(4-48)

COMPLIANCE INSPECTION REPORT

A-45

1. Name and address of licensee	2. Date of inspection
W. R. GRACE & COMPANY Davison Chemical Division Pompton Plains, New Jersey	June 29, 1961
	3. Type of inspection Follow-up
	4. 10 CFR Part(s) applicable 20 - 40

5. License number(s), issue and expiration dates, scope and conditions (including amendments)

License No.	Docket No.	Date	Exp. Date
R-196	40-86	3/27/59	3/31/60

SCOPE: Thorium-containing material from producers and distributors licensed by the AEC and through importation for processing at Pompton Plains, New Jersey and Curtis Bay, Maryland plants.

CONDITIONS: Maintenance of records of inventories, receipts and transfers of refined source material. Compliance with Part 20. Non-exceptional.

6. Inspection findings (and items of noncompliance)

This follow-up inspection was conducted to determine if the licensee had corrected all the items of noncompliance noted during the initial inspection of November 25, 1959. The inspection revealed that W. R. Grace & Company, Davison Chemical Division, Pompton Plains, New Jersey, had corrected the previous items of noncompliance and was in compliance with the Federal Regulations. No additional items of noncompliance were noted during the course of this follow-up inspection.

7. Date of last previous inspection	8. Is "Company Confidential" information contained in this report? Yes ☐ No ☒ (Specify page(s) and paragraph(s))
November 25, 1959	

DISTRIBUTION:
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Paul B. Klevin
(Inspector)

Approved by: Robert W. Kirkman, Director
New York Compliance Area
(Operations office)

August 17, 1961
(Date report prepared)

If additional space is required for any numbered item above, the continuation may be extended to the reverse of this form using foot to be format, leaving sufficient margin at top for binding, identifying each item by number and noting "Continued" on the face of form und appropriate item.

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RECOMMENDATIONS SHOULD BE SET FORTH IN A SEPARATE COVERING MEMORANDUM

PART 40 INSPECTION

W. R. GRACE & COMPANY
Davison Chemical Division
Pompton Plains, New Jersey

Date of Inspection: June 29, 1961 (Announced)

Persons Accompanying Inspector:

Mr. John Russo, New Jersey State Department of Health

Persons Contacted:

Richard Mandle, Plant Manager
Richard Stone, Sales Manager
Peter J. Garino, Health Physicist

DETAILS

9. Background Information

On November 25, 1959, an inspection of the activities conducted under License R-196 was made at the facilities of Rare Earths, Inc., Pompton Plains, New Jersey. The report was transmitted to M. M. Mann, Assistant Director, Division of Inspection, HQ. on January 26, 1960. The licensee was found to be in noncompliance with the following sections: 20.102(b)(1)(2), "Permissible levels of radiation in unrestricted areas"; 20.201(b), "Surveys"; 20.207, "Storage of licensed material"; 20.203(b), "Caution signs, labels and signals - Radiation areas"; 20.203(e)(2), "Additional requirements"; 20.305, "Treatment or disposal by incineration"; 20.301, "General Requirement"; and 20.401(c), "Records of surveys, radiation monitoring and disposal". It was found that a hazard existed, and a follow-up inspection was recommended.

On March 14, 1960, DL&R (Lyall Johnson) in a letter to D. P. Barrett, Sales Manager, Davison Chemical Company, Division of W. R. Grace & Company, 101 N. Charles Street, Baltimore 1, Maryland, informed the licensee of the above-mentioned items of noncompliance. In addition, the DL&R letter requested additional information from the licensee in order to continue their review of the licensee's renewal application.

On April 11, 1960, T. O. Tongue, Acting Production Manager, Davison Chemical Company, Division of W. R. Grace & Company, informed DL&R (Johnson) of the corrective action taken in order to comply with 10 CFR 20, and also outlined additional corrective measures which will be completed as soon as possible in order to assure complete compliance.

On June 6, 1960, DL&R (Johnson) answered the April 11 letter and also noted that in item 6 of the 4/11 letter, the licensee stated that he would make application by separate letter for approval to release source material waste to a storm sewer in accordance with Section 20.302. The letter also stated that DL&R has no record of having received such application, and that their review of the licensee's renewal application of 2/11/60 was pending receipt of further information concerning mill operations as requested in DL&R's letter of March 14, 1960.

On June 20, 1960, the licensee (T.O. Tongue) acknowledged the DL&R letter of June 6 requesting the status of application for approval to release source material to unrestricted areas and information concerning plant operations. Tongue stated that Davison people met with Rogers, Page and others to review this problem and took DL&R's suggestions that they "core drill" the plant area to appraise the significance of leaching from their tailings pile. The letter also stated that following the meeting with DL&R people, they placed orders for equipment to measure low-level activity involved, and that for the past several months, their health physicist has taken a limited number of dust samples. The samples were analyzed by Controls for Radiation, and for the most part indicated a low level of contamination.

In a memo dated January 13, 1961 from D. E. Warner, Acting Assistant Director for Materials, Division of Compliance, to Lyall Johnson, Assistant Director for Facilities and Materials Licensing, DL&R, Warner made reference to a memo from Compliance Headquarters dated November 9, 1960, requesting information as to whether enforcement action had been completed on the inspection of Davison Chemical Company, Division of W. R. Grace & Company, License R-196. The memo also noted that information that enforcement action had been completed was needed by NY before a follow-up inspection of this licensee could be scheduled.

On May 15, 1961, D. E. Warner, in a memo to Lester Rogers, Assistant Director for Nuclear Materials Safety, referred to the memo of May 5, 1960 and said that NY would continue to defer rescheduling of this licensee pending receipt of information that enforcement action had been completed or that none was contemplated.

On May 29, 1961, in a memo route slip from D. E. Warner to R. W. Kirkman, Warner informed this office that enforcement action had been completed by letter dated 6/6/60.

10. Action Taken on Items of Noncompliance

As noted prior, in a letter dated March 14, 1960, DL&R informed the licensee (Barrett, Sales Manager) of the items of noncompliance found during the course of the inspection conducted by New York on November 25, 1959. The citations, action taken by the licensee as per their letter dated 4/11/60 and current status as per inspection of June 29 are noted below:

A. Citation (DL&R's)

"Surveys to determine the concentrations of airborne radioactivity were not made as required by Section 20.201(b), 'Surveys'."

Reported Action Taken (Licensee's letter dated 4/11/60)

"Biweekly surveys to determine the concentrations of airborne radioactivity are being made throughout the facility."

Current Status

The licensee was found to conduct biweekly air samples using a Staplex air sampler. Radiation surveys are made on a monthly basis.

The licensee has conducted air samples in all the areas and has also conducted a job analysis of each operation for all the operators working in the plant. Results of the radioactive exposure to airborne thorium aerosols indicate that none of the employees is exposed to the daily rate of concentrations exceeding the levels specified in Part 20 for a 40 hour work week. A copy of a typical job analysis sheet is included as Exhibit "A".

Two air samples were taken by the inspectors at the feederhopper and ball mill areas. Samples were taken using a Hudson pump having a flow rate of approximately 30 to 35 linear feet per minute, respectively, for periods of 1/2 hour each. The collection time of the samples was 30 minutes for the air sample taken at the feederhopper and 35 minutes at the ball mill area. The samples, collected on Whatman 41 filter paper, were analyzed by HASL. Results indicated that the general air concentrations at the feederhopper were 10^{-10} uc/ml, and the ball mill area was 1.89×10^{-11} uc/ml.

Records of air sample results maintained by the licensee were reviewed. These records were noted to be recorded in uc/ml.

B. Citation (DL&R's)

"Surveys to determine the concentration of radioactivity in the plant liquid effluent were not made as required by Section 20.201(b), 'Surveys'."

Reported Action Taken (Licensee's letter of 4/11/60)

"Surveys to determine the concentration of radioactivity in the plant liquid effluent were started in December, 1959. Daily aliquots are being taken and combined into representative weekly sample for radiometric analysis. Analysis of the levels of radioactivity involved indicate only 10% of the M.P.C. for natural thorium as stated in Appendix B, Table II, Part 20, and outlined in Section 20.103."

Current Status

Daily samples are taken from the river and stream to measure effluent concentrations to the river. Daily samples are counted on a gas flow proportional counter which has been purchased by the licensee. The licensee is using a limit of thorium concentration of 10^{-7} uc/ml. A review of the records maintained by the licensee showed that the effluent concentration to the river was recorded in some decimal fraction times 10^{-7} uc/ml. The maximum amount discharged to the river was 0.2×10^{-7} uc/ml.

Two water samples were taken by the inspectors. The first was taken at the weir in the pump house, and the second was taken approximately 500' from the plant at Sheffield Brook. The samples, analyzed by HASL, were found to be 10^{-9} and 2.91×10^{-8} uc/ml, respectively.

In a letter dated July 6, 1961, received after the inspection, the licensee requested permission to continue the operations of the present system of controls and records until they could tie into a sanitary sewer system. They noted in their letter that since 1948, they were tied up to a sewer system by Sheffield Farms. This letter is included as Exhibit "B".

C. Citation

"Surveys to determine the external radiation levels in and around the plant were not complete as required by Section 20.201(b), 'Surveys'. Although surveys had been made, they did not include all areas where source material is stored and used."

Reported Action Taken

"Surveys to determine the external radiation levels in and around the plant have been set up on a monthly basis and now include all areas where source material is stored and used."

Current Status

Monthly radiation surveys have been made by the licensee of all areas of storage and use, and records are maintained. The records indicated that in unrestricted areas, the maximum direct radiation measurement around the newly installed chain-link fence surrounding the plant confines was 0.25 mr/hr, with an average radiation level of .15 mr/hr. In the restricted areas, thorium vault, a maximum of 10 mr/hr was recorded, with an average of 3 to 4 mr/hr.

The following independent measurements were made by the inspectors using a Juno and a GM-2 survey meter, calibrated June 5, 1961:

(1) Ball mill area - general radiation level, 2 mr/hr;
at contact with the drum containing ytrrium sludge, 7.5 mr/hr;
at one foot from the drum, 4 mr/hr;
at contact with the drum containing ground monazite, 10 mr/hr;
at one foot from this drum, 5 mr/hr

(2) Monazite storage area - general radiation level, 5 mr/hr at 3' from the floor;
at one foot from a bag containing monazite, 12 mr/hr

(3) Locker room area - .04 mr/hr at 3' above floor;
at contact with the floor, 7000 alpha dpm/100 cm^2

(4) Thorium vault - 10 mr/hr maximum; 3 - 4 mr/hr average

D. Citation

"Records of external radiation survey results were not maintained in the units required by Section 20.401(c), 'Records of surveys, radiation monitoring, and disposal'."

Reported Action Taken

"Records of external radiation surveys are now maintained in the units required by Section 20.401(c)."

Current Status

The records of monthly radiation surveys maintained by the licensee were reviewed. The records were recorded in the units required by 10 CFR 20.

E. Citation

"Source material waste was disposed by incineration without prior approval by the Commission. This is in violation of Section 20.305, 'Treatment or disposal by incineration'."

Reported Action Taken

"No source material waste will be disposed of by incineration without prior approval by the Commission."

Current Status

Garino, Mandle and Stone stated that no material has been disposed of by incineration since the last inspection. At present, Stone stated that they are presently storing empty monazite bags, and that this pile is growing daily. He stated that he intends to write to the Commission for approval to incinerate these bags, but that he would not incinerate unless he had prior approval. In a letter received by this office dated July 3, 1961 from Peter J. Garino, Health Physicist, to DL&R (Lyall Johnson), the licensee requested approval to incinerate. This letter is included as Exhibit "C".

F. Citation

"Source material waste was disposed by release to a storm sewer. This is in violation of Section 20.301, 'Waste disposal'."

Reported Action Taken

"Permission will be requested by separate letter for approval to release source material waste to a storm sewer in accordance with Section 20.302."

Current Status

As a precautionary measure to prevent any material run-off to enter the storm sewers, an additional culvert was built around the entire facility. As noted prior in the report, the records of effluent release show no release to their sewer system in excess of the limits specified in Part 20.

G. Citation

"Areas in which source material was stored and used were not posted as required by Section 20.203(e)(2), 'Caution signs, labels and signals'."

Reported Action Taken

"Areas in which source material are stored and used have been properly posted since the inspection on November 23, 1959, in accordance with Section 20.203(e)(2)'."

Current Status

An inspection of the facilities show that areas in which source material has been stored and used have been properly posted with a radiation caution sign and symbol. In addition, it was found that a form AEC-3 was posted at the entrance to the restricted areas.

H. Citation

"Areas in which source material was stored and used were not posted as required by Section 20.203(b), 'Caution signs, labels and signals'."

Reported Action Taken

"Areas in which source material are stored and used have been properly posted since the inspection on November 23, 1959, in accordance with Section 20.203(b)."

Current Status

An inspection of the ball mill area, thorium storage area, vault, and piles of sludge at which radiation levels in excess of 5 mr/hr at one foot existed revealed the areas to be posted with a proper radiation area sign and symbol.

I. Citation

"Radiation levels in and around the storage and dump areas were such that an individual could receive an exposure in excess of 2 mrem in any one hour or an exposure in excess of 100 mrem in any seven consecutive days. This is in violation of Section 20.102(b)(1)(2), 'Permissible levels of radiation in unrestricted areas'."

Reported Action Taken

"A restricted area will be established by erection of a fence which will include the facility and all storage and dump areas, and access to the restricted area will be controlled. Estimates for the fence have been requested from several contractors and are currently being reviewed."

Current Status

Stone stated that a fence was erected at a cost of $6000. The fence is locked when not attended. He further added that when personnel are at the plant site, the two fence gates are closed, but not locked. An inspection of the restricted areas showed that an approximately 8' high fence has been erected around the plant confines and grounds. The entire area within the fence area is designated by Mandle and Stone as the plant's restricted area.

J. Citation

"Source material in the storage area was not secured against unauthorized removal as required by Section 20.207, 'Storage of licensed material'."

Reported Action Taken

"The restricted area mentioned in paragraph 9 above"(paragraph I above)"will include storage areas for licensed source material to prevent unauthorized removal from the plant of storage."

Current Status

See paragraph I above.

Docket No. 040-0086

26 JAN 1981

A-122

W.R. Grace and Company
Davidson Chemical Division
ATTN: Mr. C.B. Kraft
Vice President of Administration
P.O. Box 2117
Baltimore, Maryland 21203

Gentlemen:

This refers to a telephone inquiry by Ms. M. Campbell of this office with Mr. A. Wille of your staff on January 20, 1981.

This inquiry was to request your cooperation regarding a request for information from Councilman David Waks of Wayne, New Jersey, concerning your facility in Wayne Township, New Jersey.

Our files of the records of the thorium processing which occurred under AEC license STA-422 do not include a record of a complete survey of the grounds of your facility. We would like to conduct a radiation survey of these grounds during the week of January 26, 1981. We would also appreciate a copy of the most recent radiation survey of this facility performed by Mr. A. Wille of your staff.

In accordance with Section 2.790 of the NRC's "Rules of Practice," Part 2, Title 10, Code of Federal Regulations, a copy of this letter will be placed in the Public Document Room.

Should you have any questions concerning this inquiry, please contact Ms.Campbell of my staff at (215)337-5342.

Sincerely,

John D. Kinneman, Chief
Materials Radiological Protection
Section

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A-123

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LABORATORY
OF THE UNITED STATES
DEPARTMENT OF ENERGY

EG&G SURVEY REPORT
NRC—8113
NOVEMBER 1981

AN AERIAL RADIOLOGICAL SURVEY OF THE

W. R. GRACE PROPERTY

WAYNE TOWNSHIP, NEW JERSEY

DATE OF SURVEY: MAY 1981

8201250285
PDR

EG&G
ENERGY MEASUREMENTS GROUP

EG&G Survey Report
NRC-8113
November 1981

AN AERIAL RADIOLOGICAL SURVEY OF THE

W. R. GRACE PROPERTY

WAYNE TOWNSHIP, NEW JERSEY

DATE OF SURVEY: MAY 1981

T. S. Dahlstrom
Project Scientist

REVIEWED BY

T. P. Stuart, Manager
Nuclear Radiation Department

This Document is UNCLASSIFIED

G. P. Stobie
Classification Officer

This work was performed by EG&G for the Environmental Protection Agency and The United States Nuclear Regulatory Commission through an EAO transfer of funds to Contract Number DE-AC08-76NV01183 with the United States Department of Energy.

ABSTRACT

During the week of 24 May 1981, an aerial radiological survey was performed over the W. R. Grace property in Wayne Township, New Jersey. The facility is occupied by a firm known as Electronucleonics, Inc. An isoradiation map was generated from the aerial data which shows increased levels of ^{208}Tl, a thorium daughter, over the burial grounds and in an area to the west believed to have resulted from subsurface water erosion of material from the burial grounds.

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9 A Survey Method, Data Analysis Equipment, Data Processing Methods and Results

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1.0 SUMMARY

An aerial radiological survey was made during the week of 24 May 1981, of the W.R. Grace property located in Wayne Township, New Jersey. The site is occupied by Electro-nucleonics, Inc. and was formerly used to extract rare earths and thorium from monzanite sands. The property contains a 1.67 acre burial site, where building debris, sludges, and ore tailing had been buried. Average radiation levels of greater than 120 μR/h at one meter over the burial ground were inferred from the aerial data. Ground surveys over the same area indicated radiation levels of some local hot spots of 800 to 1000μR/h. These levels were all due to the thorium daughter, ^{208}Tl.

The aerial survey data also suggests there had been some subsurface contamination to the west along a stream running adjacent to the property. The maximum levels in this area were inferred to be 60 to 120 μR/h at the one meter level. The average background levels were 8 to 12 μR/h including 3.7 μR/h cosmic radiation contribution.

2.0 INTRODUCTION

The United States Department of Energy (DOE) maintains an aerial surveillance operation called the Aerial Measuring System (AMS). AMS is operated for DOE by EG&G. This continuing nationwide program, started in 1958, involves surveys to monitor radiation levels in and around facilities producing, utilizing, or storing radioactive materials. The purpose of the surveys, in general, is to document, at a given point in time, the location of all areas containing gamma-emitting radionuclides (visible at the surface) and to aid in evaluating the magnitude and spatial extent of any radioactive contaminants released into the environment. At the request of federal and state agencies, AMS is deployed for various aerial survey operations.

Aerial radiological detection systems average the radiation levels due to gamma-emitting radionuclides existing over an area of several acres. The systems are capable of detecting anomalous gamma count rates and determining the specific radionuclides causing the anomalies; however, because of averaging, they tend to underestimate the magnitude of localized sources as compared with ground-based readings. As such, the indicated radiation levels in the vicinity of anomalies are not definitive. Ground surveys are required for accurate definition of the extent and intensity of such anomalies.

The results of the survey are reported as radiation exposure rates in microroentgens per hour (μR/h) at 1 meter above the ground surface. Approximate annual absorbed radiation dose levels expressed as millirem per year (mrem/y) are obtained by multiplying μR/h by 8.76. This conversion number applies only to the external radiation dose component.

This report is the result of a survey requested by the Environmental Protection Agency for an area centered on the former W. R. Grace Property in Wayne Township, N.J. The preparation of the report was requested by the Nuclear Regulatory Commission.

3.0 BACKGROUND

Natural background radiation originates from radioactive elements present in the earth and cosmic rays entering the earth's atmosphere from space. The terrestrial gamma rays originate primarily from the uranium decay chain, the thorium decay chain, and radioactive potassium. Local concentrations of these nuclides produce radiation levels at the surface of the earth in the range of 1 to 15 μR/h (9 to 130 mrem/y). Some areas with high uranium and thorium concentrations in surface minerals exhibit even higher radiation levels, especially in the western states. For example, in the Colorado Plateau area the average radiation level is above 200 mrem/y. At some locations in Brazil and India, the natural radiation level is above 1000 mrem/y. One member of each of the uranium and thorium decay chains is an isotope of the noble gas, radon, which can diffuse through soil and be borne by air to other locations. Thus, the level of this airborne radiation depends on the meteorological conditions, the mineral content of the soil, the soil permeability, and other conditions existing at each location at any particular time. The airborne radiation contributes from 1 to 10% of the natural background radiation levels.

Cosmic rays (the space component) interact in a complicated manner with the elements of the earth's atmosphere and the soil. These interactions produce an additional natural source of gamma radiation. Radiation levels due to cosmic rays vary with altitude and geomagnetic

latitude: they range from 3.7 to 23 μR/h (up to 200 mrem/y).[1] The cosmic ray contribution in Wayne Township is estimated to 3.7μR/h.

4.0 DISCUSSION AND RESULTS

The results of the aerial survey are shown in Figure 1 as exposure rate isoradiation contours. These contours are derived from gross gamma count rates at survey altitude. The contours are overlaid on a combination of an aerial photograph and a USGS map (a single photograph of the entire survey area was unavailable). Data analysis details are given in Appendix A.

As shown in Figure 1, the natural background radiation levels generally ranged from 8 to 12 μR/h. Lower radiation levels are evident over large bodies of water where cosmic radiation dominates the background levels.

Radiation levels higher than background were found over the burial ground and over an area west of the property. These contours are shown in blue in Figure 1.

The highest radiation levels inferred from the gross gamma count rates from the aerial survey data were above 120 μR/h. However, these numbers represent levels averaged over the total field-of-view of the detector system and do not reflect small localized hot spots. Measurements taken on the ground with hand-held survey meters gave exposure rates from 800 to 1000μR/h in one area (about two feet in diameter) on the western boundary of the burial ground.

The spread of contamination to the west of the plant is most likely due to subsurface erosion along the outer boundaries of a stream which runs along the eastern and southern boundaries of the property and then flows west on the opposite side of Black Oak Ridge road. The highest levels in this region (inferred from the aerial survey data) were 60 to 120 μR/h.

The blue E level contour surrounding the burial ground and the area to the west does not accurately define the boundaries of the higher radiation levels at ground level. Because the burial ground and stream exhibit relatively high level activity and are concentrated in small areas, the detectors "see" the radiation from these areas, both before the helicopter reaches them and after it has passed them.

There are additional E level contours to the west and south of the contaminated areas. However, these are most likely due to natural radiation anomalies and are not associated with the burial grounds.

A gamma ray energy spectrum was extracted from the aerial data taken over the burial ground (see appendix A). The photopeaks of the ^{208}Tl and other isotopes in the thorium decay chain dominated the spectrum.

The survey data were also processed by another method to identify those areas that contained ^{208}Tl in excess of its natural abundance. The results showed only the area contained within the blue contours. The existence of ^{208}Tl identifies the presence of thorium, which was expected to be present in the residue of monzanite sands used in the production of rare earths and thorium compounds at this facility.

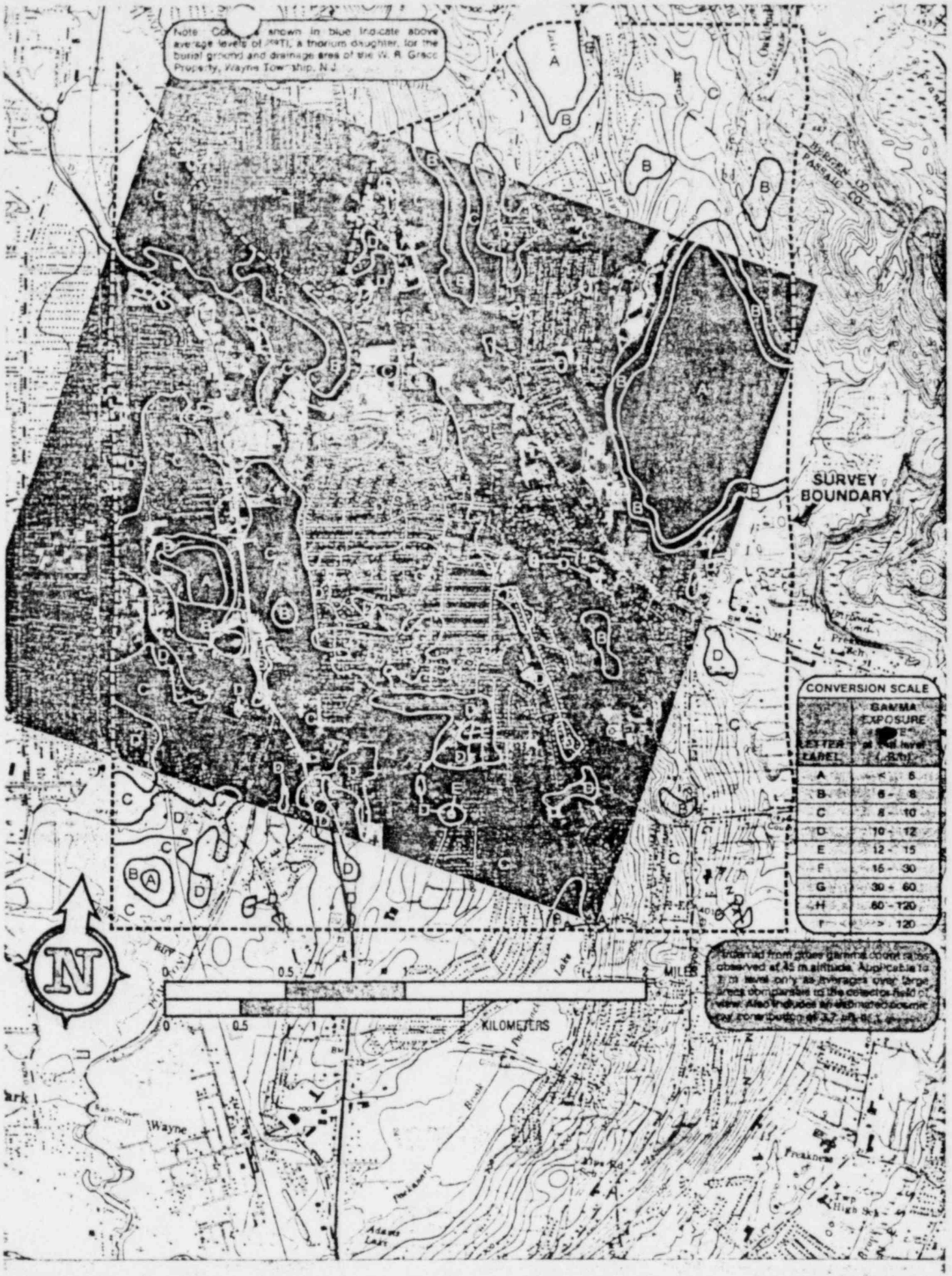

Figure 1. *EXPOSURE RATE ISORADIATION CONTOURS*

PENDIX A.
OD, DATA ANALYSIS
DATA PROCESSING
S AND RESULTS

here were generated from
n with an airborne system
24 May 1981. Gamma rays
2.7-cm diameter by 5.1-cm
ls arranged in two arrays of
cover the area of interest the
a BO-105 helicopter at 45 m
es of parallel lines. Position
microwave ranging system
agnetic tape along with the
lations between the two and
ific types of nuclides were
uter data processing system.
e equipment and operating
ound in References 2 and 3.

es

nergy spectrum measured
vers the range between 0.05
ts (MeV) and 3 MeV: This
l for identifying specific
g to the total activity. The
Figure 1 were singled out for
n. The nuclides responsible
activity were sought by
ound spectral data with
ulated while the aircraft was
area. The background was
ered at positions just before
omaly (Figure 1). A typical
m is shown in Figure A-1.
nts channel-by-channel
anomalous and background
ant peaks are due to ^{208}Tl, a

te isopleths (Figure 1) are
all counts in that portion of
rgy spectrum between 0.05
he terrestrial component of
d the sum of exposure rates
ic ray activity were produced

body of water at the survey
sure the sum of count rates
background, cosmic rays,
don daughter radionuclides.

2. Measurement of count rate over the survey area.

3. Subtraction of Item 1 from Item 2.

4. A predetermined factor obtained over a calibration range near Lake Mead was then applied to convert Item 3 above to exposure rate.

Dependent on (a) the proximity of the survey area to the body of water overflown in Step 2, (b) the differences in topography and meteorological conditions between the areas, and (c) the differences in time between execution of the two flights, the counts resulting from Step 3 and the isopleths shown in Figure 1 may be either rich or poor in airborne radon daughter content. Daily variations in airborne radon daughter concentrations can lead to discontinuities in isopleths across boundaries between areas flown on different days. When necessary, corrections were made for this effect. The correction, based on data from a single cross-track flight, adjusted counting rates to a constant component due to the airborne radon daughter levels. Although not precisely known, this airborne radon daughter component is estimated to contribute an uncertainty of no more than 10% to the exposure rate.

The calibration described in Step 4 was done over an area containing a typical mix of naturally occurring radionuclides. The conversion factor will be in error where the mix is atypical, where man-made nuclides exist, or when airborne radon daughter contributions are not completely subtracted. The conversion factor used was 987 counts per second per μR/h one meter above the ground.

It should be stressed that inherent spatial resolution in any remote sensing survey that uses uncollimated detectors (such as the airborne system) is one to two times the distance between the surveyed surface and the detector. Therefore, ground surveys using detectors at the one meter level will not compare well with an aerial survey over areas that contain sources whose lateral dimensions are small relative to the aircraft altitude. Isopleths constructed from a ground survey over a point source will indicate a source width of one to two meters, whereas aerial survey isopleths over the same source will indictate a source width of at least several tens of meters.

APPENDIX A
SURVEY METHODS, EQUIPMENT, AND METHODS

The data reported measurements take during the week of were detected in 1 thick NaI (Tl) crysta ten crystals each. To system was flown in altitude along a seri information from a was recorded on m radiation data. Corre extractions of spec effected with a comp A description of th procedures can be f

Gross Counting Rat

The gamma ray e during this survey co million electron vo spectrum is usefu nuclides contributir most active areas in spectral examinatio for the increased comparing backgr spectral data accum over the anomalous taken from data gath or just after the an background spectru Figure A-2 pres differences between data. The predomin daughter of thorium

The gross count ra based on the sum o the gamma ray ene MeV and 3 MeV. T gross count rate an due to soil and cosm as follows:

1. Overflight of a aititude to mea due to aircraf and airborne ra

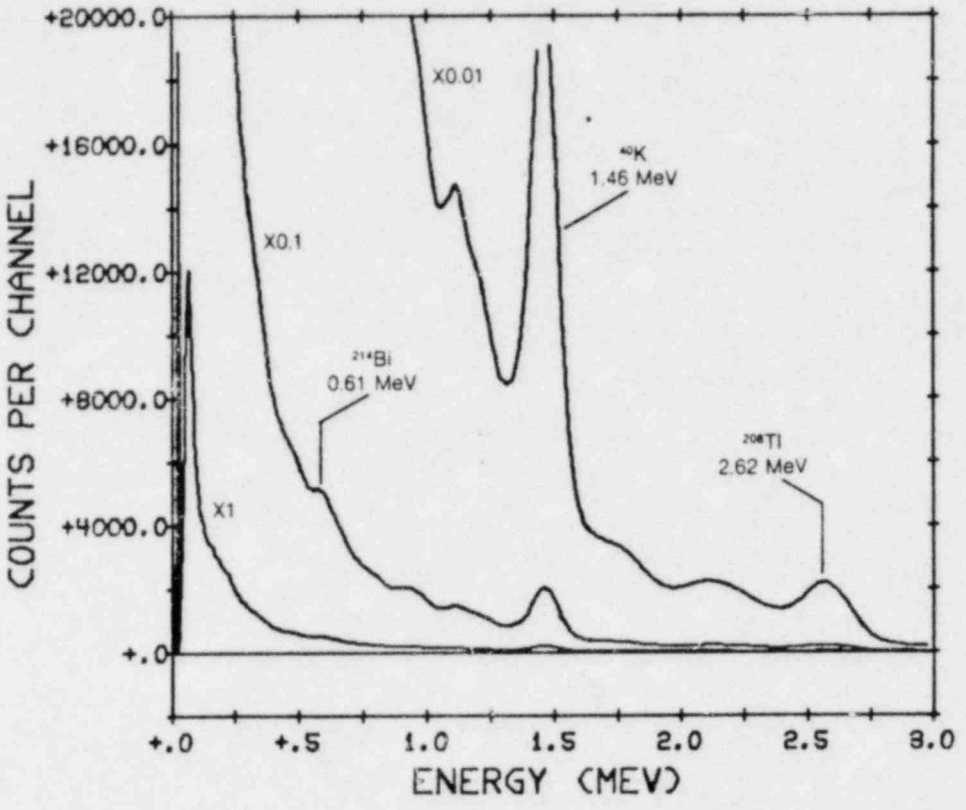

Figure A-1. *GAMMA PULSE-HEIGHT SPECTRUM OF TYPICAL BACKGROUND AREA*

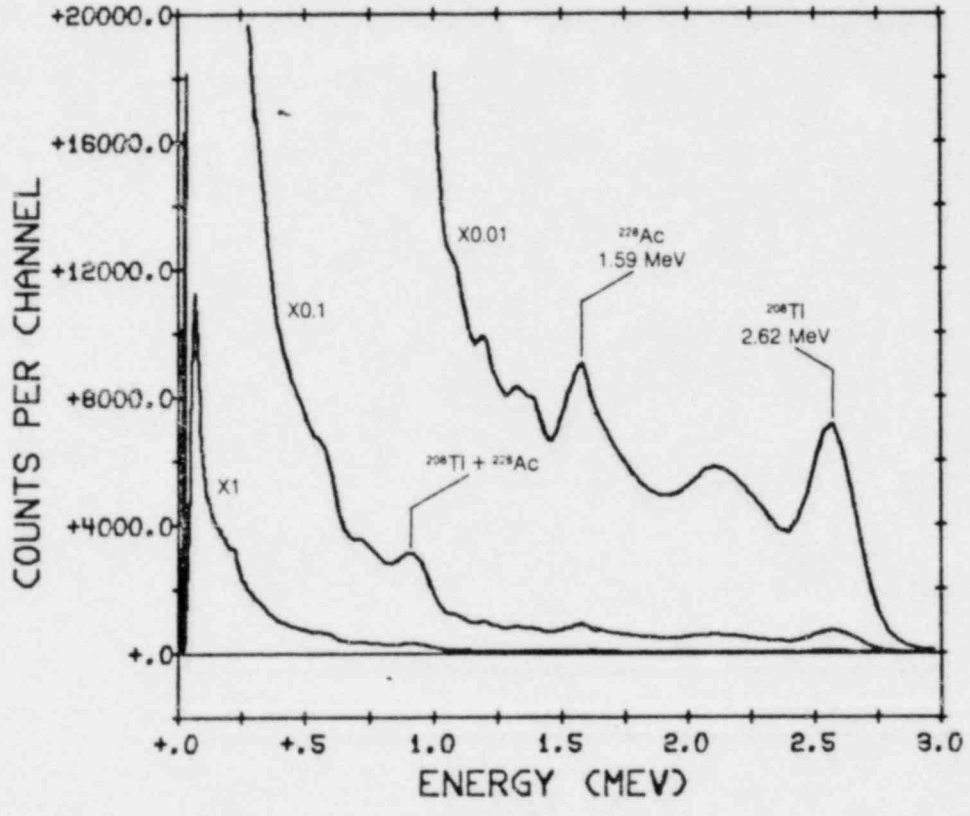

Figure A-2. *NET SPECTRUM OF ELEVATED ACTIVITY OVER THE BURIAL GROUND*

REFERENCES

1. Klement, A. W.; Miller, C. R.; Min, R. P.; Shleren, B. August 1972. *Estimate of Ionizing Radiation Doses in the United States 1960-2000.* U.S. EPA Report ORP/CD72-1. Washington, D.C.: Environmental Protection Agency.

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3. Jobst, J. E. 1979. "The Aerial Radiological Measuring Systems Program." *Nuclear Safety 20: 136-47.*

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NRC

L. K. Cohen (20)

DOE/ONS

L. J. Deal (1)

DOE/NV

J. K. Magruder (1)

EG&G

Z. G. Burson, LVAO (1)
T. S. Dahlstrom, LVAO (1)
J. F. Doyle, LVAO (1)
H. A. Lamonds, SBO (1)
R. E. Lounsbury, WAMD (4)
L. G. Sasso, LVAO (1)
T. P. Stuart, LVAO (1)
W. J. Tipton, LVAO (1)

LIBRARIES

AMO (8)
Las Vegas (1)
Santa Barbara (1)

W. R. GRACE PROPERTY
WAYNE TOWNSHIP, NEW JERSEY
NRC-8113
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