Final Radiological Status Report
for the Structure of the
Moly Building
at
Molycorp, Inc. York, Pa.

December, 1995

Contacts:

Licensee: Mr. Tim Malloy
Molycorp, Inc.
350 N. Sherman Street
York, Pa. 17403
(717-845-2624, FAX 717-846-0946)

Contractor: Theodore Rahon, Ph.D., CHP
CoPhysics Corporation
Rt 208 Box 140W-RR6
Monroe, NY 10950
(914-783-4402, FAX 914-783-7191)

TABLE OF CONTENTS

Executive Summary

In December 1995, CoPhysics Corporation conducted a radiogical survey of the Moly Building at the Molycorp, Inc., facility in York, Pa. The building is structurally unstable and must be demolished for safety reasons. Only the walls and roof will be removed, the concrete floor will remain for later assessment and removal during decommissioning of the entire facility. The Moly Building was designated as radiologically "unaffected" per NUREG/CR 5849 criteria by Molycorp.

The results of the survey show that radiation and radioactivity levels associated with the structure are well within the limits for release to the general public and are within the range of normal background levels. Thus, the debris may be disposed of as non-radioactive waste. The floor has a few spots that have surface radioactivity levels greater than background but less than release limits. Thus, workers may perform the demolition without radiation control measures.

1.0 BACKGROUND INFORMATION

Molycorp, Inc. in York, Pa manufactured lanthanide chemicals from bastnasite and cerium concentrates from the early 1960's to March, 1993. Molycorp is a wholly owned subsidiary of Union Oil Corporation of California, dba UNOCAL. Thorium and uranium occur naturally in the bastnasite ore in concentrations less than 0.25%. The facility is licensed by the United States Nuclear Regulatory Commission (USNRC) under source materials license # SMB 1408. After operations were terminated, the license was amended to possession and storage only.

Molybdenum chemicals were also produced at the facility in the "Moly Building". The raw materials used in the process were non-radioactive. The warehouse was used only for shipment of refined lanthanide and molybdenum chemicals to customers.

On December 6th through 8th, 1995, CoPhysics Corporation conducted a survey to determine the final radiological status of the Moly Building and 4 rooms in the warehouse so that the areas could be released for non-controlled purposes.

This report concerns the survey of the Moly Building.

2.0 SITE INFORMATION

2.1 Site Description

The Moly Building is a 5035 ft^2 industrial building containing various tanks, steel platforms and other equipment. The building consists of red brick bearing walls, a wood-trussed attic, and a wood-plank roof with asphalt shingles.

Molycorp is planning to demolish the above grade structure (walls and roof) due to structural problems. The concrete floor slab will not be removed. Thus, the survey addressed the walls, ceiling, attic, equipment, and surface of the slab, but did not include the slab itself or below-grade materials. Surface contamination measurements of the floor surface were performed to determine if workers could proceed with the demolition without restricted area radiological controls. The remaining slab will addressed as part of complete facility decommissioning in the near future.

2.2 Site Conditions At Time Of Final Survey

The site is not operational. There is 24 hour security surveilance and a full-time remedial investigations manager on site.

2.3 Identity of Contaminants

The primary radionuclide of concern is natural thorium (Th-232) and its progeny radionuclides. Lessor quantities of uranium-238 / radium-226 series radionuclides may also be present in some materials.

3.0 FINAL STATUS SURVEY OVERVIEW

3.1 Survey Objectives

This survey was performed to determine the final radiological status of the Moly Building structure. Survey methodology was adapted from NUREG/CR 5849, "Manual for Conducting Radiological Surveys in Support of License Termination, Draft Report for Comment".

The results of the survey are to be compared to USNRC guidelines set forth in Regulatory Guide 1.86 (1974) and "Guidelines for Decontamination of Facilities and Equipment Prior to Release for Unrestricted Use or Termination of Licenses for Byproduct, Source, or Special Nuclear Material", (1982) as per statistical methodology discussed in NUREG 5849. Specifically:

1. Surface contamination levels are within the following values:

Nuclide	Average* Fixed + Removable (dpm/100 sq cm)	Maximum** Fixed + Removable (dpm/100 sq cm)	Removable (dpm/100 sq cm)
Th-232	1000	3000	200

* The average contamination level applies to areas <= 1 m^2. For an object of less surface area, the average applies to the entire surface.

** The maximum contamination level, or hot spot, applies to an area <= 100 cm^2.

2. If levels due to contamination are greater than 20% of the above values, then some reasonable effort had been undertaken to clean up the contamination.

3. Exposure rates greater than twice background are not due to contamination associated with the structures.

3.2 Organization and Responsibilities

All apspects of the field survey and laboratory analyses were supervised by the Project Manager, Theodore E. Rahon, Ph.D., CHP of CoPhysics Corporation. CoPhysics Corporation operates under radioactive materials license # NYS 2691-3949 (NYS Dept. of Labor).

The Project Manager is responsible for ensuring that:

- the survey is conducted according to the survey plan and that any changes in the plan are documented;
- all personnel are adequately trained in performing the measurements required by the plan;
- QA and sample chain-of -custody procedures are followed; and
- data collected are statistically sufficient to be used for testing against release guidelines per NUREG 5849.

3.3 Instrumentation

Field instruments available for use during the survey are shown in Table 3.1. All instruments were calibrated within 6 months prior to the survey using NIST-traceable standards. Efficiency and background checks were performed at least once per day in the field.

Table 3.1 - Field Instrumentation

Instrument Model	Probe Model	Type of Instrument	Type of Measurement	Efficiency	Background*	MDA or Sensitivity
Ludlum Measurements, Inc. Model 12 Ratemeter	42-2	1 x1 NaI Scintillation	gamma scans	200 cpm per uR/hr	10 ± 3 uR/hr	2 uR/hr
Ludlum Measurements, Inc. Model 12 Ratemeter	44-68	gas proportional	alpha scans	0.22 cpm per dpm/100 cm^2	5 cpm	100 dpm/100 cm^2
Ludlum Measurements, Inc. Model 3 Ratemeter	43-5	ZnS Scintillation	alpha scans	0.12 cpm per dpm/100 cm^2	20 cpm	100 dpm/100 cm^2
Ludlum Measurements, Inc. Model 2350 Ratemeter	44-68	gas proportional	beta scans	0.28 cpm per dpm/100 cm^2	240 cpm	700 dpm/100 cm^2
Ludlum Measurements, Inc. Model 3 Ratemeter	44-9	Gm pancake probe	beta scans	0.30 cpm per dpm	50 cpm	2000 dpm/100 cm^2
Ludlum Measurements, Inc. Model 2200 Scaler	44-68	gas proportional	alpha activity	0.22 cpm per dpm/100 cm^2	5 ± 2 cpm	60 dpm/100 cm^2
Ludlum Measurements, Inc. Model 2350 Ratemeter	44-68	gas proportional	beta activity	0.28 cpm per dpm/100 cm^2	220 ± 13 cpm	670 dpm/100 cm^2

* Gamma background obtained from a motel parking lot and lawn approximately 1 mile from the plant (~ 7-10 uR/hr) and from the Molycorp warehouse (~9-15 uR/hr) near red brick walls. Alpha and beta backgrounds were obtained from a combination of clean surface (paper) readings and readings from the Molycorp warehouse.

Laboratory instruments available for use during the survey are shown in Table 3.2. Laboratory chain-of-custody procedures were followed for all samples collected.

Table 3.2 - Laboratory Instrumentation Used

Instrument	Type of Instrument	Type of Measurement	Efficiency	Background	MDA or Sensitivity
Ludlum Measurements, Inc. Model 2929 Sample Counter	ZnS Scintillator	alpha wipe test counter	40 cpm per dpm	0.3 cpm	MDA = 3 dpm
	Plastic Scintillator	beta wipe test counter	39 cpm per dpm	43.5 cpm	MDA = 26 dpm
Gamma Spectrometer (Aptec MCA, Bicron detector)	NaI Scintillator	gamma bulk material analysis	not applicable	not applicable	MDA = 400 pCi, or ~ 1 pCi/g Th-232 (for a 400 g sample)

3.4 Survey Procedures

3.4.1 Area Classification

According to the Molycorp representative's review of the plant operating history, the Moly Building was not used for the processing of licensable materials. Prior radiological surveys also showed negligible readings. Thus, the areas are classified as "unaffected" as shown in the following table:

Table 3.3 - Classification of Areas According to Contamination Potential

Plant Area	Building or Facility	Room or Area	Classifications of Contamination Potential	Remarks
General	Moly Building	Structure	unaffected	walls & ceiling for demolition
"	"	Floor	unaffected	not to be released
"	"	Equipment	unaffected	equipment for demolition

3.4.2 Reference Grids

A portable, data collection computer was used to log locations and instrument readings. Each measurement point was registered to a reference grid with origins in the southwest corner of the building. Because the areas surveyed were considered to be unaffected, measurement locations were not pre-specified on grid intervals. Locations of scans and fixed point measurements are discussed below.

3.4.3 Surface Scans

Surfaces scans of surfaces were performed according to the following schedule:

Table 3.4 - Types of Scans Performed

Classification of Contamination Potential	Surface	% of Surface Scanned	Types of Scans Performed
unaffected	indoor floors, lower walls (< 2 meters in height), & equipment	> 10 %	alpha, beta, gamma
unaffected	indoor ceiling & walls (> 2 meters in height)	random	alpha, beta, gamma
unaffected	outdoor walls (< 2 meters in height), wall holes and penetrations	> 10 %	beta, gamma

Instrumentation used is shown in Table 3.1. Normally, gas proportional detectors are used for beta scans of large surfaces and the smaller GM probes are used for scans of tight spaces in and around equipment and wall penetrations. Gamma scans are also performed (using NaI scinitllation probes) to detect the presence of bulk materials containing radioactivity.

Scanning speeds were approximately 1 detector width per second for alpha and beta scans, and approximately 0.5 m per second for gamma scans. Audible indicators (speakers) were used to identify locations having elevated (> 1.5 to 3 times ambient) levels of direct radiation. These locations were noted for fixed measurements or sampling.

3.4.4 Surface Activity Measurements

Direct Measurements

Measurement points were selected on the walls, floors, counter tops, shelves, process equipment, overhead beams and pipes, and other items within the survey area based on prior elevated scans, the surveyors judgment of the item's potential for contamination, and random selection. The number of points surveyed were 121, with at least 1 point per 50 m^2 of surface. Direct radiation measurements performed at each point included an alpha count and beta count rate reading. Note, in this report, beta readings indicate measurements with a beta-sensitive detector that also is sensitive to alpha and gamma radiation.

Removable Contamination Measurements

Smear, or wipe tests, were performed at 111 of the direct measurement locations.

3.4.5 Exposure Rate Measurements

Gamma exposure rates were measured at 1 meter above the floor and at 2 to 5 cm (near-contact) for other surfaces. Exposure rates were measured using a NaI gamma scintillator. The scintillator had been calibrated to environmental background gamma fields by comparison to a pressurized ionization chamber.

3.4.6 Soil/Sediment Sampling

No soil or sediment samples were collected - the survey involved above-grade structures only.

3.4.7 Special Measurements and Samples

Special samples such as process equipment scrapings and building materials were collected if the material was thought to have the potential for contamination.

3.5 Background Level Determinations

Background measurements were conducted in an area of the warehouse not used to store or process radioactive materials, mainly to determine radiation levels from the old red brick walls used in the buildings on site. Gamma spectroscopic analyses of the red brick material show potassium-40 (K-40) concentrations of approximately 30 pCi/g, thus causing the elevated gamma backgrounds (14-17 uR/hr) observed near the walls. In addition, local, off-site gamma background which was assessed at the Super 8 Motel on US Route 30, approximately 1 mile from the plant.

Beta and alpha background readings were obtained from measurement of clean surfaces such as paper as well as concrete, brick and wood surfaces in the warehouse.

3.6 Sample Analysis

Wipe tests were analyzed for gross alpha and gross beta activity.

Bulk samples collected were analyzed for thorium-232 and radium-226 by gamma spectroscopy. Three wall samples of red brick were collected: 1 background sample from the warehouse and 2 samples from the Moly Building. Also collected and analyzed were a 2 samples of dust from the attic of the Moly Building.

3.7 Data Interpretation

Data conversions and evaluations were performed, following the guidance in NUREG-5849. Calibration methods and sample calculations are shown in the Appendix. Measurement data were comverted to units of dpm/100 cm^2 (surface activity), uR/hr (exposure rates) and pCi/g (bulk material concentrations). As noted in the data tables, some values were adjusted for contributions from natural background. Individual measurement results were compared with "hot-spot" criteria. Average results for survey units were determined and compared with guidelines levels. Data for each survey unit were tested against the confidence level objective per NUREG-5849.

3.8 Records

All original survey data have been archived at CoPhysics Corporation and will remain on file for a minimum of 5 years. Samples will be returned to the Molycorp facility.

4.0 SURVEY FINDINGS AND RESULTS

4.1 Background Levels

The background exposure rates varied depending on the distance from red brick walls. The exposure rate was 12-17 uR/hr near brick walls and 7-11 uR/hr greater than 5 meters from brick walls. Background exposure rates at a nearby parking lot and lawn of a motel approximately 1 mile from the site ranged from 6-9 uR/hr. Background measurements are shown in Appendix A.

The background concentrations in the red brick material were < 1.0 pCi/g Th-232 and < 0.4 pCi/g Ra-226.

4.2 Building Surveys

Scans

No areas of elevated activity were found associated with the structure (walls and ceiling). Scans of the floor identified two areas of elevated alpha activity: on the floor of the lab room and on a stain on the floor near a tank.

Surface Activity Measurements

The results of removable and direct alpha and beta measurements are shown in the appendix. All removable results were within guideline values. All direct alpha results were within guideline values. However, two points had beta activity readings greater than 1000 dpm/100 sq.cm but less than 3000 dpm/100 sq.cm (M62 and M64 on the floor in the lab room) and one point had a beta activity reading greater than 3000 dpm/100 sq.cm (M25 in the interior of the duct leading to an outdoor dust collector).

Exposure Rate Measurements

Whole body exposure rates in the structure ranged from 10 to 17 uR/hr which are within the range of background values for the type of masonry construction surveyed.

Sampling

The results of gamma spectroscopic analysis of building materials and residual process material scrapings are listed in Appendic C. Samples of brick material from the Moly Building showed background levels of thorium and radium. Samples of process material scrapings from the floor and attic showed levels of thorium that are slightly elevated but are less than 10 pCi/g. The quantity of this material observed is small (less than 10 kg) and would not pose a radiological hazard to demolition crews.

4.3 Grounds Surveys

No grounds were surveyed as part of this investigation.

4.4 Statistical Review of Results

A statistical comparison of average surface contamination levels and guideline values is shown in Appendix D per methodology specified in NUREG/CR 5849.

5.0 SUMMARY

The final status radiological survey conducted on December 6, 1995 of structure of the Moly Building showed that the structure meets the NRC limits for release for unrestricted use, and thus may be demolished as non-radioactive materials. The floor surface, while not being released at this time, has levels of surface activity within guidelines and thus may be accessed by demolition workers without the need for radiological control measures.

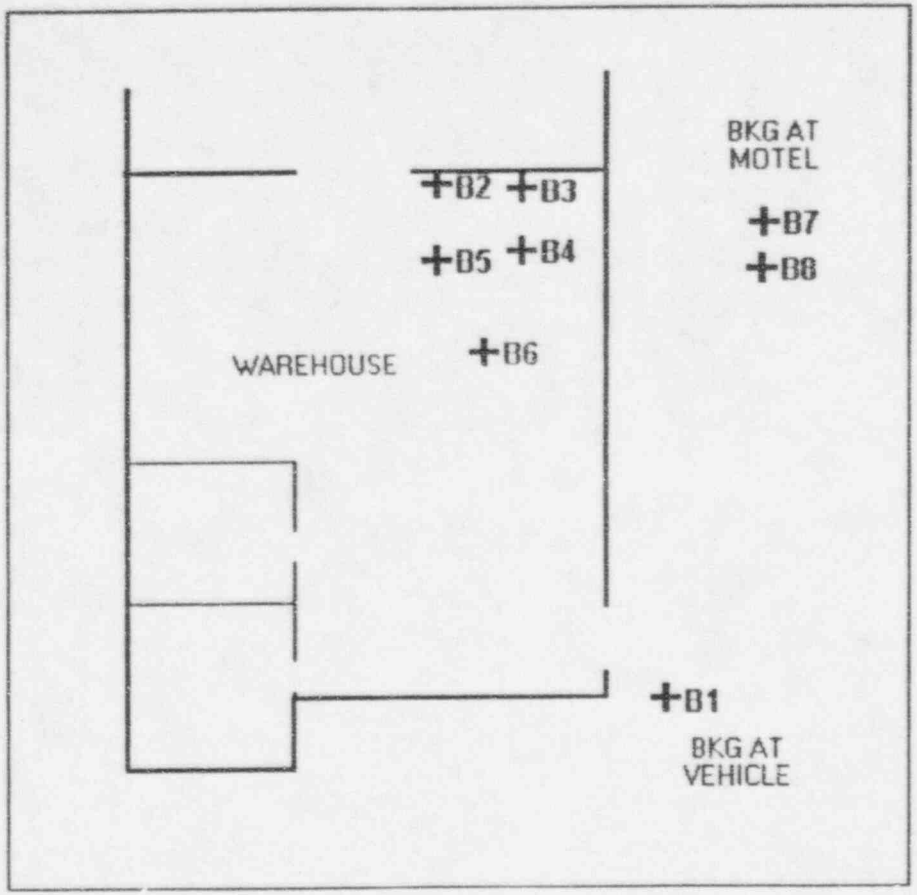
Theodore E. Rahon

Theodore E. Rahon, Ph.D., CHP
President
CoPhysics Corporation

Appendix A - Background Measurements

Molycorp Background Readings

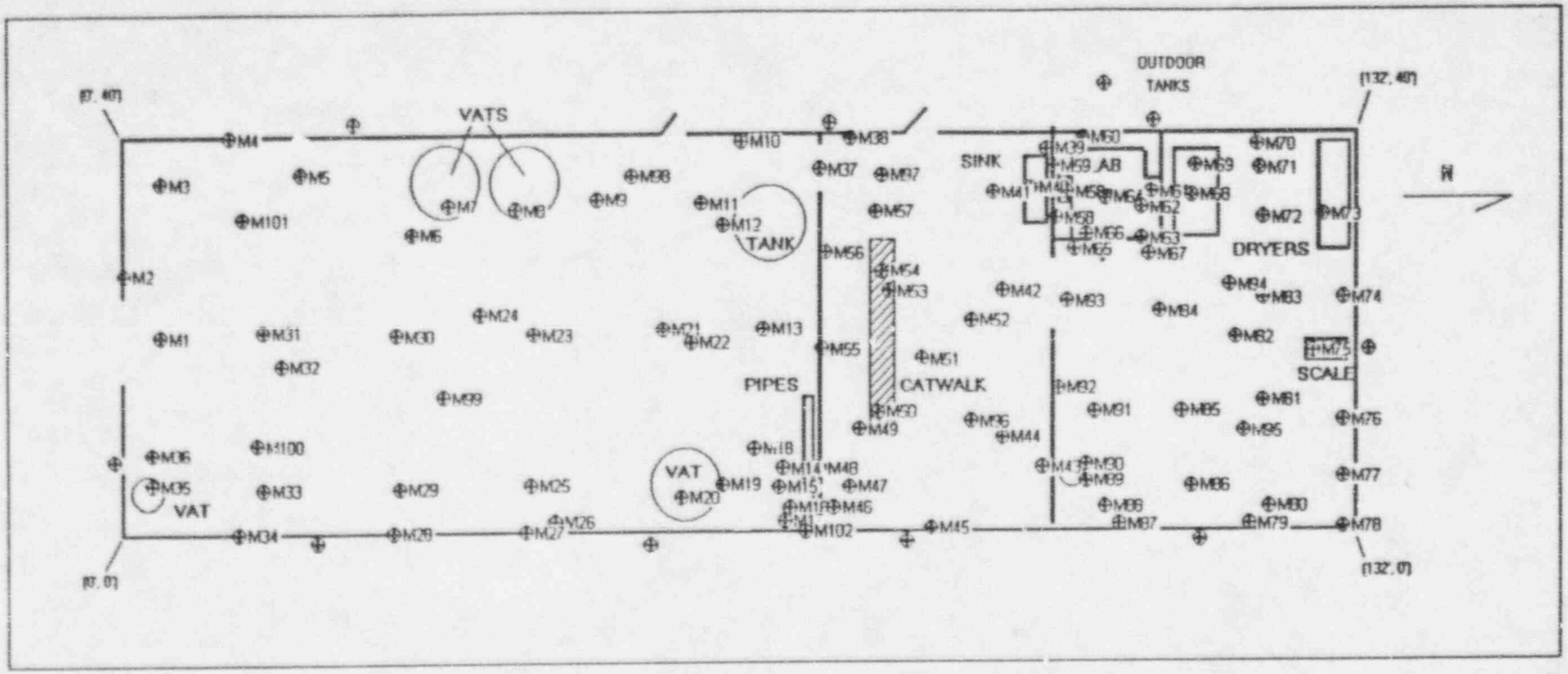
X	Y	LABEL	DESCRIPTION	GAMMAURHR	AGPCCPM	BGPCCPM
26.0	43.0	B2	WALL, BRICK	15	6	280
33.0	42.7	B3	WALL, BRICK	14	5	250
33.0	37.5	B4	FLOOR, CONCRETE	11	8	250
26.0	36.7	B5	FLOOR, CONCRETE	9	4	200
29.9	29.0	B6	WOOD PALLET	9	5	220
45.0	0.0	B1	PAPER SURFACE AT VEHICLE	8	3	220
53.0	39.8	B7	MOTEL ASPHALT PARKING LOT	7		
52.8	35.9	B8	NEAR MOTEL WALL, LANDSCAPED	9		
			AVERAGE	10	5	237
			STD DEV.	3	2	29



Map Title: LOCATIONS OF BACKGROUND READINGS

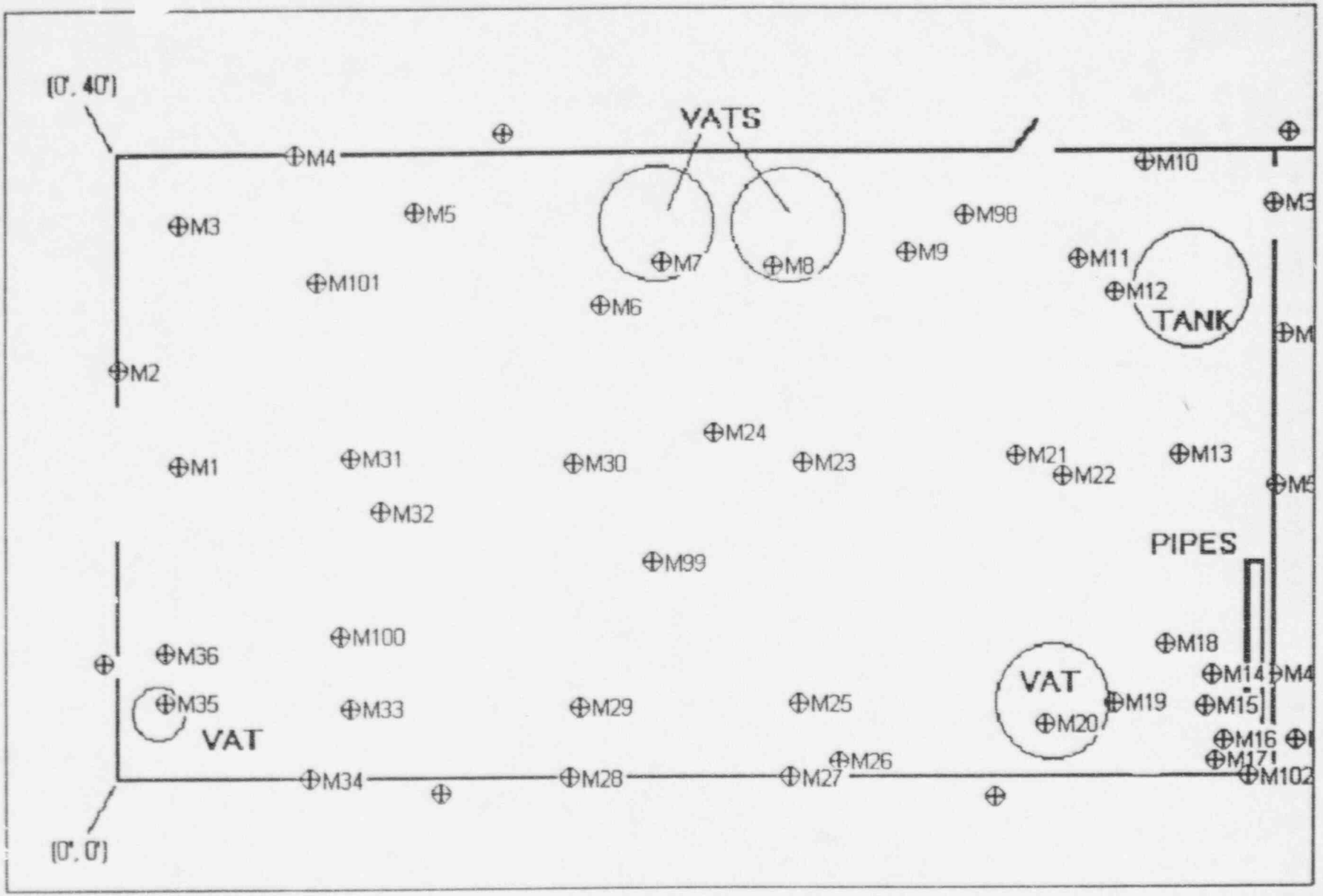
Survey Name: MOLYCORP BACKGROUND
Survey Start Date: 12/06/95
Survey End Date: 12/08/95

Appendix B - Radiological Measurement Results



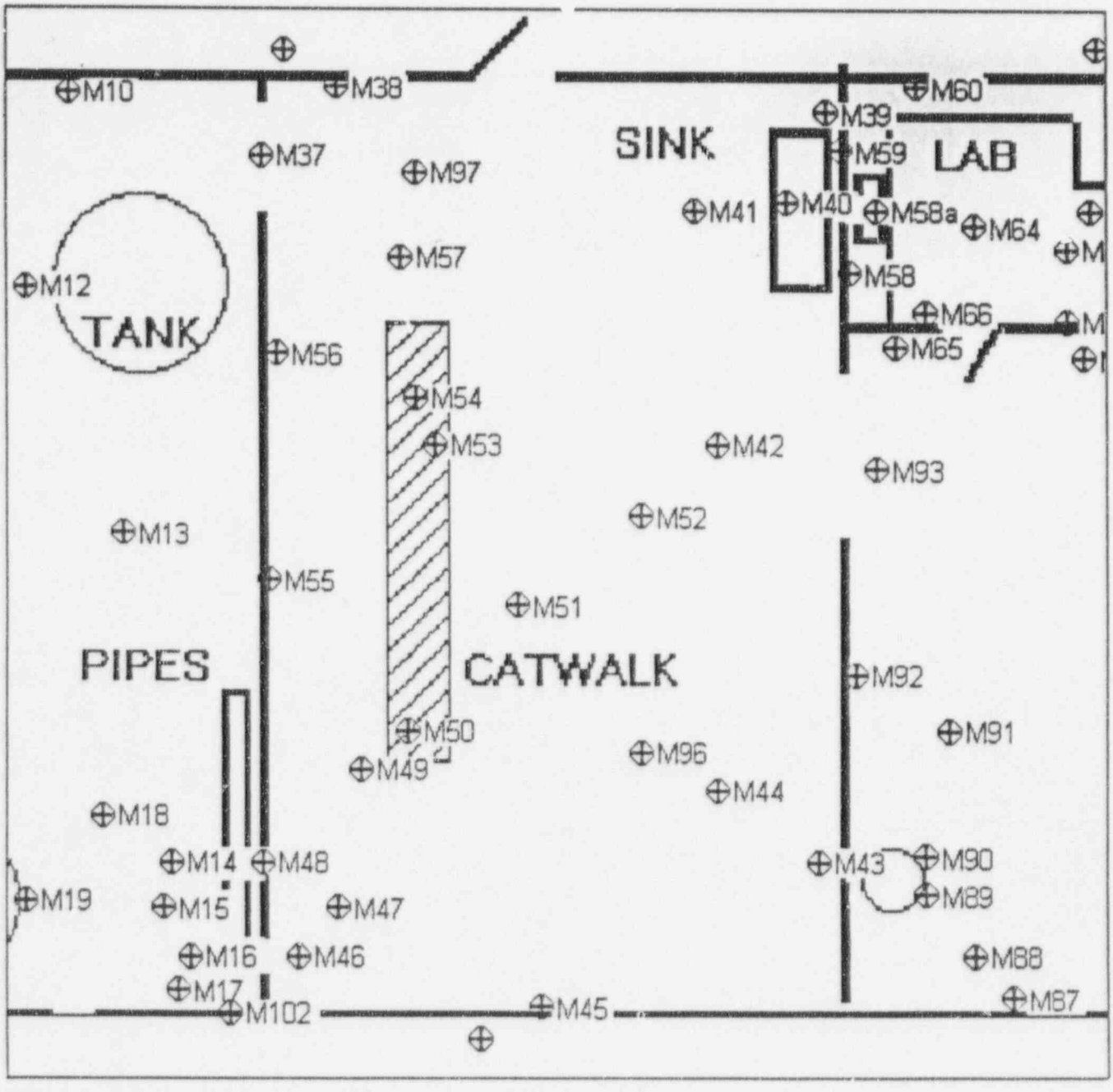
Map Title: MOLY BUILDING - SURVEY POINTS

Survey Name: MOLYCORP MOLY BUILDING
Survey Start Date: 12/06/95
Survey End Date: 12/08/95



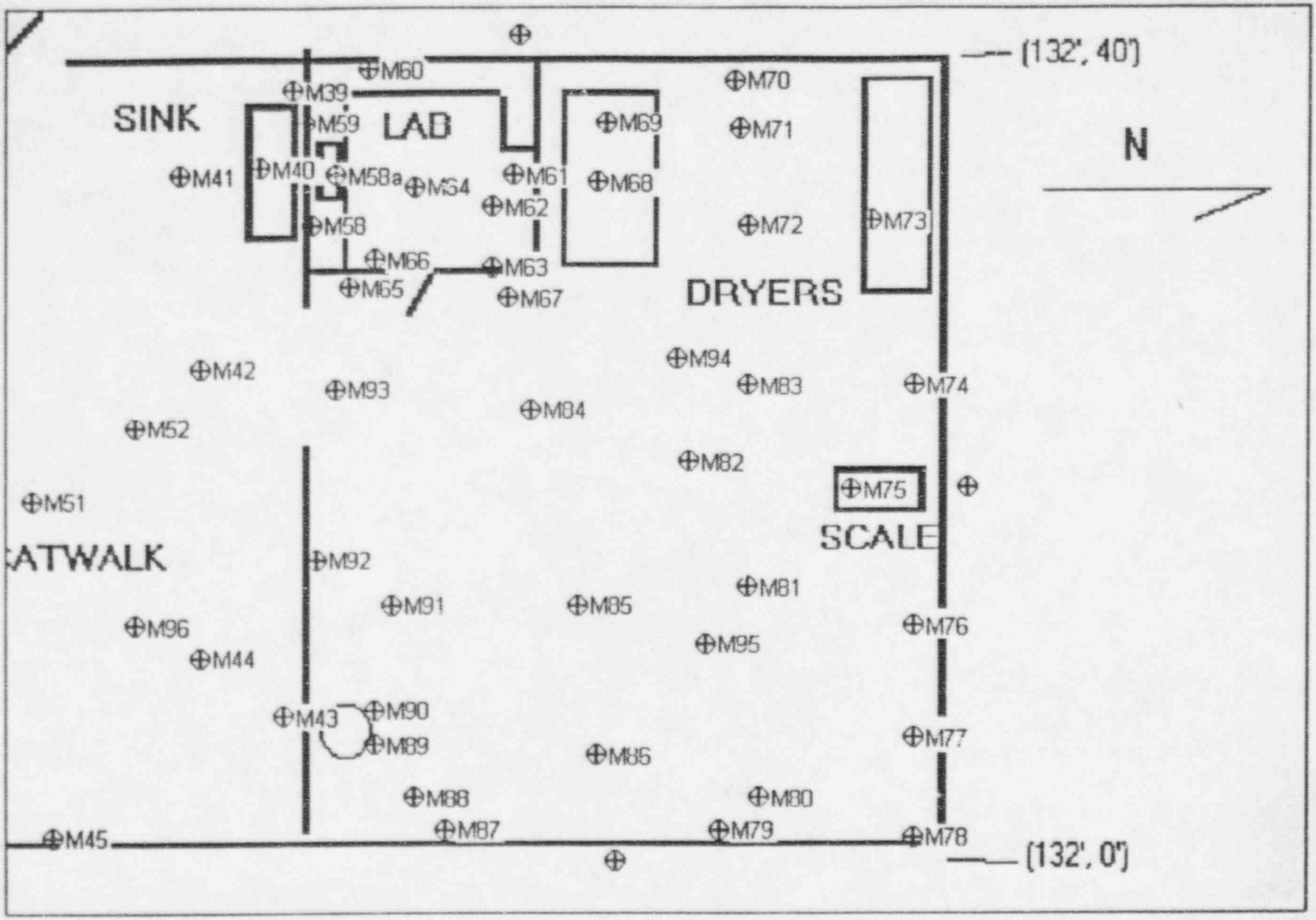
Map Title: MOLY BUILDING - 1ST BAY

Survey Name: MOLYCORP MOLY BUILDING
Survey Start Date: 12/06/95
Survey End Date: 12/08/95



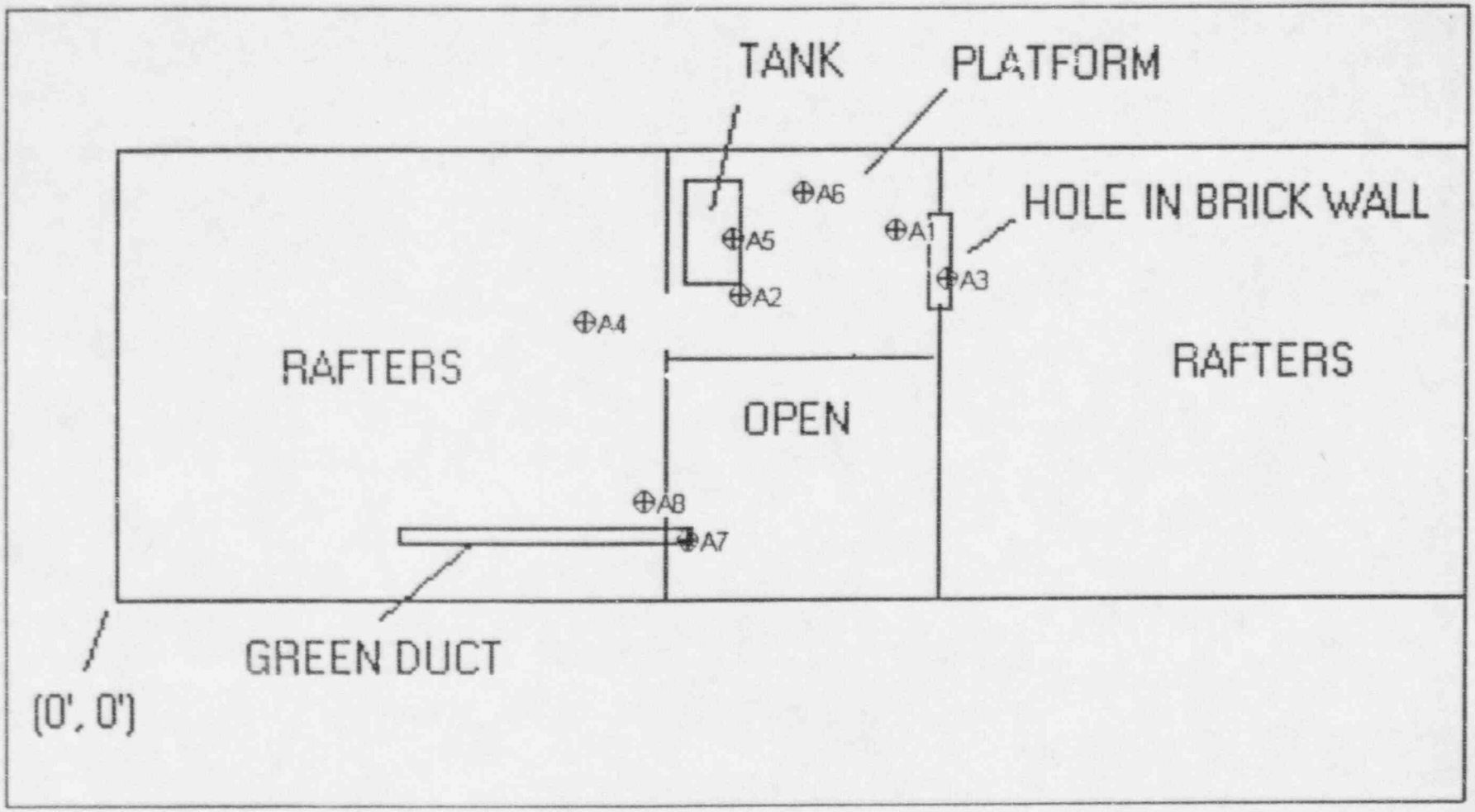
Map Title: MOLY BUILDING - 2ND BAY

Survey Name: MOLYCORP MOLY BUILDING
Survey Start Date: 12/06/95
Survey End Date: 12/08/95



Map Title: MOLY BUILDING - 3RD BAY

Survey Name: MOLYCORP MOLY BUILDING
Survey Start Date: 12/06/95
Survey End Date: 12/08/95



Map Title: MOLY BUILDING ATTIC

Survey Name: MOLYCORP WAREHOUSE & MOLY BLDG SURVEY
Survey Start Date: 12/06/95
Survey End Date: 12/08/95

Radiological Measurement Results

Moly Building

X	Y	Sample	DESCRIPTION	Exposure[1]	Direct Alpha[2]	Removable Alpha[3]			Direct Beta[4]	Removable Beta[5]		
				Rate (uR/hr)	dpm/100 sq.cm	dpm/100 sq.cm			dpm/100 sq.cm	dpm/100 sq.cm		
FLOOR MEASUREMENTS:												
4	20.1	M1	FLOOR,CONCRETE	9	123	-1	±	1	189	1	±	8
4	35.6	M3	FLOOR,CONCRETE	11	68	0	±	12	-132	12	±	8
19.1	36.3	M5	FLOOR,CONCRETE	12	150	-1	±	9	82	9	±	8
31.2	30.2	M6	FLOOR,CONCRETE WHITE CRUST	7	50	-1	±	8	-132	8	±	8
51	33.6	M9	FLOOR,CONCRETE	10	55	0	±	5	439	5	±	8
64.5	30.9	M12	STAIN UNDER TANK ON FLOOR	13	423	3	±	2	511	2	±	8
68.8	20.5	M13	FLOOR,CONCRETE	11	-5	1	±	8	261	8	±	8
71.8	2.4	M16	FLOOR,CONCRETE WHITE CRUD	12	214	1	±	15	582	15	±	8
64.5	4.7	M19	FLOOR,CONCRETE	7	123	0	±	7	618	7	±	8
58.1	20.5	M21	FLOOR,CONCRETE	9	95	2	±	10	332	10	±	8
44.3	20.1	M23	FLOOR,CONCRETE	10	50	0	±	9	154	9	±	8
46.7	1	M26	FLOOR,CONCRETE	17	114	0	±	6	332	6	±	8
29.9	4.4	M29	FLOOR,CONCRETE	9	23	0	±	5	-96	5	±	8
29.5	20.1	M30	FLOOR,CONCRETE	8	41	-1	±	6	-25	6	±	8
15.1	20.5	M31	FLOOR,CONCRETE	10	95	0	±	10	-61	10	±	8
15.1	4.4	M33	FLOOR,CONCRETE	10	50	1	±	3	46	3	±	8
3	8.1	M36	FLOOR,CONCRETE	9	132	0	±	-2	11	-2	±	8
74.9	36.6	M37	FLOOR,CONCRETE	10	41	-1	±	0	582	0	±	8
93.7	34.2	M41	FLOOR,CONCRETE	11	41	0	±	-9	46	-9	±	8
94.7	24.2	M42	FLOOR,CONCRETE	13	50	-1	±	-2	582	-2	±	8
94.7	9.4	M44	FLOOR,CONCRETE	13	59	0	±	8	582	8	±	8
78.2	4.4	M47	FLOOR,CONCRETE	12	5	0	±	6	-132	6	±	8
79.2	10.4	M49	FLOOR,CONCRETE	13	41	0	±	2	225	2	±	8
85.9	17.5	M51	FLOOR GRATE	11	41	-1	±	0	225	0	±	8
82.3	24.2	M53	FLOOR,CONCRETE	13	59	0	±	2	439	2	±	8
80.9	32.2	M58	FLOOR,CONCRETE	10	68	-1	±	-3	582	-3	±	8
109.8	32.6	M62	FLOOR,CONCRETE	10	268	0	±	7	2725	7	±	8
105.8	33.6	M64	FLOOR,CONCRETE	9	205	0	±	12	1654	12	±	8
122.9	31.6	M72	FLOOR,CONCRETE	7	68	0	±	-6	761	-6	±	8
123.5	2.4	M80	FLOOR GRATE	7	5	0	±	7	1296	7	±	8
122.9	13.1	M81	FLOOR,CONCRETE	7	41	-1	±	2	225	2	±	8
122.9	23.5	M83	FLOOR,CONCRETE	7	50	-1	±	0	546	0	±	8

Radiological Measurement Results

Moly Building

X	Y	Sample	DESCRIPTION	Exposure[1]	Direct Alpha[2]	Removable Alpha[3]			Direct Beta[4]	Removable Beta[5]		
				Rate (uR/hr)	dpm/100 sq.cm	dpm/100 sq.cm			dpm/100 sq.cm	dpm/100 sq.cm		
111.8	22.2	M84	FLOOR,CONCRETE	8	50	0	±	5	475	5	±	8
114.1	12.1	M85	FLOOR,CONCRETE	7	32	0	±	8	154	8	±	8
115.2	4.4	M86	FLOOR,CONCRETE	8	32	-1	±	5	46	5	±	8
105.8	2.4	M88	FLOOR GRATE	9	-14	0	±	8	761	8	±	8
103.8	5	M89	FLOOR,CONCRETE STAIN	7	32	-1	±	3	[illegible]	3	±	8
104.7	12.1	M91	FLOOR,CONCRETE	6	23	0	±	0	225	0	±	8
101.7	23.2	M93	FLOOR,CONCRETE	9	64	0	±	5	189	5	±	8
			mean	10	78	0			389	4		
FLOOR SUMMARY			std dev	2	82	1			539	5		
			count	39	39	39			39	39		
STRUCTURE MEASUREMENTS:												
0	26.2	M2	WALL,BRICK	12	-5	0	±	13	-61	13	±	8
11.4	40	M4	WALL,BRICK	16	-14	-1	±	-3	-132	-3	±	8
66.5	39.3	M10	WALL,BRICK	16	36	0	±	7	475	7	±	8
62.1	33.2	M11	CEILING BEAM	10	-9	0	±	17	-132	17	±	8
71.2	1	M17	WALL,BRICK	13	5	0	±	10	154	10	±	8
61.1	19.1	M22	CEILING BEAM	9	-14	0	±	7	-132	7	±	8
43.6	0	M27	WALL,BRICK & WDW SILL	17	-14	0	±	-2	154	-2	±	8
29.2	0	M28	WALL,BRICK - WDW SILL	12	14	2	±	1	-132	1	±	8
17.1	17.1	M32	CEILING BEAM	0	-23	4	±	12	-132	12	±	8
12.4	0	M34	WALL ELEC PANEL	12	-14	0	±	1	-132	1	±	8
78.2	39.6	M38	WALL,BRICK	14	-14	0	±	11	439	11	±	8
99.4	38.6	M39	WALL,BRICK	15	14	-1	±	-5	368	-5	±	8
99	6.4	M43	WALL,BRICK	15	41	-1	±	1	368	1	±	8
87	0.3	M45	WALL FAN	12	50	0	±	3	225	3	±	8
74.9	6.4	M48	WALL,BRICK	14	-5	0	±	7	154	7	±	8
91.3	21.2	M52	CEILING BEAM	10	-14	1	±	8	11	8	±	8
75.2	18.5	M55	WALL, WOOD PANEL	9	-14	-1	±	6	-239	6	±	8
75.5	28.2	M56	WALL,BRICK	15	-14	1	±	2	118	2	±	8
100	36.9	M59	WALL,BRICK	15	-14	-1	±	8	582	8	±	8

Radiological Measurement Results

Moly Building

X	Y	Sample	DESCRIPTION	Exposure[1]	Direct Alpha[2]	Removable Alpha[3]			Direct Beta[4]	Removable Beta[5]		
				Rate (uR/hr)	dpm/100 sq.cm	dpm/100 sq.cm			dpm/100 sq.cm	dpm/100 sq.cm		
103.4	39.6	M60	WALL,BRICK	9	-14	0	±	7	46	7	±	8
110.8	34.2	M61	WALL, BLOCK	7	-14	0	±	1	225	1	±	8
109.8	29.5	M63	WALL, BLOCK	10	-14	0	±	5	46	5	±	8
102.4	28.5	M65	WALL, BLOCK	9	-14	-1	±	5	-25	5	±	8
103.7	29.9	M66	TOP OF LAB	12	59	0	±	4	189	4	±	8
110.5	27.9	M67	WALL, BLOCK	8	-5	-1	±	8	-132	8	±	8
122.2	38.9	M70	WALL, BLOCK	7	68	1	±	-6	225	-6	±	8
131.6	23.5	M74	WALL, BLOCK	7	-14	0	±	-2	46	-2	±	8
131.6	11.1	M76	WALL, BLOCK	7	0	0	±	4	-132	4	±	8
131.6	0.3	M78	WALL, BLOCK	7	-14	2	±	10	-132	10	±	8
121.5	0.7	M79	WALL, BLOCK	6	-14	0	±	5	-132	5	±	8
119.9	19.5	M82	CEILING BEAM	6	5	1	±	7	-132	7	±	8
107.4	0.7	M87	WALL, BLOCK	9	-5	0	±	6	-61	6	±	8
100.7	14.4	M92	WALL,BRICK	13	-14	0	±	-6	-25	-6	±	8
119.2	24.8	M94	CEILING UNDERSIDE	9	-5	1	±	5	11	5	±	8
120.8	10.1	M95	CEILING UNDERSIDE	11	0	0	±	4	46	4	±	8
91.3	11.1	M96	CEILING UNDERSIDE	10	5	0	±	-1	11	-1	±	8
81.6	35.9	M97	CEILING UNDERSIDE	11	-9	0	±	1	-25	1	±	8
54.7	35.9	M98	CEILING UNDERSIDE	12	0	-1	±	2	-61	2	±	8
34.6	13.8	M99	CEILING UNDERSIDE	10	-5	0	±	2	-25	2	±	8
14.4	9.1	M100	CEILING UNDERSIDE	10	-9	1	±	11	-25	11	±	8
12.8	31.9	M101	CEILING UNDERSIDE	11	-5	0	±	2	-132	2	±	8
73.5	0	M102	WALL, (WIPE-FAN BLADE)	11	-23	0	±	2	-61	2	±	8
71	38	A1	ATTIC - FLOOR (POWDER)	12	-5	0	±	1	-25	-2	±	8
56.7	31.8	A2	ATTIC - CRUD UNDER TANK	8	41	2	±	1	11	5	±	8
75.6	33.3	A3	ATTIC - HOLE IN WALL	10	0	0	±	1	-25	2	±	8
42.5	29.2	A4	ATTIC - RAFTERS	10	0	0	±	1	-96	-4	±	8
62.4	41.7	A6	ATTIC - CEILING PANEL	8	-5	0	±	1	-25	-2	±	8
48	11.5	A8	ATTIC - RAFTERS	9	5	2	±	1	46	2	±	8
-1.0	7.5	no wipe	WALL, EXTERIOR	12	18				154			
21.0	-0.9	no wipe	WALL, EXTERIOR	17	32				296			
56.8	-1.3	no wipe	WALL, EXTERIOR	13	27				82			
84.3	-1.0	no wipe	WALL, EXTERIOR	11	18				296			

Radiological Measurement Results

Moly Building

X	Y	Sample	DESCRIPTION	Exposure[1]	Direct Alpha[2]	Removable Alpha[3]			Direct Beta[4]	Removable Beta[5]		
				Rate (uR/hr)	dpm/100 sq.cm	dpm/100 sq.cm			dpm/100 sq.cm	dpm/100 sq.cm		
116.1	-0.9	no wipe	WALL, EXTERIOR	9	32				46			
134.3	18.2	no wipe	WALL, EXTERIOR	13	18				154			
111.1	41.3	no wipe	WALL, EXTERIOR	9	9				154			
105.7	45.0	no wipe	TANK PAD	9	32				46			
75.9	41.2	no wipe	WALL, EXTERIOR	15	27				296			
24.9	41.3	no wipe	WALL, EXTERIOR	14	14				154			
			mean	11	4	0			56	4		
STRUCTURE SUMMARY			std dev	3	21	1			177	5		
			count	58	58	48			58	48		
EQUIPMENT & FIXTURE MEASUREMENTS:												
35.2	33	M7	IN VAT	5	-23	-1	±	5	-204	5	±	8
42.3	32.6	M8	IN VAT	5	-23	-1	±	9	-168	9	±	8
71	6.4	M14	IN GREEN DUCT	10	73	2	±	3	-132	3	±	8
70.5	4.4	M15	LARGE RED DUCT	12	-14	0	±	3	-132	3	±	8
67.9	8.4	M18	DRUMS	10	68	-1	±	7	154	7	±	8
60.1	3.4	M20	IN VAT	12	64	0	±	-2	-61	-2	±	8
38.6	22	M24	CEILING PIPE	10	-9	0	±	6	118	6	±	8
44.0	4.7	M25	VAT COVER	10	55	7	±	16	46	16	±	8
3	5	M35	TANK OUTLET	6	-23	0	±	13	-132	13	±	8
97.7	34.6	M40	SINK BASIN & TOP	15	5	0	±	-10	189	-10	±	8
76.5	2.4	M46	IN CEILING PIPE GREEN	12	14	1	±	4	332	4	±	8
81.2	12.1	M50	CEILING PIPES	10	-23	1	±	19	-132	19	±	8
81.6	26.2	M54	CEILING PIPES	9	-23	1	±	0	-132	0	±	8
100.4	31.6	M57	CRUD UNDER BENCH	13	0	0	±	6	46	6	±	8
101.7	34.2	M58a	SINK	17	45	-1	±	8	225	8	±	8
115.2	33.9	M68	DRYING RACKS	9	-14	-1	±	-1	-132	-1	±	8
115.5	36.9	M69	DUCT INTERIOR	10	-14	1	±	14	225	14	±	8
122.5	36.6	M71	TOP DUCT BETW DRIERS	8	-14	0	±	10	154	10	±	8
129.3	31.9	M73	DRYING RACKS	7	-14	0	±	-6	-132	-6	±	8
128.2	18.1	M75	SCALE	7	14	0	±	7	725	7	±	8

Radiological Measurement Results

Moly Building

X	Y	Sample	DESCRIPTION	Exposure[1]	Direct Alpha[2]	Removable Alpha[3]			Direct Beta[4]	Removable Beta[5]		
				Rate (uR/hr)	dpm/100 sq.cm	dpm/100 sq.cm			dpm/100 sq.cm	dpm/100 sq.cm		
131.6	5.4	M77	PIPES	6	-23	1	±	13	46	13	±	8
103.7	6.7	M90	VAT EXTERIOR	17	0	0	±	7	225	7	±	8
56	37.3	A5	ATTIC - TOP, SIDES OF TANK	8	-5	1	±	1	-61	0	±	8
51.9	7.7	A7	ATTIC - GREEN DUCT	8	5	2	±	1	11	1	±	8
			mean	10	5	0			45	6		
EQUIPMENT SUMMARY			std dev	3	32	2			213	7		
			count	24	24	24			24	24		

Footnotes:

1. Gross Gamma Exposure Rate; MDA = 2 uR/hr
2. Direct Alpha Net Activity; MDA = 60 dpm/100 sq.cm
3. Removable Alpha Net Activity; MDA = 2 dpm/100 sq.cm
4. Direct Beta Net Activity; MDA = 700 dpm/100 sq.cm
5. Removable Beta Net Activity; MDA = 26 dpm/100 sq.cm

Appendix C - Results of Sample Analysis

Results of Gamma Spectroscopic Analysis of Bulk Material Samples

Sample ID	Description	Mass (g)	Th-232 (pCi/g)*	Th-232 MDA (pCi/g)	Ra-226 (pCi/g)*	Ra-226 MDA (pCi/g)
S1	Crust/powder from attic wall opening	203	-0.9 ± 0.7	1.7	1.6 ± 0.3	0.7
S2	Dust from rafters above blending area	246	2.0 ± 0.7	1.7	0.2 ± 0.4	0.6
S3	Dust from rafters above front of building	145	-0.7 ± 0.8	2.0	0.1 ± 0.4	0.7
S4	Red brick from wall between bays 2 & 3	474	0.0 ± 0.5	1.0	0.8 ± 0.3	0.4
S5	Red brick from exterior wall (N side)	421	-0.4 ± 0.5	1.1	0.2 ± 0.3	0.4
S6	Red brick from warehouse wall between bays (BKG brick)	351	0.3 ± 0.5	1.2	0.2 ± 0.3	0.4

* Uncertainties are 1-sigma standard deviations.

Appendix D - Statistical Summary of Radiological Survey Results

Statistical Summary of Radiological Survey Results

Moly Building

Area or Surface	Surface Area (sq m)	N	Direct Alpha Activity dpm/100 sq cm					Direct Beta Activity dpm/100 sq cm				
			mean	SD	mu_a	C_G	$mu_a < C_G$?	mean	SD	mu_a	C_G	$mu_a < C_G$
FLOOR SUMMARY	477	39	78	82	101	1000	yes	389	539	534	1000	yes
STRUCTURE SUMMARY	1400	58	4	21	9	1000	yes	56	177	95	1000	yes
EQUIPMENT SUMMARY	470	24	5	32	16	1000	yes	45	213	118	1000	yes

Area or Surface	Surface Area (sq m)	N	Removable Alpha Activity dpm/100 sq cm					Removable Beta Activity dpm/100 sq cm				
			mean	SD	mu_a	C_G	$mu_a < C_G$?	mean	SD	mu_a	C_G	$mu_a < C_G$
FLOOR SUMMARY	477	39	0	1	0	200	yes	4	5	6	200	yes
STRUCTURE SUMMARY	1400	48	0	1	0	200	yes	4	5	5	200	yes
EQUIPMENT SUMMARY	470	24	0	2	1	200	yes	6	7	8	200	yes

Area or Surface	Surface Area (sq m)	N	Net Gamma Exposure Rate uR/hr				
			mean	SD	mu_a	C_G	$mu_a < C_G$?
FLOOR SUMMARY	477	39	0	2	0	10	yes
STRUCTURE SUMMARY	1400	58	1	3	2	10	yes
EQUIPMENT SUMMARY	470	24	0	3	1	10	yes

Appendix E - Example Calculations

Minimum detectable activities (MDA's) were calculated from the following formula adapted from NUREG-5849:

$$MDA = [2.71 + 4.65(R_b * t)^{1/2}] / (t * E * A/100)$$

where

MDA = dpm/100 cm^2
R_b = background count rate in cpm
t = counting time (minutes)
E = efficiency (cpm/dpm)
A=area of probe (cm^2)

For example, for the direct alpha measurement, the background was 5 cpm, the counting time was 1 minute, the 4-pi efficiency was 0.22, and the area of the probe was 100 cm^2. Thus,

$$MDA = [2.71 + 4.65(5 * 1)^{1/2}] / (1 * 0.22 * 100/100) = 60 \text{ dpm}/100 \text{ cm}^2$$

The activity measured at each point was calculated from the following formula adapted from NUREG-5849:

$$Activity = (R_s - R_b) / (E * A/100)$$

where

R_s = sample count rate in cpm
R_b = background count rate in cpm
E = efficiency (cpm/dpm)
A=area of probe or wipe (cm^2)

For example, for the direct alpha measurement, the instrument count was 12 counts in one minute, the background was 5 cpm, the 4-pi efficiency was 0.22, and the area of the probe was 100 cm^2. Thus,

$$Activity = (12-5) / (0.22 * 100/100) = 32 \text{ dpm}/100 \text{ cm}^2$$

This result is less than the MDA and as such is statistically indistinguishable from background. Thus, in the data tables, the result would be reported as is, even if less than zero. The reporting of actual calculated results instead of "< MDA" allows the proper calculation of averages from the data.