

50-352/35304

I-AWPP-3

SWARTHMORE COLLEGE  
SWARTHMORE, PENNSYLVANIA 19081

5/8/84

DEPARTMENT OF MATHEMATICS

April 26, 1984

(218) 447-7246

Mr. Frank Romano  
61 Forest Avenue  
Ambler, PA 19002

Dear Mr. Romano:

As I told you on the phone yesterday, I am a statistician by training and profession.

I did undergraduate work in mathematics, sociology and statistics. After receiving masters degrees in mathematics and sociology, I went on to get my Ph.D. in statistics from Harvard University in 1969.

I came to Swarthmore College as an associate professor of statistics and was promoted to professor of statistics seven years ago. Since 1972, I have been a statistical consultant at Swarthmore College's Center for Social and Policy Studies. I have been accepted as an expert witness in statistics in federal district court in Philadelphia, and I have testified for the defense in two cases, Presseisen v. Swarthmore College and Kunda v. Muhlenberg College. In addition, I have worked on several other Title VII cases. I am a member of the American Statistical Association.

Sincerely,

*Gudmund Iversen*

Gudmund R. Iversen, Ph.D.  
Professor of Statistics

GRI/g

U.S. NUCLEAR REGULATORY COMMISSION

EXHIBIT No. 3

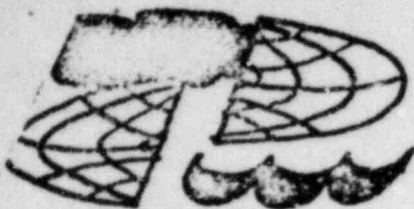
Applicant State

Identified by receipt

Date: 5-8-84

Reporter: J. BURKS

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# AIR and WATER

## Pollution Patrol

BROAD AXE, PA.

May 1, 1984

U.S. Nuclear Regulatory Commission  
Washington, D.C. 20555

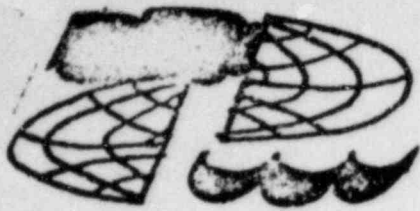
### BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In The Matter Of  
PHILADELPHIA ELECTRIC COMPANY  
(Limerick Generating Station  
Units 1 and 2)

Docket Nos. 50-352  
and 50-353

### TESTIMONY OF GUDMUND R. IVERSEN CONCERNING AUDITING AND SAMPLING AS IT RELATES TO QUALITY ASSURANCE RE WELDING AT THE LIMERICK GENERATING STATION

- Question #1      Would you state your name and position, please?
- Answer    #1      My name is Gudmund R. Iversen, Ph.D., Professor of Statistics, Swarthmore College.
- Question #2      Have you prepared a statement of your professional qualifications?
- Answer    #2      Yes. A statement of my qualifications (letter of April 26, 1984 to Mr. Frank Romano), is attached to this testimony.
- Question #3      What is the purpose of your testimony?
- Answer    #3      The purpose of my testimony is to state the requirements of statistical methods, procedures, etc., as it relates to highest probability of validity of conclusions made from sampling a population, whatever that population.
- Question #4      Will you discuss the terms generally used in statistics such as sample, sampling, random sampling, sample size, population, probability, deviation, standard deviation, confidence levels and other important terminology used in statistical analysis, procedures and results?



# AIR and WATER

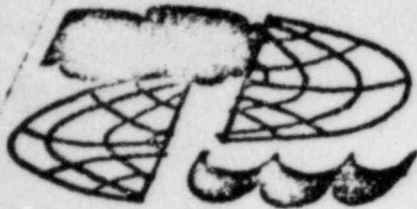
## Pollution Patrol

BROAD AXE, PA.

(2)

Testimony of Gudmund R. Iversen continued:

- Answer #4 When examining a set of objects (population), one can examine all of them or a properly selected statistical sample and use probability theory to generalize from sample to population. The main sampling methods are simple random, stratified and cluster sampling. The sample size is determined before the sample is drawn in such a way that the sampling distribution has a small enough standard deviation (standard error) to permit the chosen confidence level to produce confidence intervals that are short enough for the problem under study.
- Question #5 Will you discuss the relevance and importance of sample selection to Quality Control and Quality Assurance?
- Answer #5 In order to generalize from sample to population the sample must be chosen in accordance with proper statistical procedures, and the sample must be large enough to give the desired precision for the analysis.
- Question #6 Does the nature of an activity, for example, welding at a nuclear reactor, require a greater degree of confidence in sampling than welding in an office building?
- Answer #6 The importance of the subject matter determines the confidence level for estimating properties of the population, and nuclear reactors are often thought to be more important than office buildings.
- Question #7 As it related to P.E. audit report on page 244 of 5/12/81 can you show any weak points from a statistician's view point?
- Answer #7 Nothing is said about how the hangers were selected. If this is not a proper statistical sample, then the results apply only to the selected hangers and it is not possible to say anything about the population of hangers.
- Question #8 As it relates to P.E. audit report Page 308 of 6/2 to 6/15/82, can you show any weak points from a statistician's standpoint?



**AIR and WATER**  
**Pollution Patrol**  
BROAD AXE, PA.

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Testimony of Gudmund R. Iversen continued:

Answer #8 Same as answer 7.

Question #9 Same for Audit report No. P316 of 6/30-7/7/82.

Answer #9 The audit does not state how large the population of small pipe hangers is, how large the sample of inspected hangers is and how the sample was selected.

Question #10 Same re No. P 331 of 8/26 to 9/3/82.

Answer #10 Same as answer 7.

Question #11 Same re page 354 of 11/8/82.

Answer #11 A 10% sample rate, assuming a properly drawn sample, seems low. With that sample size, the probability of zero defective welds is larger than 0.05 as long as the percentage defective welds in the population lies between 0 and 11.

Question #12 Same re page 374 of 2/8 -3/4/83.

Answer #12 Same as answer 7.

Question #13 same re page 374 of 3/10/83.

Answer #13 Same as answer 7.



# AIR and WATER

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(4)

Testimony of Gudmund R. Iversen continued:

Question #14 Same re page 285 of 2/19/82

Answer #14 Same as answer 7.

Question #15 Same as page 289 of 3/22/82.

Answer #15 Same as answer 7.

Question #16 Same re page 307 of 6/1/82.

Answer #16 Same as answer 7.

Question #17 A group of other Quality Assurance infractions have been sent to the ASLB by Air & Water Pollution Patrol, will you, as an expert statistician comment on them from a statistical viewpoint?

Answer #17 Yes I will.