NUCLEAR POWER: ENGINEERING FACTS
AND ENVIRONMENTAL ISSUES

Final Report

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University of Michigan
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June 24, 1974 - June 28, 1974

MASTER

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NUCLEAR POWER: ENGINEERING FACTS AND ENVIRONMENTAL ISSUES

1. INTRODUCTION

The Department of Nuclear Engineering of the University of Michigan under the sponsorship of the U.S. Atomic Energy Commission this year conducted it's second workshop for high school teachers from June 24th to June 28th. The general organization of the workshop was similar to that conducted last year, but this year even more emphasis was placed on the discussion of the environmental aspects of power generation and on safety requirements for nuclear power plants.

2. PARTICIPANTS

Over thirty applications from high school teachers in southern lower Michigan were accepted. Of these accepted applicants 27 actually participated in the course. A list of the participants is attached to this report as appendix A. The main field of interest of the participants was physics (10 participants), chemistry (4), biology (11), earth science (1), and general science (1).

3. INSTRUCTORS

The following members of the Department of Nuclear Engineering contributed to the workshop through lectures and laboratory sessions: J. J. Duderstadt, C. Kikuchi, and D. H. Vincent. These staff members were also responsible for the organization and the conductance of the workshop.

In addition two other staff members each gave a one-hour lecture: W. Kerr on reactor licensing and R. D. Martin on environmental aspects of power plant operation.

Guest lecturers from outside the department and their topics were as follows:

P. A. Plato, Associate
Professor of Radiological Health
School of Public Health
University of Michigan

Environmental
Surveillance
Around Nuclear
Power Plants

Professor Plato also conducted one of the laboratory experiments on airborne radioactivity.

Marc H. Ross
Professor of Physics
University of Michigan

How Much Energy
Will We Need?

G. A. Drake, M.D.
Petosky, Michigan

A Physician's View of
Nuclear Power

D. E. Van Farowe, Chief
Division of Radiological Health
Dept. of Public Health
State of Michigan

Nuclear Power - A
Candid Environmental
Review

J. P. Lagowski, Director
Consumer Projects Department
The Detroit Edison Company
Detroit, Michigan

Greenwood Planning

4. DESCRIPTION OF THE COURSE

The instructional activity in the workshop consisted of lectures, demonstration laboratory sessions, and two excursions. A course schedule is included as appendix B to this report.

Printed material distributed to the participants included

lecture notes, laboratory handouts, one copy each of WASH 1261 and WASH 1262, all available AEC pamphlets and selected copies of the AEC booklets. Two companies, The Nucleus, Oak Ridge, Tenn. and Elscint, Inc., Palisades Park, N. J. made inexpensive radiation detection equipment available for use in the laboratory experiments.

The instructional activities may be grouped in the following manner:

1. Radioactivity and its measurement

Lecture: Characterization of Radioactive Material (D. H. Vincent)

Laboratory: $1/r^2$ - Law
Radioactive Decay
Gamma Ray Absorption
Alpha Ray Absorption
Beta Ray Absorption
(D. H. Vincent and Nuclear Engineering graduate students)

2. Nuclear Power Generation (J. J. Duderstadt)

Lectures: Nuclear Power Generation; Overview of the Industry
How Does a Nuclear Reactor Work?
A Case Study: Fermi II
Nuclear Reactor Safety
The Future of Nuclear Power Generation

3. Power Demands and Power Resources for Michigan

Lectures: Scenario: Michigan Power Plants 1990 (Kikuchi)

Greenwood Planning (Lagowski)

How Much Energy Do We Need? (Ross)

Are There Viable Alternative Energy
Sources for Michigan (Kikuchi)

Excursions: Visit to the construction site of the
Fermi II power plant near Monroe, Mich.

Visit to the Michigan Electric Power
Coordination Center, Ann Arbor, Mich.

4. Environmental Impact of Power Generation and Safety Concerns

Lectures: Effects of Overdose from Radiation and/or
Drugs (Kikuchi)

Environmental Radioactivity (Kikuchi)

Statistics: Nuclear and Human Population
Samples (Kikuchi)

Environmental Aspects of Power Plant
Operation (Martin)

Environmental Surveillance around Nuclear
Power Plants (Plato)

Recent Advances in Environmental Radiation
Monitoring (Kikuchi)

Nuclear Power - A Candid Environmental
Review (Van Farowe)

Reactor Licensing (Kerr)

A Physician's View of Nuclear Power (Drake)

Waste Products - Radioactive and Others
(Kikuchi)

Laboratory: Airborne Radioactivity (Plato)

As is obvious from the above listing, great emphasis was put on environmental problems related to power production. In order to have some representation of opposing views, Dr. Drake from Petoskey was invited to speak on the results of his survey

of the incidence of leukemia in the State of Michigan.

In general many of the subjects discussed during the workshop were treated with reference to the special conditions in Michigan.

5. EVALUATION OF THE WORKSHOP

Of the 27 participants attending the workshop 25 submitted course evaluation forms. Copies of these forms were sent to Dr. Harold H. Young of the Division of Biomedical and Environmental Research, USAEC, Washington, D. C. with a preliminary report on this workshop on July 31, 1974.

The new evaluation forms are definitely more useful than the ones used last year in that they challenge the participants to a more critical review of the course. It was found that on the average much more detailed comments were made this year as compared to 1973. We also observed a higher rate of return on the new forms. The results of a detailed analysis of the evaluation forms are summarized in App. D to this report.

APPENDIX A

List of Participants

High School Science Teacher Workshop on Nuclear Power

Department of Nuclear Engineering, The University of Michigan, Ann Arbor, Michigan

June 24, 1974 - June 28, 1974

<u>Name of Participant</u>	<u>High School</u>	<u>Areas of Interest</u>
David Callaghan	St. Thomas High School Ann Arbor	Physics, Chemistry, Physical Science, Algebra
Merlyn L. Dasse	Pioneer High School Ann Arbor	Chemistry
Janice M. Dow	Howell Senior High School Howell	Biology, Natural Resources
F. J. Gezich	Parkside High School Jackson	Chemistry, Natural Science
June Hamilton	Fitzgerald Public Schools Warren	Biology, Earth Science
Sr. Rita Hoban	St. Mary Academy Monroe	Earth Science, Physical Science
Harold M. Jones	Loy Norrex High School Kalamazoo	Physics, Astronomy
Mark Kennedy	Mt. Clemens High School Mt. Clemens	Physics, Astronomy
Rudolph A. Martinak	Fordson High School Dearborn	
Richard N. Miller	Southfield High School Southfield	Physical Science, SEEK

High School Science Teacher Workshop on Nuclear Power

List of Participants (continued)

<u>Name</u>	<u>High School</u>	<u>Areas of Interest</u>
Kenneth R. Morris	Brother Rice High School	Physics, College Electronics
Sr. Marie Ouellette	St. Mary Academy Monroe	Physics, Geometry, Mathematics
Sr. Mary Philip Ozdych	St. Mary's Prep. School Orchard Lake	Physics, Chemistry
John M. Preston	Belleville High School Belleville	Physics
M. Timm Pschigoda	St. Joseph High School St. Joseph	Biology, Physical Science
Sr. Albertine Simmerer		Biology
Irene M. Skulas	Bedford Public Schools Temperance	Biology, Chemistry
Victor F. Skuratowicz	Churchhill High School Livonia	Chemistry
Jay C. Starkey	Saline High School Saline	Biology, Earth Science
Norris L. Sutton	Loy Norris High School Kalamazoo	Chemistry
Frederick H. Taggart	Austin Catholic Prep. School Detroit	Physics, Physical Science

High School Science Teacher Workshop on Nuclear Power

List of Participants (Continued)

<u>Name</u>	<u>High School</u>	<u>Areas of Interest</u>
Marshal Wied	Belleville High School Belleville	Ecology, Biology
William M. Wilson	Wayne Memorial High School Wayne	Biology
Harold P. Winters	Jackson High School Jackson	Human Physics, Chemistry
Brandt F. Young	Edmonson Jr. High School Ypsilanti	General Science
Louise Young	Clawson High School Clawson	Biology

APPENDIX B

NUCLEAR POWER:

ENGINEERING FACTS AND ENVIRONMENTAL ISSUES

A workshop for high school science teachers,

Conducted by the Department of Nuclear Engineering, The University of Michigan,

Sponsored by the United States Atomic Energy Commission,

Ann Arbor, Michigan, June 24 to June 28, 1974.

Course Schedule

Most of the lectures will be given by three faculty members of the Department of Nuclear Engineering at The University of Michigan:

Professor James J. Duderstadt

Professor Chihiro Kikuchi

Professor Dietrich H. Vincent.

The affiliation of our guest lecturers is listed at the appropriate place in the time schedule.

Monday, June 24

8:30-9:00am	Registration
Room 133, Chrysler Center, North Campus
9:00-9:30	Welcome
(John S. King, Chairman Designate
Department of Nuclear Engineering)
Organizational Remarks
(D. H. Vincent)
9:30-10:15	Nuclear Power Generation: Overview of the Industry;
What Does It Take To Build A Plant; Summary of Licensing
Procedure; Components Of A Nuclear Power Plant
(J. J. Duderstadt)
10:30-11:15	Characterization Of Radioactive Material
(D. H. Vincent)
11:30-12:15pm	Environmental Aspects of Power Plant Operation
(R. D. Martin, Reactor Manager, Michigan Memorial-
Phoenix Project, and Lecturer, Department of
Nuclear Engineering, The University of Michigan)
2:00-5:00
at 2250
G. G. Brown	First Laboratory Session: $1/r^2$ - Law, Radioactive
Decay, Gamma Ray Absorption
(D. H. Vincent with L. Emmons and D. Kopinski)

Tuesday, June 25

- 8:30-9:15am Scenario: Michigan Power Plants 1990
(C. Kikuchi)
- 9:30-10:15 How Does A Nuclear Reactor Work? Chain Reactions and Control; Heat Removal; Reactor Types
(J. J. Duderstadt)
- 10:30-11:15 Effects of Overdose From Radiation And/Or Drugs
(C. Kikuchi)
- 11:30-12:15pm Environmental Surveillance Around Nuclear Power Plants
(P. A. Plato, Associate Professor of Radiological Health and of Environmental and Industrial Health, School of Public Health, The University of Michigan)
- 1:45-5:00 Excursion to the Construction Site of the Fermi II Nuclear Power Plant of the Detroit Edison Company near Monroe, Michigan, by University of Michigan bus. The bus will be waiting on Bonisteel Boulevard near the Chrysler Center.

Wednesday, June 26

- 8:30-9:15am Environmental Radioactivity
(C. Kikuchi)
- 9:30-10:15 A Case Study: Fermi II
(J. J. Duderstadt)
- 10:30-11:15 Recent Advances in Environmental Radiation Monitoring
(C. Kikuchi)
- 11:30-12:15pm How Much Energy Will We Need?
(Marc H. Ross, Professor of Physics, The University of Michigan)
- 2:00-5:00 Second Laboratory Session: Alpha Ray Absorption,
at 2250 Beta Ray Absorption, Airborne Radioactivity
G. G. Brown (D. H. Vincent with L. Emmons, D. Kopinski, and P. A. Plato)

Thursday, June 27

- 8:30-9:15am Statistics: Nuclear And Human Population Samples
(C. Kikuchi)
- 9:30-10:15 Nuclear Reactor Safety: What Can Happen? How Is This Prevented?
(J. J. Duderstadt)
- 10:30-11:15 Reactor Licensing
(W. Kerr, Chairman, Department of Nuclear Engineering, The University of Michigan, and Member of the Advisory Committee on Reactor Safeguards of the U.S. Atomic Energy Commission)

- 11:30-12:15pm A Physician's View of Nuclear Power
(G. A. Drake, M.D., Petoskey, Michigan)
- 2:00-2:45 Nuclear Power--A Candid Environmental Review
(D. E. Van Farowe, Chief, Division of Radiological
Health, Department of Public Health, State of Michigan)
- 3:00 Excursion to the Michigan Electric Power Coordination
Center at 1901 South Wagner Road, Ann Arbor, by private
cars.

Following the
excursion: Picnic at the home of Professor C. Kikuchi at 260 Sumac
Lane, Ann Arbor. Spouses are invited.

Friday, June 28

- 8:30-9:45am Are There Viable Alternative Energy Sources for Michigan?
(C. Kikuchi)
- 10:00-10:45 The Future Of Nuclear Power Generation Fuel Supply;
Waste Disposal; Future Reactor Development
(J. J. Duderstadt)
- 11:00-12:15pm Waste Products--Radioactive And Others
(C. Kikuchi)
- 2:00-2:45 Greenwood Planning
(J. P. Lagowski, Director, Consumer Projects Depart-
ment, Public Affairs, The Detroit Edison Company,
Detroit, Michigan)
- 3:00 Discussion

NUCLEAR POWER: ENGINEERING FACTS AND ENVIRONMENTAL ISSUES

A Workshop for High School Science Teachers
Ann Arbor, Michigan, June 24 to June 28, 1974

Brief Time Schedule

	Monday, June 24	Tuesday, June 25	Wednesday, June 26	Thursday, June 27	Friday, June 28
Time					
8:30am	Registration Welcome (King) Organizational (Vincent)	Scenario: Michi- gan Power Plants 1990 (Kikuchi)	Environmental Radioactivity (Kikuchi)	Statistics: Nuclear and Human Population Samples (Kikuchi)	Are There Viable Alternative Energy Sources for Michi- gan? (Kikuchi)
9:30	Nuclear Power Gen- eration (Overview) (Duderstadt)	How Does a Nu- clear Reactor Work? (Duderstadt)	A Case Study: Fermi II (Duderstadt)	Nuclear Reactor Safety (Duderstadt)	
10:30	Characterization of Radioactive Material (Vincent)	Effects of Over- dose from Radi- ation and/or Drugs (Kikuchi)	Recent Advances in Environmental Rad- iation Monitoring (Kikuchi)	Reactor Licensing (Kerr)	10:00 The Future of Nuclear Power Generation (Duderstadt)
11:30	Environmental As- pects of Power Plant Operation (Martin)	Environmental Sur- veillance Around Nuclear Power Plants (Plato)	How Much Energy Will We Need? (Ross)	A Physician's View of Nuclear Power (Drake)	11:00 Waste Pro- ducts--Radioactive and Others (Kikuchi)
12:15pm	Lunch	Lunch	Lunch	Lunch	Lunch
2:00	Lab I (Vincent)	1:45pm Excursion to Fer- mi II Reactor Site	Lab II (Vincent)	Nuclear Power: A Candid Environmental Review (Van Farowe) 3:00 Excursion to Michigan Electric Power Coordination Center Picnic	Greenwood Planning (Lagowski) 3:00 Discussion

APPENDIX D

Summary of an Analysis of the

Workshop Evaluation Sheets

High School Science Teacher Workshop on Nuclear Power

Department of Nuclear Engineering,

The University of Michigan,

Ann Arbor, Michigan

June 24, 1974 to June 28, 1974

In analysing the workshop evaluation sheets, an effort has been made to extract common elements in the answers given to the various questions asked. The summary below is organized in the order of the questions on the evaluation sheet. Following each question from the evaluation sheet, the number of answers falling into a certain category is listed together with the general content (or spirit) of the answers in that category.

Question 1: What were your three most important objectives in attending the workshop?

- 13 To obtain knowledge, materials and reference resources (i.e., speakers, tours) for classroom presentation and discussion.
- 12 To obtain general personal knowledge of nuclear reactors, their construction and operation.
- 12 To obtain knowledge of the effects nuclear energy has on people and the environment; its advantages vs. hazards, relative safety/health effects, waste disposal, etc.
- 9 To obtain knowledge of what is being done about present and future energy needs and the possible alternatives.
- 6 To obtain knowledge of what nuclear energy is all about and the latest developments within the field.
- 5 To observe and meet personnel related to the field (e.g., University personnel, the nuclear engineering department, etc.)
- 4 To go through a general review of facts and theory of nuclear engineering.
- 1 To gain experience through laboratory work.
- 1 To gain knowledge of the economics and practicability of nuclear energy.

Question 2: What were the three most important benefits received?

- 17 An update and newer perspectives of nuclear energy and the problems involved (i.e., political, technical and environmental).
- 11 Exposure to different types of reactors; their construction, licensing, operation.
- 9 The tours and laboratory work (FNR and Fermi II).
- 8 Learning of the future need and future resources of energy, presentation of different points-of-view leading to alternatives.
- 7 The useful and usable information via hand-outs, bibliography, other source information, and availability of speakers.
- 7 The informal interaction between knowledgeable people in the field and the workshop participants (particularly as provided by the picnic).
- 4 Personal experience and satisfaction; having all of the "objectives" cited in Question #1 met.

Question 3: What were the three most important deficiencies noted?

- 8 Too much lecture time and not enough discussion time with guest speakers.
- 5 Areas not covered enough dealing with future aspects (i.e., more exotic types), alternate energy forms and opponents opinions.
- 5 Closed door attitude in tour of Fermi II.
- 3 Not enough time spent with fellow participants.
- 3 Math and statistical data too "heavy".
- 3 Labs seemed to be too hard and too concentrated for time allowed.
- 3 Labs seemed to be too elementary and time consuming.
- 2 Workshop was too short and not credited.
- 6 No comment or answer.

Question 4: Was the concept of cost-benefit assessment of present and planned energy sources developed and understood?

25 Yes.

specifically:

Overwhelming understanding
Well done
Very clear
Clearly presented

Understanding, that there is no clear-cut answers to the problem

Added to appreciation of situation at hand.

Very well presented in terms of monetary and environmental health cost

Question 5: Do you believe the health and environmental effects of nuclear and fossil fuel energy sources are generally known and understood?

25 No.

specifically:

General public isn't educated on the topic.

More work must be done on determining precisely the effects.

Most notions are vague and without real knowledge or understanding.

Too much false and misinformation propagated to the general public.

"Well" educated people and those working in the field do not understand.

Question 6: How have your views on the role of nuclear and fossil energy sources to meet our electrical needs been affected by this workshop?

- 11 Convinced now or have known that nuclear energy is a major source of electricity in the near future and am willing to accept their presence if more safety control is procured.
- 5 Views have been brought up-to-date and re-evaluated but no decisions either way have been made.
- 4 Nuclear energy is a "very" possible source of electricity for our future needs but research in this area plus other possible areas should continue.
- 3 If consumption is not cut back then nuclear energy is the future.
- 2 Definitely not fossil-sided but nuclear energy is not convincingly the alternative.

Question 7: What alternative(s) do you see as realistic energy sources in the near term future?

- 16 Nuclear power -- under greater control and understanding of environmental effects.
- 7 Reduction of energy consumption -- both personally and by governmental control, also by way of re-education of the public.

- 3 Coal
- 2 Solar energy
- 2 Research and development should be pushed in all possible fields.
- 1 Gas and oil
- 1 Hydroelectric and geothermal in areas of high stream gradients and volcanic regions.
- 1 Economics and education shall determine which source or sources we will use.
- 3 No alternatives

Question 8: How do you plan to use the knowledge gained:

- 25 (a) In your teaching?
 - To up-date program
 - In Ecology units in school program
 - Stimulating students to do further study in area
- 18 (b) In your community activities?
 - Lectures if possible
 - Discuss with friends and colleagues
 - Community education
 - Making others aware of the problems
 - Especially when voting on such proposals
- (c) Other?
 - Motivated drive for more personal information
 - In university work for Master's and Ph.D. degrees
 - Personal financial planning