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 **EG&G**  
ENERGY MEASUREMENTS GROUP

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THE  
**REMOTE  
SENSING  
LABORATORY**  
OF THE UNITED STATES  
DEPARTMENT OF ENERGY

OR.01

AN AERIAL RADIOLOGICAL SURVEY OF THE AREA SURROUNDING THE

# **BUREAU OF MINES SITE**

ALBANY, OREGON

DATE OF SURVEY: FEBRUARY 1980

AN AERIAL RADIOLOGICAL SURVEY OF THE  
BUREAU OF MINES SITE  
ALBANY, OREGON

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1.0 SUMMARY OF RESULTS

An aerial radiological measuring system was used to survey areas surrounding the Bureau of Mines Site near Albany, Oregon in February 1980. The survey was conducted for the U.S. Department of Energy's Office of Operational Safety by the Department's Remote Sensing Laboratory of Las Vegas, Nevada.

Natural background exposure measured by the aerial system and normalized to 3 feet above the ground generally ranged from 5 to 8  $\mu\text{R}/\text{h}$  throughout the survey area. No activity other than natural radiation levels was observed. Detailed analysis of the data, designed to sense the presence of man-made contaminants, or enhanced uranium and thorium, revealed no concentrations above naturally occurring levels.

2.0 INTRODUCTION

An aerial radiological survey was conducted over a 7 square mile area surrounding the Bureau of Mines Site on the outskirts of Albany, Oregon. The data were obtained between 14 and 21 February 1980 for the U.S. Department of Energy's Office of Operational Safety (OOS) by EG&G of Las Vegas, Nevada using an H-500 helicopter.

The OOS conducts radiological surveys at sites and facilities where nuclear operations were formerly conducted for the Government. The purpose of this aerial survey was to provide information to help guide the planning of any future ground-based surveys in the same vicinity. The survey was flown at an altitude of 300 feet with 300 foot line spacings.

Aerial radiological detection systems average the radiation levels produced by gamma-emitting radionuclides existing over an area of several acres. These detection systems are capable of determining specific radionuclides causing radiological anomalies. However, because of averaging, airborne systems tend to underestimate the magnitude of localized sources as compared to ground-based measurements. The detailed systems and procedures employed in obtaining and processing aerial radiation data are presented in References 1 and 2.

In aerial radiological surveys, the energy of gamma rays, their source concentration, and relative distribution are measured by specialized instrumentation. The results are reported as radiation exposure rates in microroentgens per hour ( $\mu\text{R}/\text{h}$ ) at 3 feet above the ground. The maximum annual radiation dose that could be absorbed through continuous exposure (24 hours a day for 365 days to a constant source of radiation), is expressed in millirem per year (mrem/y), and is obtained by multiplying the exposure rate in  $\mu\text{R}/\text{h}$  by 8.76. These results apply to external gamma radiation only and do not account for inhalation or ingestion of radioactive materials. The actual amount of radiation absorbed depends on the duration and circumstances of exposure.

### 3.0 BACKGROUND RADIATION

Background radiation originates from naturally occurring radioactive elements present in the earth (terrestrial radiation) 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. Variable concentrations of these nuclides produce estimated annual background radiation doses at the surface of the earth in the United States of about 15 to 140

mrem/y. These background radiation dose estimates are based on typical instead of continuous exposure conditions. Higher background radiation dose levels (up to 140 mrem/y) are found in western states, primarily in the Colorado Plateau area, and are a result of high uranium and thorium concentrations in surface minerals and increased cosmic radiation because of higher elevation.

The uranium decay chain includes radium-226 and its daughter, radon, which is a noble gas, i.e., it will not combine chemically with other elements. The radionuclide radon can both diffuse through soil and move through the air to other locations. Thus, the level of radiation contributed by this noble gas is dependent upon meteorological conditions, mineral and moisture content and permeability of the soil, and other physical conditions existing at each location at any particular time. Radium-226 and radon are always found with uranium ore and tailings. They produce radiation exposure rates greater than the normal background radiation. Radon contributes from 1 to 10% of the natural background radiation levels.

Cosmic rays, the space component of the natural radiological background, interact in a complicated manner with the elements of the earth's atmosphere and soil. These cosmic ray interactions produce additional background radiation dose rates which vary slightly with latitude and directly with altitude, increasing from 26 mrem/y at sea level in Florida to 107 mrem/y at 10,000 feet above sea level at some locations in Colorado. The cosmic ray dose rate in Denver, Colorado (one mile above sea level) is about 50 mrem/y.

The aerial survey results include the terrestrial gamma radiation measured throughout the survey area and an estimated cosmic ray exposure rate but does not include the contribution from airborne radon.

#### 4.0 SURVEY BOUNDARIES

The survey area is shown bounded by a dashed line in Figure 1. The actual survey area was 2 miles by 3.5 miles covering an area of 7 square miles. It included most of the city of Albany, Oregon with the Bureau of Mines site centered in the survey area.

#### 5.0 SURVEY RESULTS

The results of the aerial survey are presented in Figure 1 as closed contour curves of total radiation exposure rates (isoradiation contours) in units of  $\mu\text{R/h}$  at 3 feet above ground, overlaid on a map. These data also include an estimated 4  $\mu\text{R/h}$  cosmic ray contribution.

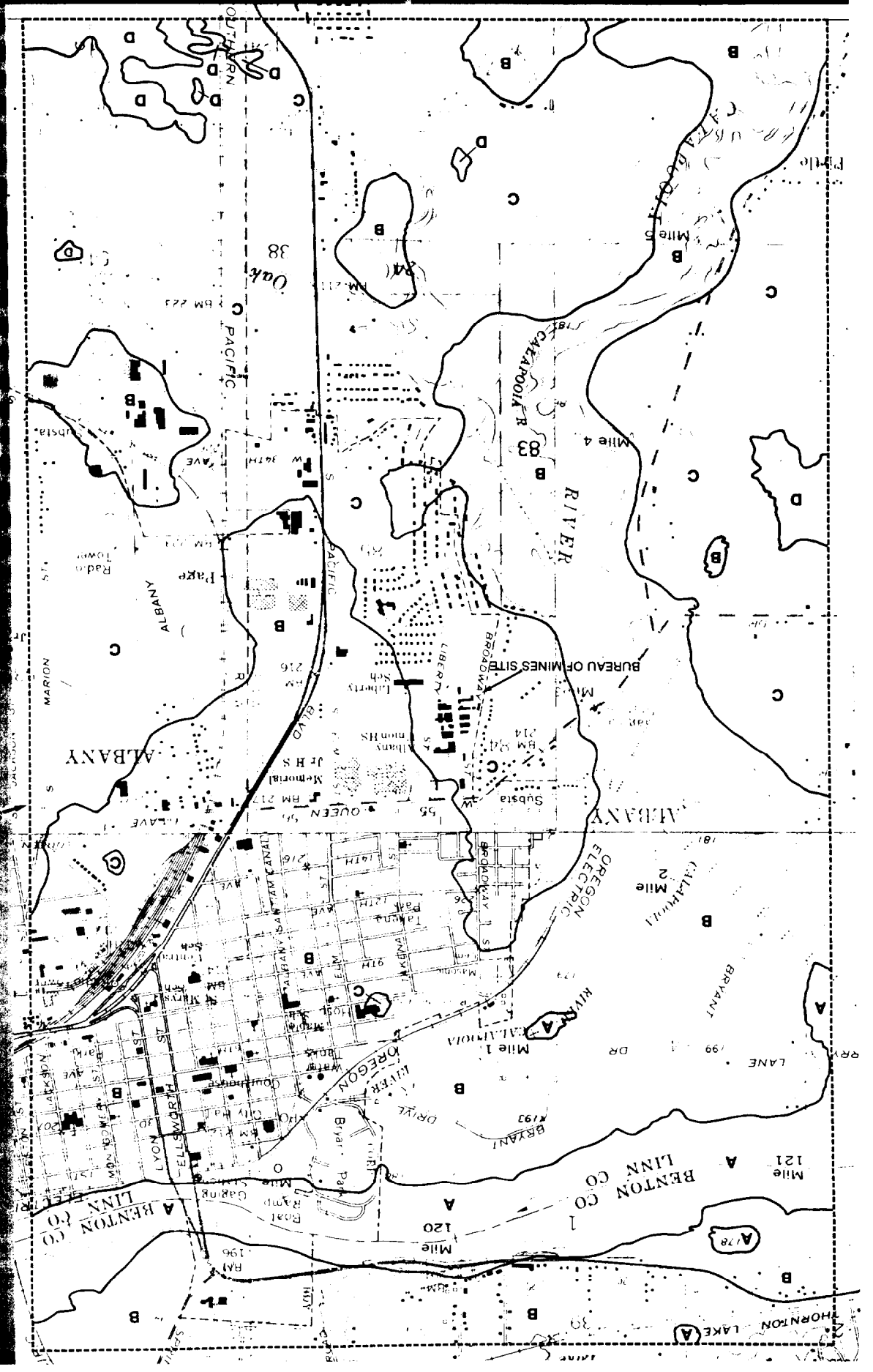
The natural background radiation levels generally ranged from 5 to 6  $\mu\text{R/h}$  in the northern half of the survey, including most of the city of Albany, and from 6 to 8  $\mu\text{R/h}$  in the southern half. Low levels ( $< 5$   $\mu\text{R/h}$ ) are shown over the river areas indicating the dominance of cosmic radiation over water. Some small areas in the southern half of the survey indicated natural background levels of 8 to 10  $\mu\text{R/h}$ . The background levels over the Bureau of Mines site were from 6 to 8  $\mu\text{R/h}$ .

Special data processing techniques were used to identify the presence of natural radioisotopes concentrated by man's activity. No man-made contaminants nor excess concentrations of thorium or uranium were found.

#### REFERENCES

1. Boyns, P.K. July 1976. The Aerial Radiological Measuring System (ARMS): Systems, Procedures, and Sensitivity (1976). Report No. EGG-1183-1691. Las Vegas, Nevada. EG&G.
2. Jobst, J.E. 1979. "The Aerial Measuring Systems Program." Nuclear Safety 20:136-47.

ALBANY, OREGON, 1:25,000, 1954  
SHEET 1 OF 2  
U.S. GEOLOGICAL SURVEY  
WATER RESOURCES DIVISION  
RADIOACTIVE ISOTOPE RATE ISORADIATION CONTOUR MAP FOR THE AREA  
AROUND THE K-25 FUEL ELEMENT FABRICATION PLANT, ALBANY, OREGON



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