d	5.45	4.9			.241	3.9
↓			5.686	95.1				
$^{220}_{86}Rn$	Emanation Thoron (Tn)	55.6 s	6.288	99.9			.55	.07
↓								
$^{216}_{84}Po$	Thorium A	.15 s	6.78	100			.128	.002
↓								
$^{212}_{82}Pb$	Thorium B	10.64 h			.158	5.2	.239	44.6
↓					.334	85.1	.300	3.4
					.573	9.9		
$^{212}_{83}Bi$	Thorium C	60.55 m	6.05	25	1.59	8	.040	1.0
↓			6.09	9.6	2.246	48.4	.727	11.8
							1.620	2.75
64.07% ↓ $^{212}_{84}Po$	Thorium C	305 ns	8.785	100				
35.93% ↓ $^{208}_{81}Tl$	Thorium C"	3.07 m			1.28	25	.277	6.8
					1.52	21	.5108	21.6
					1.80	50	.583	85.8
							.860	12
↓ $^{208}_{82}Pb$	Thorium D	Stable					2.614	100

a This expression describes the mass number of any member in this series, where n is an integer. For example: $^{232}_{90}Th$ (4n).....4(58) = 232

b Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series. Gamma % in terms of observable emissions, not transitions.

Uranium Series (4n + 2)[a]

(Personal communication L. Slaback after Kocher 1981 and ICRP Report No. 38, 1983. In case of discrepancy, ICRP value given)

Nuclide	Historical Name	Half-life	Major Radiation Energies (MeV) and Intensities[b]					
			α		β		γ	
			MeV	%	MeV	%	MeV	%
$^{238}_{92}U$	Uranium I	4.468×10^9 y	4.15 4.20	22.9 76.8			.0496	.07
↓								
$^{234}_{90}Th$	Uranium X_1	24.1 d			.076 .095 .096 .1886	2.7 6.2 18.6 72.5	.0633 .0924 .0928 .1128	3.8 2.7 2.7 .24
↓								
$^{234m}_{91}Pa$	Uranium X_2	1.17 m			2.28	98.6	.766 1.001	.207 .59
99.87% | 0.13%								
$^{234}_{91}Pa$	Uranium Z	6.7 h			22 βs E Avg = 0.224 Emax = 1.26		.132 .570 .883 .926 .946	19.7 10.7 11.8 10.9 12
$^{234}_{92}U$	Uranium II	244,500 y	4.72 4.77	27.4 72.3			.053 .121	.12 .04
↓								
$^{230}_{90}Th$	Ionium	7.7×10^4 y	4.621 4.688	23.4 76.2			.0677 .142 .144	.37 .07 .045
↓								
$^{226}_{88}Ra$	Radium	1600 ± 7 y	4.60 4.78	5.55 94.4			.186	3.28
↓								
$^{222}_{86}Ra$	Emanation Radon (Rn)	3.823 d	5.49	99.9			.510	.078
↓								
$^{218}_{84}Po$	Radium A	3.05 m	6.00	~100	.33	.02	.837	.0011
99.98% | 0.02%								
$^{214}_{82}Pb$	Radium B	26.8 m			.67 .73 1.03	48 42.5 6.3	.2419 .295 .352 .786	7.5 19.2 37.1 1.1
$^{218}_{85}At$	Astatine	2 s	6.66 6.7 6.757	6.4 89.9 3.6			.053	6.6
$^{214}_{83}Bi$	Radium C	19.9 m	5.45 5.51	.012 .008	1.42 1.505 1.54 3.27	8.3 17.6 17.9 17.7	.609 1.12 1.765 2.204	46.1 15.0 15.9 5.0
99.979% | 0.021%								
$^{214}_{84}Po$	Radium C'	164 μs	7.687	100			.7997	.010
$^{210}_{81}Tl$	Radium C"	1.3 m			1.32 1.87 2.34	25 56 19	.2918 .7997 .860 1.110 1.21 1.310 1.410 2.010 2.090	79.1 99 6.9 6.9 17 21 4.9 6.9 4.9
$^{210}_{82}Pb$	Radium D	22.3 y	3.72	.000002	.016 .063	80 20	.0465	4
↓								

Actinium Series (4n + 3)[a]

(Personal communication L. Slaback after Kocher 1981 and ICRP Report No. 38, 1983. In case of discrepancy, ICRP value given)

Nuclide	Historical Name	Half-life	Major Radiation Energies (MeV) and Intensities[b]					
			α		β		γ	
			MeV	%	MeV	%	MeV	%
$^{235}_{92}U$	Actinouranium	7.038×10^8 y	4.2–4.32	10.3			.1438	10.5
↓			4.366	17.6			.163	4.7
			4.398	56			.1857	54
			4.5–4.6	11.3			.205	4.7
$^{231}_{90}Th$	Uranium Y	25.5 h			.205	15	.0256	14.8
↓					.287	49	.0842	6.5
					.304	35		
$^{231}_{91}Pa$	Protoactinium	3.276×10^4 y	4.95	23			.0274	9.3
↓			5.01	25.6			.2837	1.6
			5.029	20.2			.300	2.3
			5.058	11.1			.3027	4.6
							.330	1.3
$^{227}_{89}Ac$	Actinium	21.77 y	4.94	.53	.019	10	.070	.017
			4.95	.66	.034	35	.100	.032
98.62% | 1.38%					.044	54	.160	.019
$^{227}_{90}Th$	Radioactinium	18.718 d	5.757	20.2			.050	8.5
↓			5.978	23.3			.236	11.2
			6.038	24.4			.300	2.0
							.304	1.1
							.330	2.7
$^{223}_{87}Fr$	Actinium K	21.8 m	5.44	~.006	1.15	~100	.050	34
							.0798	9.2
					25 betas		.2349	3.4
					Eavg. = 0.343			
					E_{max} = 1.097			
$^{223}_{88}Ra$	Actinium X	11.43 d	5.607	24.1			.144	3.3
↓			5.716	52.2			.154	5.6
			5.747	9.45			.269	13.6
							.324	3.9
							.338	2.8
$^{219}_{86}Rn$	Emanation Actinon (An)	3.96 s	6.425	7.4			.271	9.9
↓			6.55	12.1			.4018	6.6
			6.819	80.3				
$^{215}_{84}Po$	Actinium A	1.78 ms	7.386	~100	.74	~.00023	.4388	.04
~100% | .00023%								
$^{211}_{82}Pb$	Actinium B	36.1 m			.26	4.8	.405	3.0
					.97	1.4	.427	1.38
					1.37	92.9	.832	2.8
$^{215}_{85}At$	Astatine	~0.1 ms	8.026	~100			.404	.047
$^{211}_{83}Bi$	Actinium C	2.14 m	6.28	16	.579	.27	.351	12.7
			6.62	84				
0.273% | 99.73%								
$^{211}_{84}Po$	Actinium C'	.516 s	7.42	98.9			.570	.54
							.898	.52
$^{207}_{81}Tl$	Actinium C"	4.77 m			1.42	99.8	.897	0.24
$^{207}_{82}Pb$	Actinium D	stable						

a This expression describes the mass number of any member in this series, where n is an integer.
For example: $^{207}_{82}Pb$ (4n+3)...4(51) + 3= 207

b Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series. Gamma %s in terms of observable emissions, not transitions.

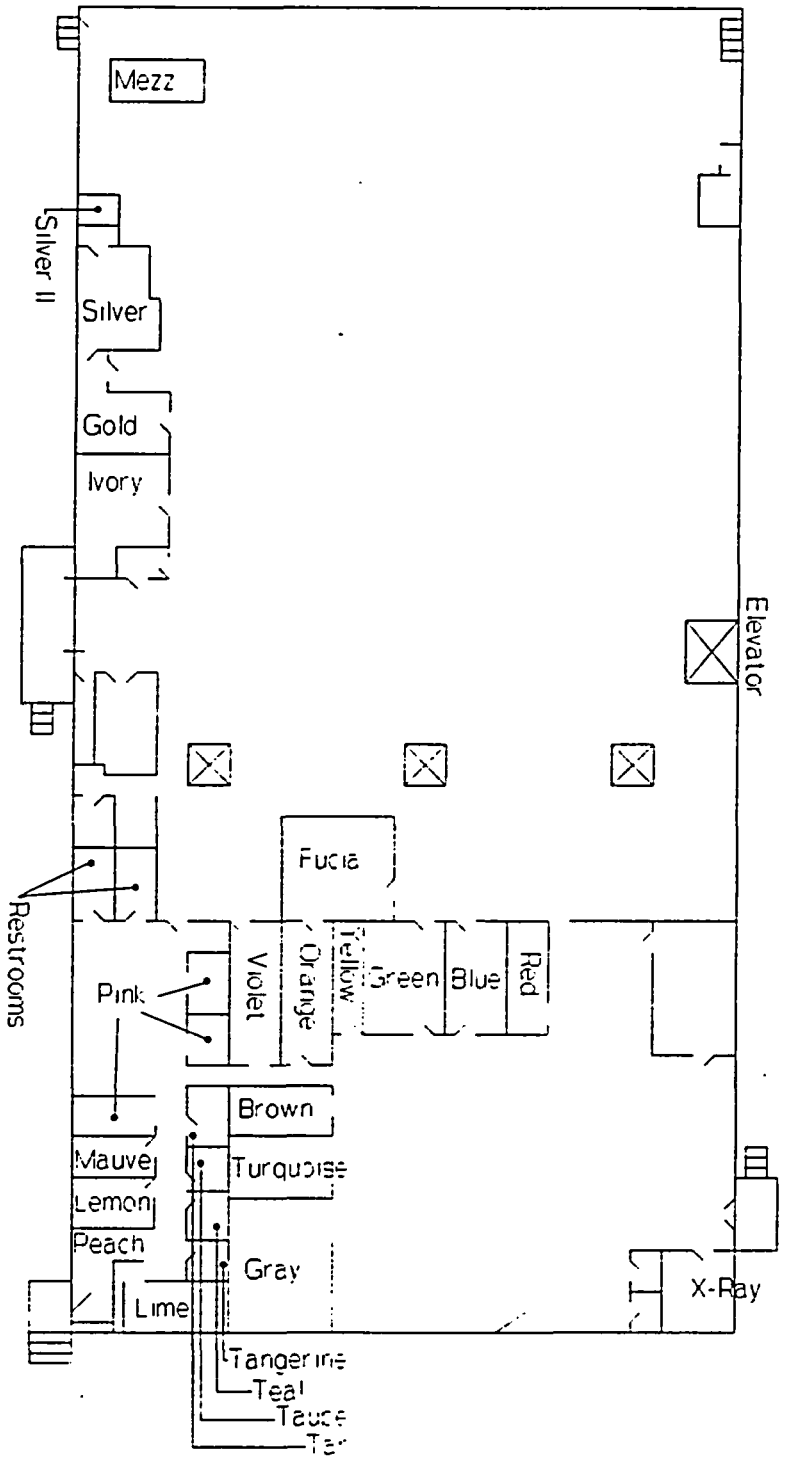
$^{210}_{83}Bi$	Radium E	5.01 d	4.65 4.69	.00007 .00005	1.161	−100		
−100% .00013%								
$^{210}_{84}Po$	Radium F	138.378 d	5.305	100			.802	.0011
$^{206}_{81}Tl$	Radium E*	4.20 m			1.571	100	.803	.0055
$^{206}_{82}Pb$	Radium G	stable						

a This expression describes the mass number of any member in this series, where n is an integer.
For example: $^{206}_{82}Pb$ (4n+2)...4(51) + 2 = 206

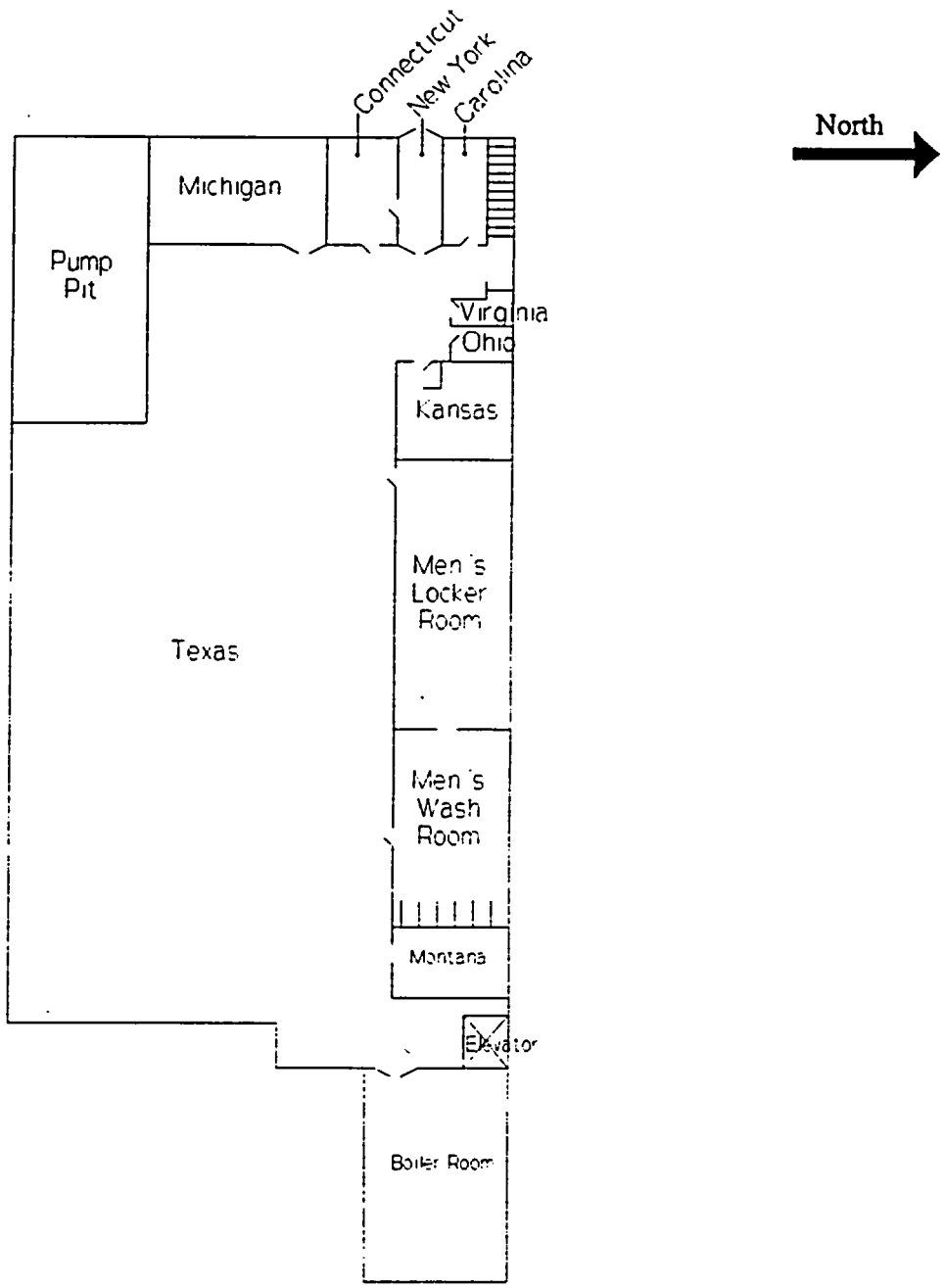
b Intensities refer to percentage of disintegrations of the nuclide itself, not to original parent of series. Gamma %s: in terms of observable emissions, not transitions.

APPENDIX B

FLOOR PLANS



Pratt & Whitney
Pine Street Facility
First Floor



Pratt & Whitney
Pine Street Facility
Basement

APPENDIX C

RÉSUMÉS

Résumé

K. PAUL STEINMEYER

EDUCATION AND TRAINING

U.S. Naval Nuclear Power School and Prototype Training

Submarine School

Various Navy Courses in Electronics and Instrumentation

Bachelor of Arts (Honors), University of Connecticut

"Radiological Controls," Naval Reactor Prototype, Windsor, Connecticut

"Radiation Protection Surveys," University of Michigan

"Radiation Protection Technology--Phase I," Northeast Utilities, Berlin, Connecticut

"Radiation Protection Technology--Phase II," Northeast Utilities, Berlin, Connecticut

Various University Courses in Mathematics, Statistics, Metallurgy, and Radiochemistry

Factory-Authorized Service Training on SCBA Regulators, Mine Safety Appliances Company, Pittsburgh, Pennsylvania

Factory-Authorized Service Training on SCBA Regulators, Scott Aviation, Lancaster, New York

"Environmental Monitoring for Radioactivity" - Oak Ridge Associated Universities

EXPERIENCE

1981 to Present

President, Radiation Safety Associates, Inc. Provide consulting, training and technical services in health and safety matters on a nationwide basis to the nuclear industry, general industry, local, state and the federal government, and academic institutions. Special emphasis is given to the areas of respiratory protection, radiation safety, decontamination and health physics. Editor of *Radiation Protection Management*, the

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	7.50E-02		
MN-54	<	7.05E-02		
CO-57	<	2.23E-02		
CO-60	<	2.45E-02		
ZN-65	<	2.65E-01		
RU/RH106	<	1.74E-01		
AG-108M	<	9.98E-02		
AG-110M	<	1.29E-01		
SB-125	<	2.24E-01		
CS-134	<	1.79E-01		
CS-137	<	9.40E-02		
CE-144	<	5.11E-01		
PB-212		8.7164E-01	.17	.17
Pu	<	2.34E-01		
TH-234	<	1.50E+00		
PA-234	<	3.43E-01		
TH-230	<	1.13E+01		
RA-226	<	1.84E+00		
PB-214		7.1809E-01	.17	.17
BI-214		7.6643E-01	.17	.17
PB-210	<	7.91E-01		
U-235	<	1.05E-01		
TH-231	<	2.32E-01		
PA-231	<	3.58E-01		
TH-227	<	1.34E+00		
RA-223	<	7.86E-01		
RN-219	<	8.89E-01		
AC-228		1.0789E+00	.30	.31
TH-228	<	3.48E+00		
RA-224	<	1.79E+00		
BI-212	<	4.31E-01		
TL-208	<	3.76E-02		
K-40		1.1335E+01	1.54	1.58
PB-211	<	1.63E+00		
BI-211	<	1.00E+00		
FR-223	<	1.40E-01		
U-234	#	7.4781E-01	.10	.10
Ac-227	<	2.72E+00		
J-131	<	2.10E-02		

All peaks for activity calculation had bad shape.

S U M M A R Y

TOTAL ACTIVITY(2.4 to 3193.6 keV) 1.5517690E+01 pCi/gm

Spectrum name: 02381.SPC

Sample description
PWA MANCHESTER, SOIL BACKGROUND, SAMP #1, 507.1 gm, pbm

Spectrum Filename: 02381.SPC

Acquisition information

Start time	21-SEP-93 12:49:09
Live time	1200
Real time	1200
Dead time	.04%
Detector/Geometry IDs	1 & 1

Detector system
No detector description was entered

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 & 11-AUG-93 15:17:06
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

Analysis parameters

Start channel	10 for an energy of 2.42keV
Stop channel	16000 for an energy of 3193.63keV
Peak rejection level	15.000%
Activity scaling factor	2.7000E+01/ 5.0710E+02 = 5.3244E-02
Detection limit method:	
RISÚ method	
Additional random error:	0.0000000E+00
Additional systematic error:	0.0000000E+00

Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	NO	
Peaked background correction	YES	SBLANK.PBC 21-SEP-93 05:16:16
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

Energy calibration normalized difference: .0943

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	9.92E-02		
MN-54	<	8.59E-02		
CO-57	<	3.58E-02		
CO-60	<	2.71E-02		
ZN-65	<	2.49E-01		
RU/RH106	<	1.75E-01		
AG-108M	<	9.86E-02		
AG-110M	<	2.15E-01		
SB-125	<	1.31E-01		
CS-134	<	1.75E-01		
CS-137		4.7000E-01	.11	.11
CE-144	<	7.46E-01		
PB-212		1.0896E+00	.20	.21
Pu	<	2.47E-01		
TH-234	<	1.56E+00		
PA-234	<	4.54E-01		
TH-230	<	1.78E+01		
RA-226	<	1.77E+00		
PB-214		6.9092E-01	.16	.17
BI-214		6.6440E-01	.16	.16
PB-210	<	9.81E-01		
U-235	<	1.33E-01		
TH-231	<	1.43E-01		
PA-231	<	3.18E-01		
TH-227	<	1.60E+00		
RA-223	<	8.01E-01		
RN-219	<	9.43E-01		
AC-228	#	9.1831E-01	.25	.25
TH-228	<	4.08E+00		
RA-224	<	2.20E+00		
BI-212	<	2.69E-01		
TL-208	<	7.68E-02		
K-40		9.3630E+00	1.47	1.50
PB-211	<	1.86E+00		
BI-211	<	1.04E+00		
FR-223	<	7.75E-02		
U-234		9.2289E-01	.11	.12
Ac-227	<	3.02E+00		
J-131	<	4.29E-02		

All peaks for activity calculation had bad shape.

---------- S U M M A R Y ----------

TOTAL ACTIVITY(2.4 to 3193.6 keV) 1.4119110E+01 pCi/gm

APPENDIX E

CONTAMINATED AREAS INSIDE

Journal of Applied Health Physics. Founder and Associate Editor of *Respiratory Protection Newsletter.*

1981 to 1986

Radiation Protection Specialist (Health Physics), Northeast Utilities, Berlin, Connecticut. Responsible for standardizing health physics equipment and procedures among three operating nuclear power units and one under construction. Coordinated medical emergency planning among the reactor plants, three hospitals, and several ambulance companies and fire departments. Oversaw the respiratory protection programs at the operating nuclear units. Performed health physics supervisor and technician training as required. Radiation Safety Officer.

1979 to 1981

Radiation Protection Specialist (Field Services), Northeast Utilities, Berlin, Connecticut. Supervised work activities of health physics technicians at three commercial nuclear power reactors during major refueling shutdowns. Researched, developed and wrote a compliance respiratory protection program for these reactor sites and assisted with the implementation of this program. Conducted training as required.

1976 to 1979

Health Physics Foreman, Connecticut Yankee Atomic Power Company, Haddam Neck, Connecticut. Responsible for supervising all aspects of the radiation protection program at this commercial nuclear power reactor, both during normal operations and when shut down for refueling and overhaul.

1975 to 1976

Health Physics Technician, Connecticut Yankee Atomic Power Company, Haddam Neck, Connecticut. Performed and evaluated all radiological surveys required. Collected samples and performed chemical analyses on reactor coolant and liquid waste.

PROFESSIONAL ACTIVITIES

President, Radiation Safety Associates, Inc.

Editor, *Radiation Protection Management*, the Journal of Applied Health Physics

Founder and Editor, *Respiratory Protection Newsletter*

Registered Radiation Protection Technologist (NRRPT)

Faculty Member (Part Time), Industrial Technology Department, Central Connecticut State University

Member, Health Physics Society (National)

Member, Connecticut Chapter, Health Physics Society

Member, American Nuclear Society

PUBLISHED ARTICLES

"Radioactive Decay by Beta Particle Emission." *Radiation Protection Management*, 6 (January/February 1989): 60-63

"Calculating Exposure Rates from Known Quantities of Gamma-Emitting Radioisotopes." *Radiation Protection Management*, 6 (May/June 1989): 62-76.

"Beta Particle Shielding." *Radiation Protection Management*, 6 (July/August 1989): 71-76.

"Respiratory Protection Practices in the Nuclear Industry." *ECON; Environmental Contractor*, September 1989.

"Respirator Fit Testing and the Exercise Protocol." *Radiation Protection Management*, 6 (September/October 1989): 72-77.

"NIOSH Approval--What It Means To You." *Respiratory Protection Newsletter*, 5 (September/October 1989).

"Converting Activity Concentration in $\mu Ci/cm^3$ to Units of Parts Per Million." *Radiation Protection Management*, 7 (September/October 1989): 34-37.

"Training and Fit Testing: Where Do You Draw the Line?" *Respiratory Protection Newsletter*, 7 (January/February 1991).

"Estimating *Bremsstrahlung* Yield." *Radiation Protection Management*, 7 (November/December 1990): 57-62.

Résumé

DAVID J. DURKEE

EDUCATION AND TRAINING

U.S. Naval Nuclear Power School and Prototype Training

Engineering Laboratory Technician School

Machinist's Mate "A" School

Quality Assurance Inspector School

Associate Degree in Nuclear Technology from University of Phoenix

Health Physics Technician Level I Basic - Radiation Safety Associates, Inc.

Respiratory Protection at Nuclear Facilities - Radiation Safety Associates, Inc.

"Environmental Monitoring for Radioactivity" - Oak Ridge Associated Universities

EXPERIENCE

October 1991 to Present

Radiation Safety Associates, Inc., Hebron, Connecticut
Health Physicist. Responsible for service to clients as required by individual contracts. This includes performance of audits, radiological surveys, writing license applications and amendments, maintaining radiological safety programs, providing technical advice, and performing training.

Conduct formal training courses including "Health Physics Technician Level I," "Radiation Worker Training," "Fundamentals of Radiation Protection," "Radiation Safety Officer," and "Radiation Safety Officer Refresher."

Write, edit, and develop course materials and technical articles. Research state and federal regulations having to do with radiation protection; packaging, surveying, labeling and shipping radioactive materials; and radioactive materials licensing. Assistant Editor of *Radiation Protection Management*, the Journal of Applied Health Physics.

1983 to October 1991

United States Navy, Submarine Qualified. Served on board two nuclear-powered submarines. Qualified: Leading Engineering Laboratory Technician, Engineering Watch Supervisor, Engineering Duty Petty Officer, Reactor Laboratory Division Petty Officer, Quality Assurance Inspector, Duty Section Leading Mechanic.

Supervised and performed chemistry and radiological controls on reactor plant primary and secondary systems. Sampled primary coolant and secondary water chemistry and analyzed results to detect abnormal trends and out of specification conditions. Established and certified radiologically controlled areas, conducted radiation contamination surveys, evaluated man-rem exposure and processed radioactive waste. Calibrated and operated radiation detectors and chemistry analytical equipment. Directed the day-to-day efforts of five junior Laboratory Technicians.

Drafted detailed work procedures and quality assurance work packages for nuclear and non-nuclear maintenance efforts. Performed in-process inspections to verify that materials and procedures met required specifications. Also drafted numerous instructions and policies delineating divisional administrative practices.

APPENDIX D

BACKGROUND SOIL SAMPLE ANALYSIS

Spectrum name: 02380.SPC

Sample description
PWA MANCHESTER, SOIL BACKGROUND, SAMP #2, 561.1 gm, pbm

Spectrum Filename: 02380.SPC

Acquisition information

Start time	21-SEP-93 13:18:05
Live time	1200
Real time	1200
Dead time	.04%
Detector/Geometry IDs	1 & 1

Detector system
No detector description was entered

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 & 11-AUG-93 15:17:06
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

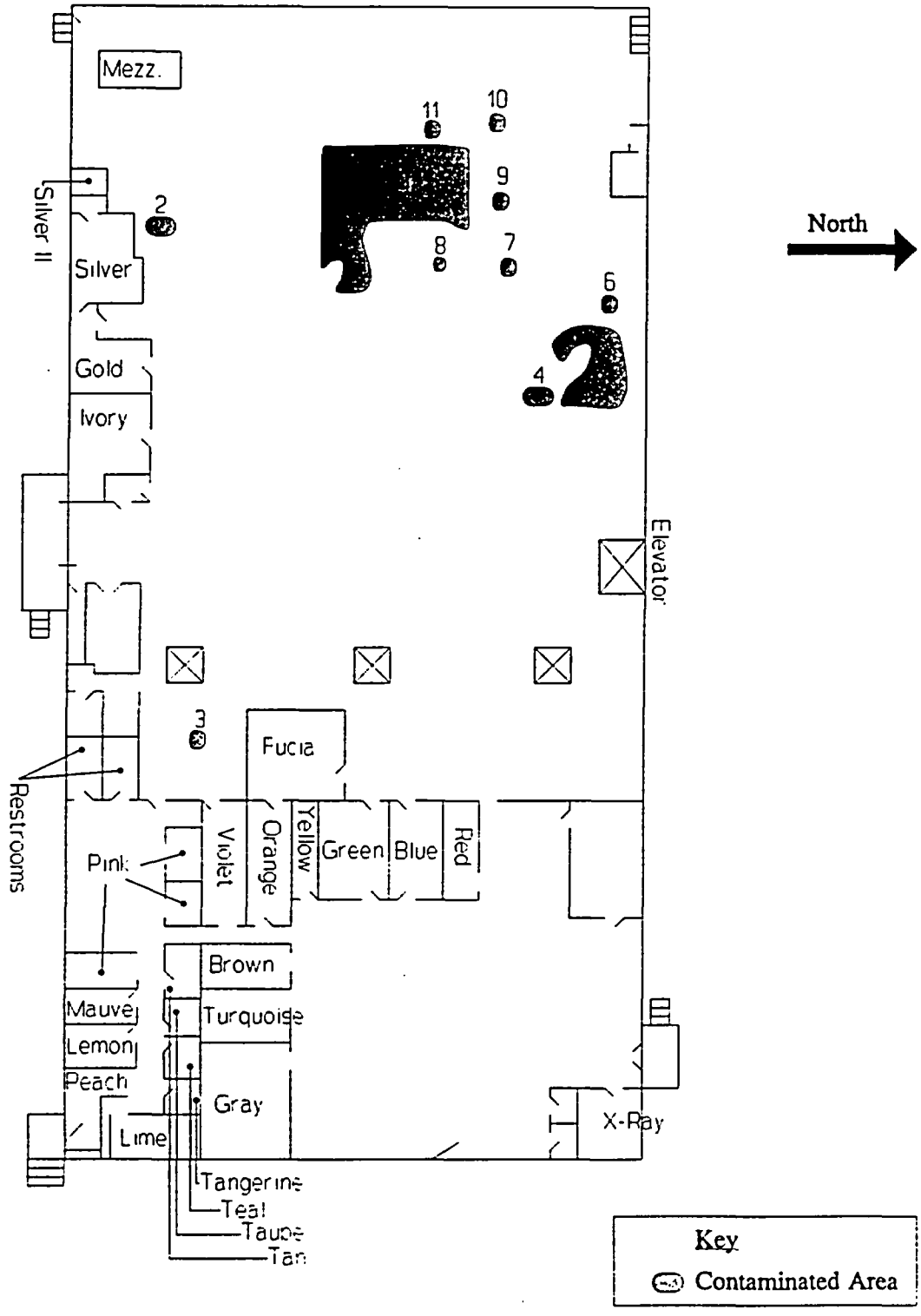
Analysis parameters

Start channel	10 for an energy of 2.42keV
Stop channel	16000 for an energy of 3193.63keV
Peak rejection level	15.000%
Activity scaling factor	2.7000E+01/ 5.6110E+02 = 4.8120E-02

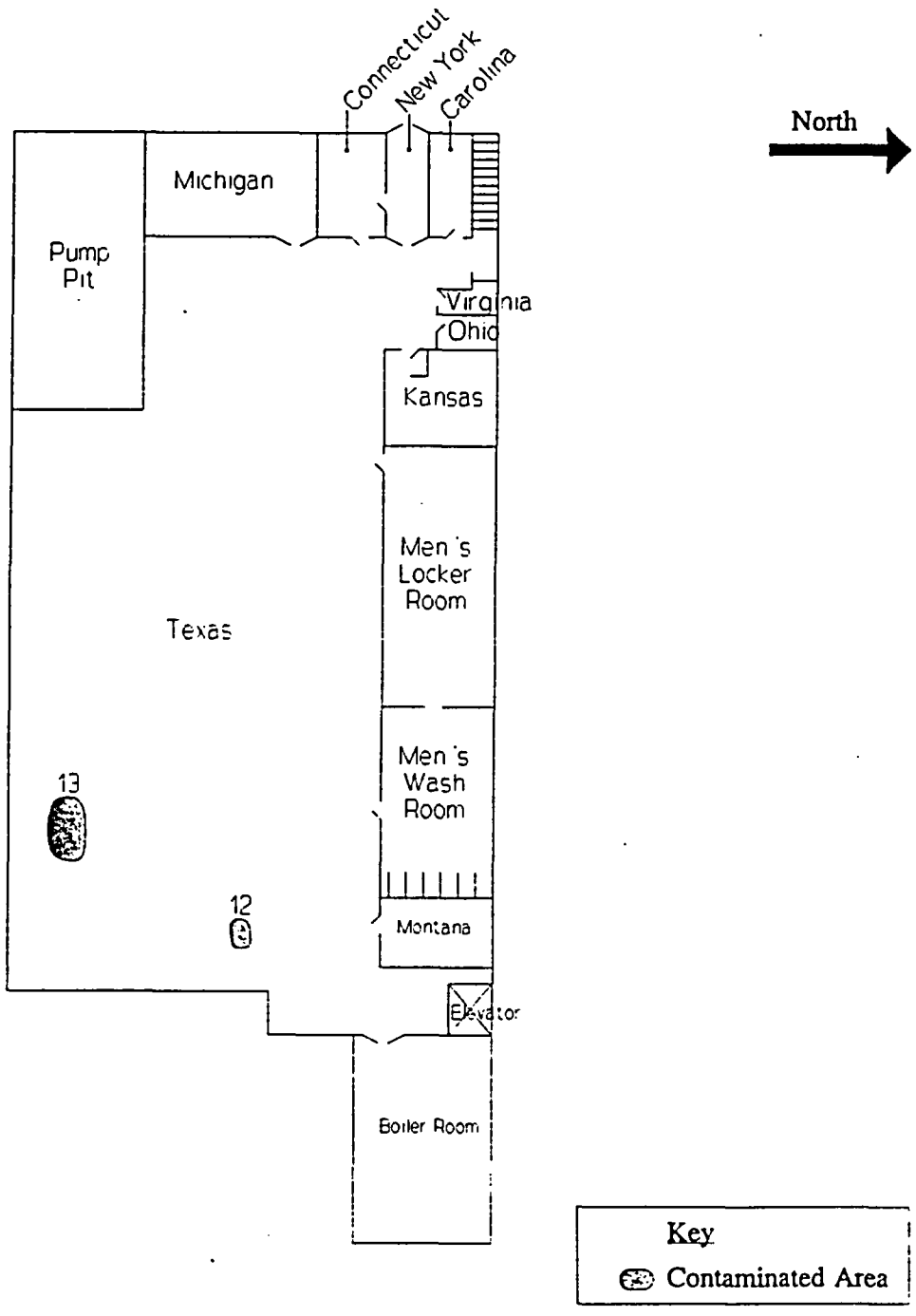
Detection limit method:
RISÚ method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	NO	
Peaked background correction	YES	SBLANK.PBC 21-SEP-93 05:16:16
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

Energy calibration normalized difference: .0664



Pratt & Whitney
Pine Street Facility
First Floor
Contaminated Areas



Pratt & Whitney
Pine Street Facility
Basement
Contaminated Areas

TABLE E-1

Elevated Surface Activity Measurements

NUMBER	LOCATION	ACTIVITY (dpm/100 cm^2)
1	First Floor	19,350
2	First Floor	12,900
3	First Floor	19,350
4	First Floor	5,160
5	First Floor	12,900
6	First Floor	5,160
7	First Floor	5,160
8	First Floor	5,160
9	First Floor	5,160
10	First Floor	12,900
11	First Floor	21,930
12	Basement	5,160
13	Basement	8,385

APPENDIX F

SPECIAL SAMPLE ANALYSIS RESULTS

GROSS ALPHA/BETA RSA J ROTCHFORD
ID: TDNICKEL SN: 001 Repeat: 00 10-01-93 11:49:09
Net Wt mg: 0.00 sd: 0.00
BG TIME (min): 30.00 SAMPLE TIME (min): 18.00
Alpha to Beta cpm: 103.29 sd: 5.65

---	- COUNTS -	--- CPM ---	-BG CPM-	- NET CPM -	- %EFF-	--- DPM ---	- LLD dpm-
A	7837	435.39	0.10	435.29	20.75	2097.78	1.63
sd	88.53	4.92	0.08	4.92	0.16	28.70	
B	58445	3246.94	1.53	3142.12	34.67	9062.93	2.66
sd	241.75	13.43	0.26	14.57	0.22	71.23	

GROSS ALPHA/BETA RSA J ROTCHFORD
ID: 002379 SN: 002 Repeat: 00 10-01-93 12:07:46
Net Wt mg: 400.54 sd: 0.00
BG TIME (min): 30.00 SAMPLE TIME (min): 18.00
Alpha to Beta cpm: 2.61 sd: 0.24

---	- COUNTS -	--- CPM ---	-BG CPM-	- NET CPM -	- %EFF-	--- DPM ---	- LLD dpm-
A	167	9.28	0.10	9.18	6.41	143.27	5.30
sd	12.92	0.72	0.08	0.72	0.16	11.83	
B	639	35.50	1.53	31.36	25.12	124.82	3.67
sd	25.28	1.40	0.26	1.45	0.22	5.87	

GROSS ALPHA/BETA RSA J ROTCHFORD
ID: 00050 SN: 001 Repeat: 00 09-29-93 13:13:21
Net Wt mg: 401.82 sd: 0.00
BG TIME (min): 30.00 SAMPLE TIME (min): 18.00
Alpha to Beta cpm: 6.94 sd: 0.45

---	- COUNTS -	--- CPM ---	-BG CPM-	- NET CPM -	- %EFF-	--- DPM ---	- LLD dpm-
A	441	24.50	0.10	24.40	6.41	380.65	5.29
sd	21.00	1.17	0.08	1.17	0.16	20.57	
B	1928	107.11	1.53	98.64	25.11	392.76	3.67
sd	43.91	2.44	0.26	2.50	0.22	10.51	

GROSS ALPHA/BETA RSA J ROTCHFORD
ID: 00130 SN: 002 Repeat: 00 09-29-93 13:31:51
Net Wt mg: 400.19 sd: 0.00
BG TIME (min): 30.00 SAMPLE TIME (min): 18.00
Alpha to Beta cpm: 0.45 sd: 0.09

---	- COUNTS -	--- CPM ---	-BG CPM-	- NET CPM -	- %EFF-	--- DPM ---	- LLD dpm-
A	30	1.67	0.10	1.57	6.41	24.42	5.29
sd	5.48	0.30	0.08	0.31	0.16	4.94	
B	277	15.39	1.53	13.41	25.13	53.37	3.67
sd	16.64	0.92	0.26	0.97	0.22	3.87	

Spectrum name: 02379.SPC

Sample description
PW MANCHESTER LOADING DOCK NET WT 814.6 JER

Spectrum Filename: 02379.SPC

Acquisition information

Start time	21-SEP-93 11:36:25
Live time	1200
Real time	1205
Dead time	.49%
Detector/Geometry IDs	1 & 1

Detector system
No detector description was entered

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 & 11-AUG-93 15:17:06
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

Analysis parameters

Start channel	10 for an energy of 2.42keV
Stop channel	16000 for an energy of 3193.63keV
Peak rejection level	15.000%
Activity scaling factor	2.7000E+01/ 8.1460E+02 = 3.3145E-02

Detection limit method:
RISÚ method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	NO	
Peaked background correction	YES	SBLANK.PBC 21-SEP-93 05:16:16
Absorption (Internal)	NO	
Geometry correction	NO	
Random summing	NO	

Energy calibration normalized difference: .1144

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	2.04E-01		
MN-54	<	1.32E-01		
CO-57	<	1.09E-01		
CO-60	<	2.75E-02		
ZN-65	<	9.52E-01		
RU/RH106	<	8.90E-01		
AG-108M	<	2.24E-01		
AG-110M	<	2.49E-01		
SB-125	<	4.36E-01		
CS-134	<	7.18E-01		
CS-137	<	2.25E-01		
CE-144	<	1.65E+00		
PB-212		4.6048E+00	.50	.53
Pu	<	4.22E-01		
TH-234		1.5449E+01	2.77	4.49
PA-234	<	1.02E+00		
TH-230	<	3.35E+01		
RA-226		2.3982E+01	4.30	4.37
PB-214		2.0752E+01	.67	1.25
BI-214		2.0628E+01	.69	1.05
PB-210	<	2.28E+00		
U-235		1.0108E+00	.27	.27
TH-231	<	4.59E-01		
PA-231	<	6.87E-01		
TH-227	<	3.57E+00		
RA-223	<	2.23E+00		
RN-219	<	2.70E+00		
AC-228		5.2458E+00	.80	.83
TH-228	<	1.17E+01		
RA-224		1.9292E+01	4.31	4.36
BI-212		3.3320E+00	.83	.84
TL-208		1.5190E+00	.12	.13
K-40	<	8.85E-01		
PB-211	<	5.64E+00		
BI-211	<	4.13E+00		
FR-223	<	1.80E-01		
U-234	<	1.03E-02		
Ac-227	<	4.73E+00		
J-131	<	1.03E-01		

S U M M A R Y

TOTAL ACTIVITY(2.4 to 3193.6 keV) 1.1581480E+02 pCi/gm

Spectrum name: 00050.SPC

Sample description
Scrapings from floor P+W Manchester 3.10 gms JER

Spectrum Filename: 00050.SPC

Acquisition information

Start time	30-SEP-93 06:05:18
Live time	3600
Real time	3601
Dead time	.04%
Detector/Geometry IDs	1 & 1

Detector system
No detector description was entered

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 & Two point calibr
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

Analysis parameters

Start channel	10 for an energy of 2.42keV
Stop channel	16000 for an energy of 3193.63keV
Peak rejection level	10.000%
Activity scaling factor	2.7000E+01/ 3.1000E+00 = 8.7097E+00

Detection limit method:
RISÚ method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	NO	
Peaked background correction	YES	PETBLANK.PBC 29-SEP-93 06:21:03
Absorption (Internal)	NO	
Geometry correction	YES	GMX-70 30-SEP-93 05:29:44 GMX-70230-S
Random summing	NO	

Energy calibration normalized difference: .0343

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	1.79E+00		
MN-54	<	2.41E+00		
CO-57	<	7.12E-01		
CO-60	<	3.86E-01		
ZN-65	<	8.45E+00		
RU/RH106	<	4.11E+00		
AG-108M	<	2.48E+00		
AG-110M	<	2.08E+00		
SB-125	<	1.39E+00		
CS-134	<	6.34E+00		
CS-137	<	2.00E+00		
CE-144	<	8.47E+00		
PB-212	<	4.53E+00		
Pu	<	2.65E+00		
TH-234	<	1.31E+01		
PA-234	<	5.05E+00		
TH-230	<	1.57E+02		
RA-226	<	3.60E+01		
PB-214		7.2797E+01	4.49	6.19
BI-214		7.0266E+01	6.05	6.94
PB-210	<	8.21E+00		
U-235	<	2.26E+00		
TH-231	<	2.05E+00		
PA-231	<	2.73E+00		
TH-227	<	2.29E+01		
RA-223	<	1.27E+01		
RN-219	<	1.53E+01		
AC-228	<	1.13E+00		
TH-228	<	8.56E+01		
RA-224	<	4.17E+01		
BI-212	<	1.09E+01		
TL-208	<	3.19E+00		
K-40	<	3.85E+00		
PB-211	<	3.36E+01		
BI-211	<	3.31E+01		
FR-223	<	9.55E-01		
U-234	<	6.72E-02		
Ac-227	<	3.71E+01		
J-131	<	5.77E-01		

S U M M A R Y

TOTAL ACTIVITY(2.4 to 3193.6 keV) 1.4306290E+02 pCi/gm

TOTAL P.05

Sample description
Manchester white ceramic chips 3.06 gms petri JER

Spectrum Filename: 00130.SPC

Acquisition information

Start time	29-SEP-93	19:52:12
Live time	28800	
Real time	28804	
Dead time	02%	
Detector/Geometry IDs	1 &	1

Detector system
No detector description was entered

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 & Two point calibr
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

Analysis parameters

Start channel	10 for an energy of	2.42keV
Stop channel	16000 for an energy of	3193.63keV
Peak rejection level	10.000%	
Activity scaling factor	2.7000E+01/ 3.0600E+00 =	8.8235E+00

Detection limit method:
RISÚ method
Additional random error: 0.0000000E+00
Additional systematic error: 0.0000000E+00
Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	NO	
Peaked background correction	YES	PETBLANK.PBC 29-SEP-93 06:21:03
Absorption (Internal)	NO	
Geometry correction	YES	GMX-70 30-SEP-93 05:29:44 GMX-70230-S
Random summing	NO	

Energy calibration normalized difference: .0290

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	5.17E-01		
MN-54	<	4.42E-01		
CO-57	<	1.14E-01		
CO-60	<	1.98E-01		
ZN-65	<	1.21E+00		
RU/RH106	<	2.44E+00		
AG-108M	<	3.10E-01		
AG-110M	<	5.80E-01		
SB-125	<	8.95E-01		
CS-134	<	7.68E-01		
CS-137	<	5.50E-01		
CE-144	<	1.54E+00		
PB-212		3.0470E+00	.53	.55
Pu	<	6.00E-01		
TH-234	<	2.97E+00		
PA-234	<	5.73E-01		
TH-230	<	1.93E+01		
RA-226	<	5.64E+00		
PB-214		3.0281E+00	.51	.54
BI-214	<	1.03E+00		
PB-210	<	2.03E+00		
U-235	<	3.21E-01		
TH-231	<	5.15E-01		
PA-231	<	7.95E-01		
TH-227	<	3.99E+00		
RA-223	<	2.90E+00		
RN-219	<	3.55E+00		
AC-228	<	1.32E+00		
TH-228	<	1.03E+01		
RA-224	<	7.12E+00		
BI-212	<	4.99E+00		
TL-208		3.1657E+00	.46	.48
K-40		4.5515E+01	6.97	7.24
PB-211	<	9.63E+00		
BI-211	<	3.05E+00		
FR-223	<	2.36E-01		
U-234	<	8.51E-03		
Ac-227	<	7.50E+00		
J-131	<	2.40E-01		

S U M M A R Y

TOTAL ACTIVITY(2.4 to 3193.6 keV) 5.4755520E+01 pCi/gm

Sample description
TD nickle sheet metal disk, 19 191 gm net, 9/30/93, pbm

Spectrum Filename: TDNIDISK.SPC

Acquisition information

Start time	30-SEP-93 19:13:25
Live time	1200
Real time	1219
Dead time	1.63%
Detector/Geometry IDs	0 & 1

Detector system
GMX-70320-S, 76% eficiency, n-type

Calibration
Filename: SOILCAL.SPC
Created: 11-AUG-93 15:05:21 &
Energy calibration from 0 to 3000 keV
500ml plastic wide mouth jar

Zero offset .423 keV; Gain .200 keV/channel

Library Files
Main analysis library: PRATT.LIB

Analysis parameters

Start channel	10 for an energy of 2.42keV
Stop channel	16000 for an energy of 3193.63keV
Peak rejection level	10.000%
Activity scaling factor	2.7000E+01/ 1.9191E+01 = 1.4069E+00
Detection limit method:	
RISÚ method	
Additional random error:	0.0000000E+00
Additional systematic error:	0.0000000E+00

Background width: best method (based on spectrum).

Corrections	Status	Comments
Decay correct to date	NO	
Decay during acquisition	YES	
Peaked background correction	NO	
Absorption (Internal)	NO	
Geometry correction	YES	GMX-70 30-SEP-93 05:29:44 GMX-70230-S
Random summing	NO	

Energy calibration normalized difference: .0705

********** U N I D E N T I F I E D P E A K S U M M A R Y **********

PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 2 SIGMA %	FWHM keV	SUSPECTED NUCLIDE	
372.93	74.84	4690.	7989.	6.657	3.91	.811	-	M
384.58	77.17	3694.	14612.	12.177	2.58	.864	-	M
435.02	87.23	2682.	5650.	4.708	4.89	1.062	Tb-160	sM
448.85	89.99	2725.	4180.	3.484	6.01	.955	Nd-147	M
465.88	93.39	2516.	4393.	3.661	6.62	.843	Th-234	M
525.61	105.31	2590.	1626.	1.355	15.50	1.464	Eu-155	s

s Peak fails shape tests.
M Peak is close to a library peak.

********** I D E N T I F I E D P E A K S U M M A R Y **********

NUCLIDE	PEAK CENTROID CHANNEL	ENERGY	BACKGROUND COUNTS	NET AREA COUNTS	INTENSITY CTS/SEC	UNCERT 2 SIGMA %	FWHM keV
U-234	63.06	13.01	10.	4735.	3.946	2.92	.231s
Ac-227	63.02	13.00	14913.	0.	.000	52852.12	.000D
Pu	66.03	13.60	6210.	0.	.000	.00	.700D
CO-57	71.00	14.59	12.	0.	.000	692.82	.000s
TH-231	125.52	25.47	716.	29.	.024	370.94	.303s
PA-231	134.99	27.36	2147.	0.	.000	.00	.723D
J-131	144.80	29.32	1058.	0.	.000	67.83	.388s
J-131	145.90	29.54	701.	0.	.000	185.48	.271s
SB-125	175.01	35.35	976.	67.	.055	164.37	.278s
PB-210	226.43	45.61	943.	41.	.034	236.95	.255s
TH-227	248.94	50.10	1200.	66.	.055	170.78	.201D
FR-223	248.94	50.10	1248.	0.	.000	14215.48	.000D
U-234	264.38	53.18	537.	23.	.019	252.50	.348s
PB-214	262.00	52.71	291.	0.	.000	3437.44	.000s
TH-234	319.58	64.20	2959.	736.	.613	40.70	.656s
TH-230	335.09	67.29	2297.	233.	.194	93.11	.332s
BI-211	363.43	72.95	3191.	93.	.078	203.45	.491s
TH-227	397.77	79.80	566.	0.	.000	203.55	.138D
FR-223	397.77	79.80	566.	0.	.000	203.55	.138D
CE-144	.00	80.11	433.	0.	.000	3712.55	-.021s
J-131	404.32	81.11	1584.	89.	.074	149.20	.478s
TH-231	420.75	84.38	3117.	1410.	1.175	18.07	.772
TH-228	420.68	84.37	2378.	1805.	1.504	8.97	.817D
FR-223	426.05	85.44	550.	0.	.000	209.98	.205s
FR-223	.00	88.47	647.	0.	.000	.00	.000s
TH-234	463.00	92.82	1581.	0.	.000	12433.29	.000s
TH-234	463.97	93.01	2370.	0.	.000	.00	.103s
AC-228	496.86	99.57	2207.	954.	.795	26.23	.850s
U-235	542.46	108.67	2080.	790.	.658	30.65	1.451s
TH-234	563.49	112.87	1462.	0.	.000	148.16	.223s
PB-212	575.10	115.19	1640.	564.	.470	34.22	.961s
CO-57	613.00	122.75	864.	50.	.042	160.26	.000s
RA-223	613.00	122.75	329.	0.	.000	3699.73	.000s
AC-228	644.73	129.08	4931.	1852.	1.543	11.69	.889D
PA-234	655.80	131.29	3625.	30.	.025	564.31	.893D

Spectrum name: TDNIDISK.SPC

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
TH-228	657.42	131.61	3469.	73.	.061	229.46	.893D
CE-144	667.10	133.54	2325.	0.	.000	.00	.896D
CO-57	676.72	135.47	1168.	0.	.000	252.70	.179s
U-235	715.32	143.17	1268.	0.	.000	137.03	.182s
RA-223	715.32	143.17	1268.	82.	.068	137.03	.182s
PA-234	758.08	151.70	1098.	62.	.052	179.56	.675s
RA-223	770.11	154.10	1723.	0.	.000	30.52	.878
U-235	820.31	164.12	1205.	71.	.059	203.95	.337s
SB-125	883.21	176.67	1493.	197.	.165	73.57	.712s
U-235	928.53	185.71	2118.	67.	.056	194.93	.979D
RA-226	931.02	186.21	1971.	7.	.006	1764.62	.980D
U-235	1008.00	201.57	619.	0.	.000	.00	.000s
FR-223	1019.67	203.90	1269.	0.	.000	78.58	.346s
U-235	1026.73	205.31	1418.	5.	.004	2146.46	1.010D
AC-228	1046.24	209.20	1907.	3018.	2.515	7.84	.961
TH-228	1079.50	215.84	1421.	415.	.346	40.81	1.214
FR-223	1175.00	234.90	1298.	0.	.000	227.23	.000s
TH-227	1180.52	236.00	44900.	234.	.195	256.21	1.058D
PB-212	1193.71	238.63	5673.	38317.	31.931	1.16	1.062D
RA-224	1205.48	240.98	4952.	3626.	3.022	6.42	1.066D
PB-214	.00	241.98	1282.	0.	.000	16625.28	.000s
TH-227	1281.33	256.12	1067.	126.	.105	172.88	.207s
PB-214	1294.31	258.71	237.	0.	.000	367.74	.240s
RA-223	1348.20	269.46	6629.	1.	.001	18905.87	1.110D
AC-228	1352.05	270.23	4415.	1980.	1.650	10.50	1.111D
RN-219	1357.08	271.23	6070.	16.	.014	1355.45	1.113D
PB-214	1370.00	273.81	441.	0.	.000	7296.57	.000s
TL-208	1387.74	277.35	1251.	1393.	1.160	8.96	1.122D
PA-231	1422.05	284.20	349.	0.	.000	330.27	.238s
J-131	1422.05	284.20	349.	19.	.016	330.27	.238s
PB-214	1472.55	294.28	814.	89.	.074	142.11	.372s
PA-231	1501.53	300.06	1052.	0.	.000	7.86	1.184
PB-212	1501.85	300.12	1184.	2135.	1.779	9.15	1.192
PA-231	1513.88	302.52	544.	0.	.000	112.43	.387s
RA-223	1621.17	323.93	170.	0.	.000	432.60	.182s
AC-228	1639.74	327.64	1272.	1438.	1.198	8.78	1.199D
TH-227	1650.06	329.70	1803.	25.	.021	475.97	1.202D
PA-231	1653.00	330.29	226.	0.	.000	3019.93	.000s
RA-223	1692.84	338.24	1099.	0.	.000	3.88	1.146
AC-228	1692.84	338.24	1099.	6622.	5.518	3.88	1.146
BI-211	1757.15	351.07	972.	29.	.024	304.83	1.234D
PB-214	1761.41	351.92	734.	70.	.058	112.19	1.235D
J-131	1823.89	364.39	931.	89.	.074	157.42	.211s
SB-125	1904.74	380.52	394.	23.	.019	257.12	.381s
RN-219	2016.35	402.80	404.	0.	.000	146.08	.497s
PB-211	2028.91	405.30	473.	81.	.067	106.93	.654s
AC-228	2049.40	409.39	941.	1034.	.861	17.66	1.064
PB-211	2138.03	427.08	817.	1.	.001	5687.82	1.347D
SB-125	2142.10	427.89	665.	14.	.011	535.74	1.348D
AG-108M	2166.92	432.84	651.	246.	.205	67.89	.463s
RA-223	2236.00	446.63	572.	0.	.000	.00	.000s
AC-228	2317.36	462.86	650.	1814.	1.512	8.68	1.308
SB-125	2318.40	463.07	3284.	0.	.000	28100.63	.202s
CS-134	2380.87	475.54	176.	6.	.005	504.23	.139s

Spectrum name: TDNIDISK.SPC

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
PB-214	2435.15	486.37	276.	23.	.019	259.12	.198s
TL-208	2556.38	510.56	876.	3163.	2.636	6.58	1.377s
CS-134	2819.10	562.99	828.	502.	.418	36.48	1.163s
CS-134	2852.33	569.62	365.	0.	.000	294.21	.339s
PA-234	2862.84	571.72	719.	165.	.137	94.90	.204s
PB-214	2905.08	580.15	12030.	172.	.143	181.54	1.565D
TL-208	2920.06	583.14	596.	11249.	9.374	1.98	1.569D
SB-125	2990.49	597.19	510.	0.	.000	142.19	.255s
CS-134	3028.10	604.70	2017.	42.	.035	303.86	1.599D
SB-125	3039.00	606.87	67.	0.	.000	1443.26	.000s
BI-214	3051.22	609.31	1479.	48.	.040	230.39	1.606D
AG-108M	3083.57	615.77	731.	0.	.000	77.42	.320s
RU/RH106	3114.00	621.84	54.	0.	.000	.00	.000s
SB-125	3181.54	635.32	263.	0.	.000	119.46	.291s
J-131	3181.87	635.38	673.	184.	.153	104.23	.336s
AG-110M	3293.93	657.75	1250.	83.	.069	123.00	1.672D
CS-137	3313.48	661.65	813.	50.	.042	164.05	1.677D
BI-214	3332.54	665.45	624.	25.	.021	289.42	1.682D
SB-125	3364.30	671.79	290.	45.	.038	139.34	.292s
CO-57	3473.12	693.51	401.	82.	.068	102.64	.224s
PA-234	3511.19	701.10	577.	172.	.143	69.02	1.460
J-131	3617.90	722.40	282.	0.	.000	117.07	.483s
AG-108M	3620.65	722.95	3778.	63.	.053	276.82	1.759D
BI-212	3641.80	727.17	672.	2751.	2.292	4.65	1.765D
PA-234	3669.11	732.62	46.	14.	.011	127.75	.243s
TL-208	3822.00	763.13	1718.	167.	.139	71.82	1.812D
AG-110M	3825.99	763.93	1748.	59.	.050	200.45	1.813D
BI-214	3848.18	768.36	1214.	4.	.004	2256.45	1.818D
AC-228	3867.29	772.17	470.	441.	.368	16.84	1.823D
BI-212	3930.14	784.71	608.	496.	.413	39.56	1.417s
PB-214	3936.14	785.91	783.	0.	.000	.00	1.841D
AC-228	3980.19	794.70	1232.	943.	.785	12.39	1.853D
CS-134	3985.93	795.84	1811.	286.	.238	43.77	1.854D
CS-134	4016.43	801.93	578.	49.	.041	141.78	1.862D
BI-214	4037.69	806.17	325.	49.	.041	108.45	1.867D
PB-211	4166.00	831.78	78.	0.	.000	.00	.018s
MN-54	4181.26	834.83	987.	0.	.000	.00	1.904D
AC-228	4184.64	835.50	459.	531.	.442	14.34	1.905D
PB-214	4202.33	839.03	717.	0.	.000	.00	1.909D
TL-208	4309.88	860.49	345.	1421.	1.184	10.74	1.704
PA-234	4423.86	883.24	211.	26.	.022	162.77	1.965D
AG-110M	4431.01	884.67	231.	21.	.018	207.13	1.966D
BI-211	4495.19	897.48	93.	42.	.035	94.95	.750s
PA-234	4502.83	899.00	177.	0.	.000	.00	1.984D
AC-228	4563.41	911.09	327.	7680.	6.400	2.97	1.809
BI-214	4678.52	934.06	156.	25.	.021	147.98	2.027D
AG-110M	4695.64	937.48	141.	45.	.037	81.04	2.031D
AC-228	4831.54	964.60	4768.	1379.	1.149	15.15	2.064D
AC-228	4854.14	969.11	246.	4540.	3.783	3.13	2.070D
CS-134	5201.68	1038.47	44.	48.	.040	66.24	.230s
RU/RH106	5253.79	1048.87	50.	11.	.009	216.41	.396s
BI-212	5401.46	1078.34	168.	159.	.132	63.03	.294s
ZN-65	5587.78	1115.52	112.	48.	.040	68.12	2.241D
BI-214	5611.67	1120.29	219.	18.	.015	243.27	2.246D

Spectrum name: TDNIDISK.SPC

Nuclide	Channel	Energy	Background	Net area	Cnts/sec	Uncert	FWHM
BI-214	5780.78	1154.04	90.	96.	.080	60.50	.938s
CS-134	5838.31	1165.52	165.	131.	.109	76.30	.195s
CO-60	.00	1173.22	9.	0.	.000	666.33	-.019s
BI-214	6194.33	1236.57	64.	108.	.090	57.42	.338s
NA-22	6384.60	1274.54	187.	31.	.026	131.49	2.415D
BI-214	6416.77	1280.96	129.	23.	.019	145.53	2.422D
CO-60	6693.63	1336.21	46.	37.	.031	88.33	.295s
CS-134	6835.48	1364.52	60.	81.	.067	69.15	.327s
BI-214	6930.25	1383.44	16.	0.	.000	.00	.000s
AG-110M	6934.58	1384.30	115.	8.	.007	373.23	2.528D
BI-214	7020.76	1401.50	128.	3.	.002	1184.70	2.545D
BI-214	7053.23	1407.98	131.	16.	.013	210.86	2.552D
K-40	7317.20	1460.66	87.	0.	.000	.00	.296s
BI-214	7562.11	1509.54	8.	2.	.002	316.23	.186s
AC-228	7960.13	1588.97	107.	992.	.826	10.40	2.537s
BI-212	8117.92	1620.46	139.	357.	.297	27.32	1.452s
BI-214	8323.14	1661.42	11.	10.	.008	115.17	.196s
BI-214	8660.98	1728.85	4.	1.	.001	353.06	.161s
BI-214	8846.00	1765.77	12.	14.	.012	112.49	.000s
BI-214	9394.64	1875.27	10.	28.	.023	66.56	.301s
BI-214	10611.81	2118.19	13.	7.	.006	146.14	.369s
BI-214	11042.12	2204.07	19.	4.	.003	301.18	.178s
BI-214	12269.50	2449.04	26.	40.	.033	81.45	.698s
TL-208	13097.65	2614.33	18.	4156.	3.463	3.30	3.256

s Peak fails shape tests.
D Peak area deconvoluted.

***** S U M M A R Y O F N U C L I D E S I N S A M P L E *****

NUCLIDE		TIME OF COUNT ACTIVITY pCi/gm	UNCERTAINTY 2 SIGMA COUNTING pCi/gm	TOTAL pCi/gm
NA-22	<	2.48E+00		
MN-54	<	4.54E+00		
CO-57	<	1.06E+00		
CO-60	<	1.27E+00		
ZN-65	<	3.49E+00		
RU/RH106	<	8.87E+00		
AG-108M	<	9.06E+00		
AG-110M	<	4.72E+00		
SB-125	<	7.18E+00		
CS-134	<	5.31E+00		
CS-137	<	4.02E+00		
CE-144	<	1.46E+01		
PB-212		9.3049E+02	10.82	47.15
Pu	<	2.66E+00		
TH-234	<	3.47E+01		
PA-234	<	9.56E+00		
TH-230	<	3.26E+02		
RA-226	<	5.53E+01		
PB-214	<	4.97E+00		
BI-214	<	9.66E+00		
PB-210	<	1.43E+01		

U-235	<	3.47E+00		
TH-231	<	1.78E+00		
PA-231	<	5.31E+00		
TH-227	<	9.00E+01		
RA-223	<	3.25E+01		
RN-219	<	4.02E+01		
AC-228		8.9070E+02	26.46	52.31
TH-228		9.2852E+02	83.32	94.27
RA-224		9.8058E+02	62.91	76.35
BI-212		6.7061E+02	31.20	44.70
TL-208		2.6923E+02	8.89	14.10
K-40	<	1.73E+01		
PB-211	<	5.64E+01		
BI-211	<	1.64E+01		
FR-223	<	2.25E+00		
U-234	<	1.03E-01		
Ac-227	<	3.63E+01		
J-131	<	2.65E+00		

---------- S U M M A R Y ----------

TOTAL ACTIVITY(2.4 to 3193.6 keV) 4.6701320E+03 pCi/gm

The library has energies which are not separable.

********* S U M M A R Y O F D I S C A R D E D P E A K S *********

13.00	-	U-234	13.00	%	Ac-227	13.60	!	Pu	14.41	%	CO-57
25.64	-	TH-231	27.36	!	PA-231	29.46	%	J-131	29.78	%	J-131
35.49	?	SB-125	46.50	&	PB-210	50.10	?	TH-227	50.10	&	FR-223
53.20	+	U-234	53.23	&	PB-214	63.29	&	TH-234	72.87	?	BI-211
79.80	%	TH-227	79.80	%	FR-223	80.11	&	CE-144	80.18	&	J-131
85.43	%	FR-223	88.47	&	FR-223	92.38	%	TH-234	92.80	+	TH-234
112.81	%	TH-234	122.06	&	CO-57	122.32	%	RA-223	129.08	-	AC-228
133.54	%	CE-144	136.48	&	CO-57	143.76	&	U-235	144.24	&	RA-223
152.70	&	PA-234	154.21	%	RA-223	163.35	&	U-235	202.12	&	U-235
205.00	&	FR-223	209.28	-	AC-228	234.90	%	FR-223	241.98	&	PB-214
256.20	+	TH-227	258.79	%	PB-214	270.23	-	AC-228	274.53	&	PB-214
277.35	-	TL-208	283.67	?	PA-231	284.30	+	J-131	295.21	&	PB-214
300.02		PA-231	300.09	-	PB-212	302.67	?	PA-231	323.87	%	RA-223
327.64	-	AC-228	330.00	%	PA-231	338.28		RA-223	364.48	%	J-131
380.43	?	SB-125	401.81	&	RN-219	433.93	&	AG-108M	445.03	&	RA-223
463.01	-	AC-228	463.38	?	SB-125	475.35	%	CS-134	487.08	?	PB-214
510.84	+	TL-208	569.32	%	CS-134	569.50	&	PA-234	583.14	+	TL-208
600.56	&	SB-125	606.64	%	SB-125	614.37	&	AG-108M	621.84	%	RU/RH106
635.90	?	SB-125	636.97	&	J-131	671.41	?	SB-125	692.00	&	CO-57
699.00	&	PA-234	722.89	%	J-131	733.00	?	PA-234	785.46	+	BI-212
785.91	!	PB-214	794.70	-	AC-228	831.96	-	PB-211	834.83	!	MN-54
839.03	%	PB-214	860.37	+	TL-208	897.83	+	BI-211	899.00	%	PA-234
1038.57	?	CS-134	1050.47	&	RU/RH106	1078.62	?	BI-212	1155.19	&	BI-214
1167.94	&	CS-134	1173.22	&	CO-60	1238.11	&	BI-214	1332.49	&	CO-60
1365.15	?	CS-134	1377.67	&	BI-214	1460.81	%	K-40	1509.23	%	BI-214
1588.00	+	AC-228	1661.28	?	BI-214	1729.59	%	BI-214	1764.49	?	BI-214
1874.42	?	BI-214	2118.55	%	BI-214	2204.21	%	BI-214	2447.86	?	BI-214

* - Peak is too wide, but only one peak in library.
! - Peak is part of a multiplet and this area went

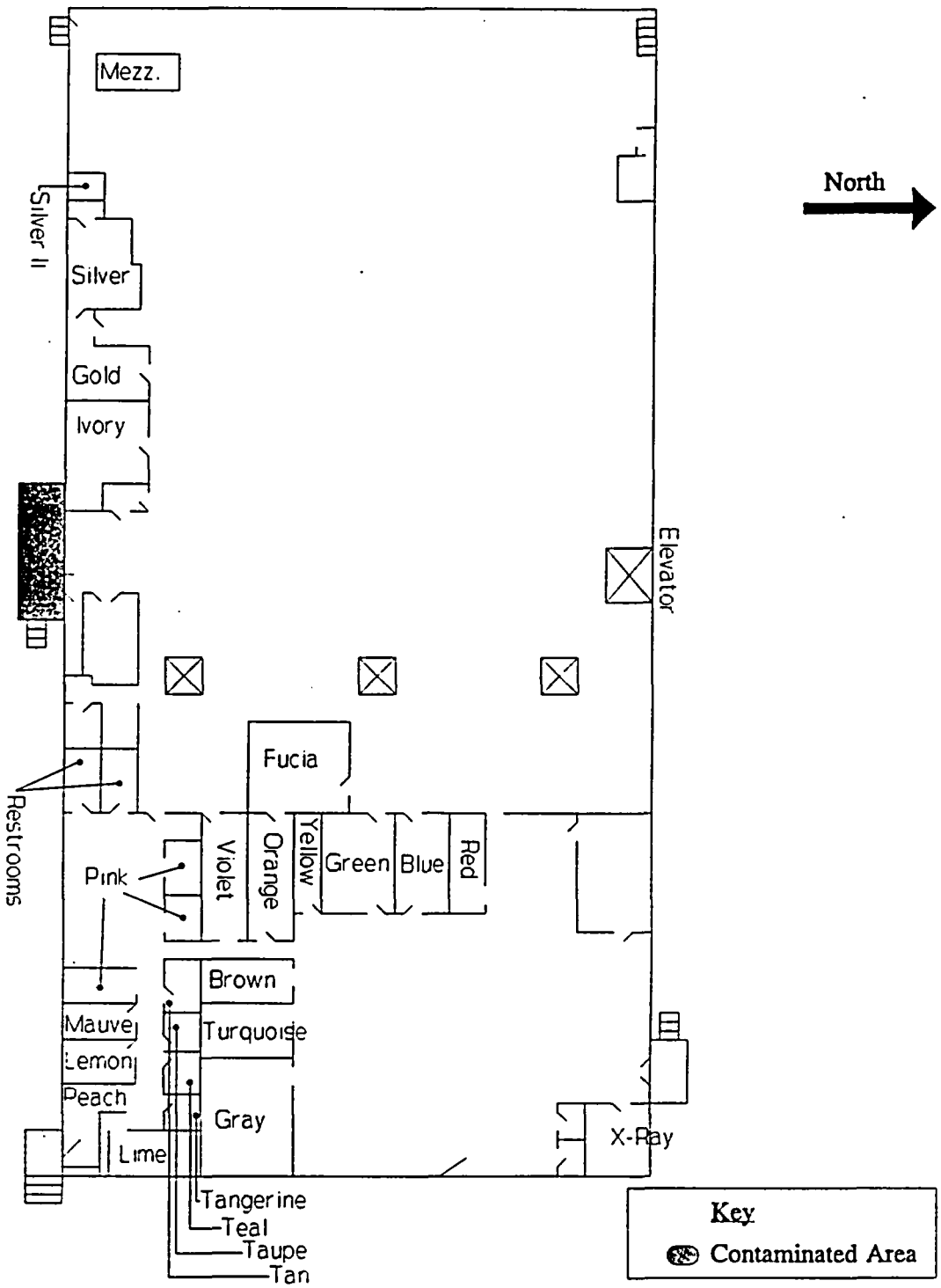
negative during deconvolution.
? - Peak is too narrow.
@ - Peak is too wide at FW25M, but ok at FWHM.
% - Peak fails sensitivity test.
$ - Peak identified, but first peak of this nuclide failed one or more qualification tests.
+ - Peak activity higher than counting uncertainty range.
- - Peak activity lower than counting uncertainty range.
= - Peak outside analysis energy range.
& - Calculated peak centroid is not close enough to the library energy centroid for positive identification.
P - Peakbackground subtraction

- -

Analysis time 8.4 seconds.

APPENDIX G

CONTAMINATED AREA OUTSIDE



Pratt & Whitney
Pine Street Facility
Exterior Contamination