

State of Idaho

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**INEL** Oversight  
Program

**DIRECTIONAL DEPENDENCY OF AIR SAMPLING**

**RESEARCH AND DEVELOPMENT GRANT #4**

*JANUARY 15, 1994*

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#### ACKNOWLEDGMENT

A field study was performed by Idaho State University-Environmental Monitoring Laboratory (EML) to examine the directional dependency of low-volume air samplers. This report was generated by the EML under contract #211-032-59 for the INEL Oversight Program.

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# Directional Dependency of Air Particulate Sampling: A Field Study

## Introduction

A typical continuous low volume air sampler contains a sample head that is mounted on the sampler housing either horizontally through one of four walls or vertically on an exterior wall "looking down or up." In 1992, a field study was undertaken to estimate sampling error and to detect the directional effect of sampler head orientation. Approximately 1/2 mile downwind from a phosphate plant (continuous source of alpha activity), four samplers were positioned in identical orientation alongside one sampler configured with the sample head "looking down". At least five consecutive weekly samples were collected. The alpha activity, beta activity, and the Be-7 activity collected on the particulate filter were analyzed to determine sampling error. Four sample heads were then oriented to the four different horizontal directions. Samples were collected for at least five weeks. Analysis of the alpha data can show the effect of sampler orientation to a known near source term. Analysis of the beta and Be-7 activity shows the effect of sampler orientation to a ubiquitous source term.

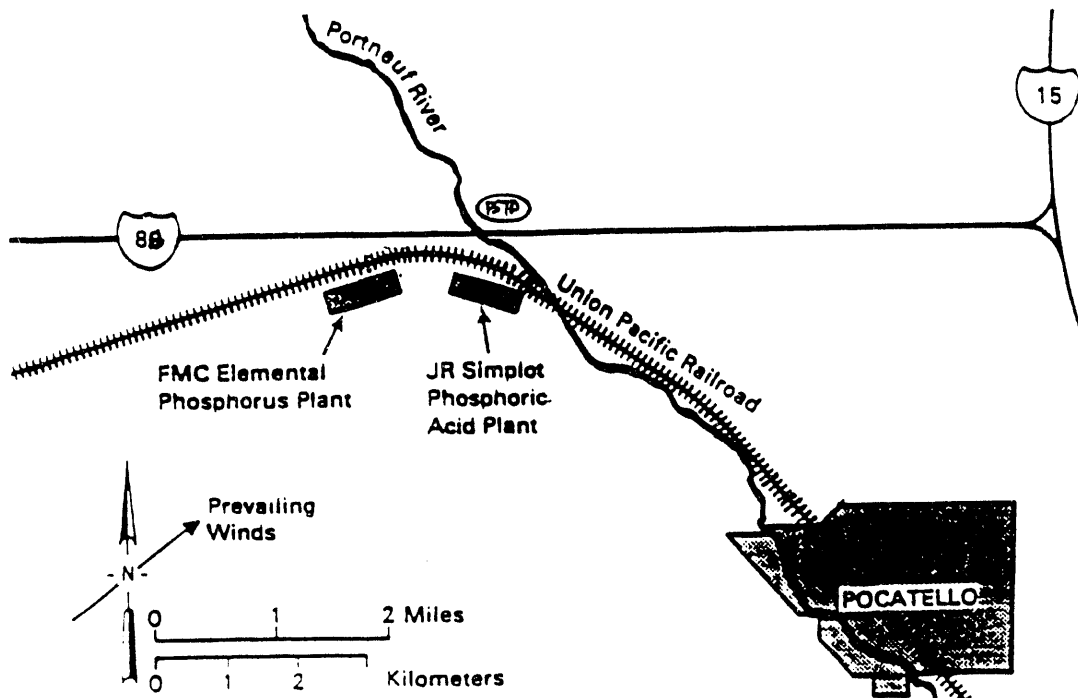
## Sampling Methods

The particulate filter holder accommodates a 47mm Gelman Versapor-1200 filter with an efficiency >99% for 0.3 micron particles. The filterholder is mounted to the end of a 12 inch long by 2 inch diameter sample tube. The sample tube is mounted horizontally on a swivel approximately 6 feet above ground level. The "down looker" is mounted rigidly at the same height with an "umbrella" shroud to protect the filter from rain and snow. The figure below is representative of the In-line portion of the study. The the individual sample heads are rotated for the directional portion.



The systems were set to sample at approximately 4 cfm and filters were collected weekly and returned to Idaho State University for analysis of alpha, beta, and Be-7 activity.

The field site is located on the grounds of the Pocatello Sewage Treatment Plant (PSTP) approximately 1/2 mile north of the J.R. Simplot phosphoric acid plant and 3/4 mile northeast of the FMC elemental phosphorus plant. The plants are located about three miles northwest of Pocatello, Idaho. The prevailing winds in the area are typically from the Southwest.



## Results

The study was designed to investigate sampler variation and directional effect of sampler orientation by collection of several low volume particulate filters. Each filter was analyzed for alpha, beta, and Be-7 activity. The experimental design is such that gross alpha concentrations are assumed to be representative of a local source of airborne radioactivity. Gross beta is assumed to be representative of a ubiquitous source of airborne radioactivity presumably of local origin and the Be-7 concentrations represent a ubiquitous source of airborne radioactivity presumably of distant origin.

For the In-line portion of the experiments, each set of data were analyzed via ANOVA. Again, the Null Hypotheses states that there is no difference among the samplers. The following is a list of P-values from the ANOVA analysis for the In-line experiment. The P-values are defined as the probability that the variations are due to randomness.

GROSS ALPHA: P = 0.003

GROSS BETA: P = 0.747

BE-7: P = 0.164

When analyzing the results from beta and Be-7 the Null Hypotheses cannot be rejected. When analyzing the results from gross alpha, the Null Hypotheses is rejected. The significance of the difference is questionable. Further analysis of the data show that Unit 1 is different than Unit 5 and Unit 2. There is no difference among Units 2, 3, 4, and 5.

For the Directional portion of the experiment, each set of data were analyzed via ANOVA. The Null Hypotheses states that there is no difference among the samplers. The following is a list of P-values from the ANOVA analysis. The P-values are defined as in the probability that the variations are due to randomness.

GROSS ALPHA: P = 0.953

GROSS BETA: P = 0.225

BE-7: P = 0.664

When analyzing the results the Null Hypotheses cannot be rejected for any of the three cases.

The data for the experiment can be visualized from the graphs in the appendix. The T-bars represent a two sigma counting error.

## CONCLUSIONS

The conclusions for the experiment are as follows:

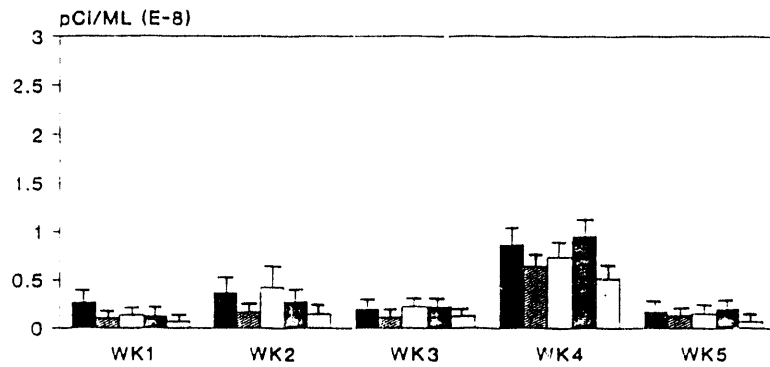
For the In-line Study: There is no practical difference among the samplers. The weekly variation is greater than the sampler variation.

For the Directional Study: There is no evidence of directional dependency. The variation among the samplers is larger than the directional variation. The weekly variation is greater than the sampler variation.

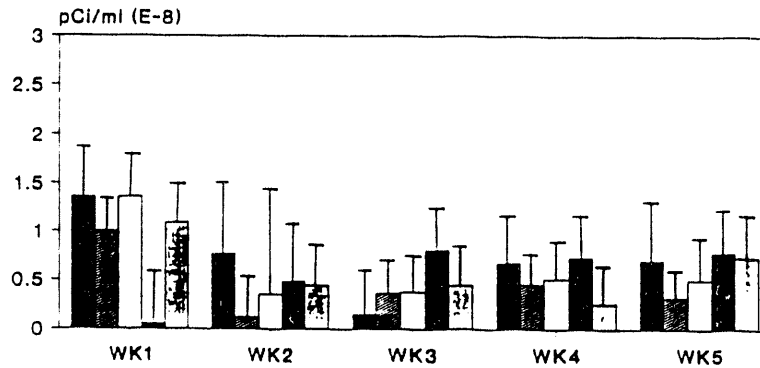
Further field studies will be done to, estimate the sampling error, effects of sampling height upon results, effects of a nearby structure upon the results, and measure the particle size for the samples collected.

# PSTP IN-LINE STUDY

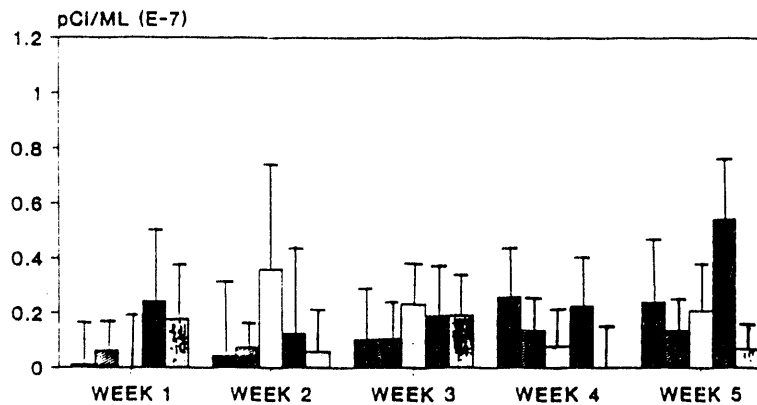
## ALPHA COMPARISONS



## BETA COMPARISONS



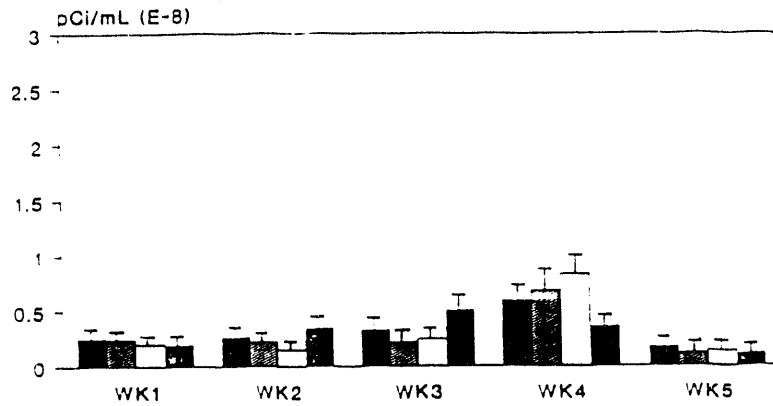
## BE-7 COMPARISONS



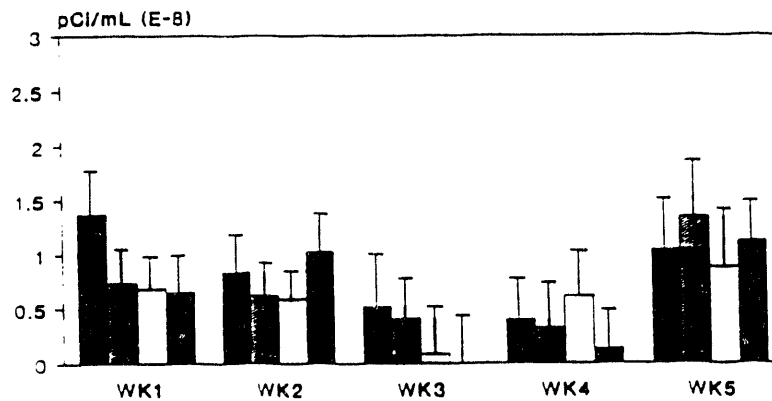
#1 IN-LINE     
  #2 IN-LINE     
  #3 IN-LINE  
 #4 IN-LINE     
  #5 DOWN

# PSTP DIRECTIONAL STUDY

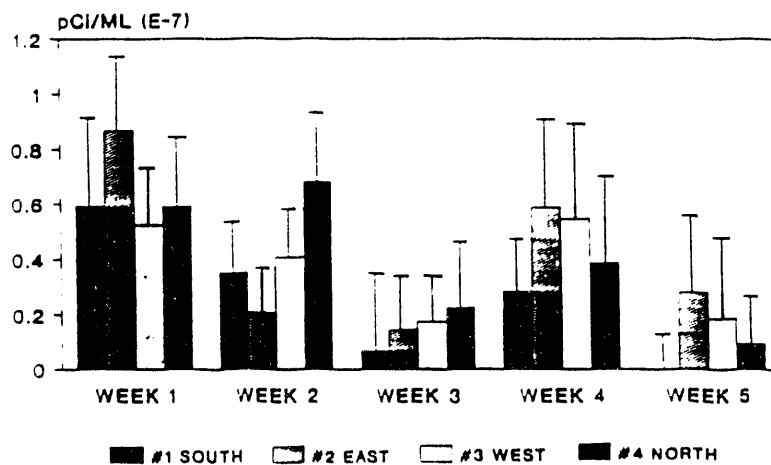
## ALPHA COMPARISONS



## BETA COMPARISONS



## BE-7 COMPARISONS





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