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ELECTRICAL POWER GENERATION
COMPARATIVE RISKS AND BENEFITS
A ONE-WEEK WORKSHOP FOR HIGH SCHOOL SCIENCE TEACHERS
FINAL REPORT

August 16, 1973

Max W. Carbon and K. Ted Hartwig

University of Wisconsin
Madison, Wisconsin

Report period

August 6, 1973 - August 10, 1973

(The Week of Our 1973 Summer Workshop.)

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Abstract

A live-in type workshop available for academic credit covering basic nuclear power generation and the tradeoffs and problems that exist between nuclear power and alternative means to generate electricity was held between August 6th and 10th, 1973 for thirty-seven high-school teachers at the Madison campus of the University of Wisconsin. The program was evidently a considerable success (see Appendices E and F), and participants felt that similar future workshops are needed.

Significant improvements over last year's program included:

- 1) The distribution of a large amount of information (see Appendices C and D)
- 2) The distribution of two minicourse outlines on the subject of power and the environment entitled:
 - a) "The Environmental Impact of Electrical Power Generation: Nuclear and Fossil" prepared by the Pennsylvania State Dept. of Education
 - b) "Science III Matter-Energy Interactions in Natural Systems" prepared by Carl Pfeiffer of Monona Grove High School, Monona, Wisconsin

These minicourses ignited considerable interest.

A larger percentage of this year's group, when compared to last year's, felt that both sides of controversial issues were covered as evidenced below by the response to the question "Do you feel both sides of controversial issues were covered?"

	1972 Response (Total 39)	1973 Response (Total 36)
YES	17	20
SOMEWHAT	7	15
NO	15	1

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Electrical Power Generation -- Comparative Risks and Benefits

Final Report

August 16, 1973

Introduction

A workshop for high school science teachers covering basic nuclear power generation and the tradeoffs and problems that exist between nuclear power and alternative means to generate electricity was held at the University of Wisconsin-Madison campus early in August, 1973. The program provided an excellent means to inform an audience whose beliefs and concerns about this subject will likely influence other elementary and secondary school teachers, our young adults in elementary and secondary schools, the parents of these children, and other members of the communities from which the participants came. Written evaluations of the workshop by the participants have indicated that it was an apparent success (see Appendices E and F) and that other similar workshops should be held in the future.

Participants left Madison knowledgeable in the area of electrical power generation with an excellent collection of related printed material (see Appendices C and D) and in many cases a new philosophy about nuclear power. Dissemination of information within the communities from which those attending came will be aided by information sent to local newspapers and local school officials. This latter notification took the form of a notice of attendance along with a short description of the workshop and its purpose.

Description of the Workshop

The Electrical Power Generation Workshop spanned five days and was held the week of August 6 through 10, 1973. The primary objective was to provide the background needed for meaningful discussions of nuclear electrical power generation and its environmental costs-benefits in relation to other energy sources. A variety of topics was covered ranging from basic nuclear engineering to a review of alternative means for generating electrical power for both the present and the future. A day to day schedule of the workshop is attached as Appendix A. Listed below in chronological order are the talks given, the speaker and his affiliation and a short description of material presented.

"Welcome" Dean W. R. Marshall, College of Engineering, UW; reasons for workshops like these, role of University, acknowledge AEC financial support, pleasure at having these visitors.

"Power Uses by Our Society" Mr. W. Buehring, Nuclear Engineering Graduate Student, UW; relative uses of power by society (gasoline, electricity, etc.), uses of electricity (homes, factories, etc.), advantages and disadvantages of electric power, future needs.

"A Biologist's View of Power Generation and Usage", Professor John Neess, Zoology Department, UW; energy conservation, reduction in energy usage, the need for a change in our energy related value system.

"History of Nuclear Power" Professor Max W. Carbon, Nuclear Engineering Department, UW; development of nuclear power, types of reactors, status world wide (especially England, Russia, Japan, Germany).

"Alternate Sources of Energy", Professor John Steinhart, Geophysics and Institute for Environmental Studies, UW; extensive discussion of solar

power, mention of fossil, geothermal, tidal and wind alternate power systems, energy reductions, and energy intensive spots in our economy.

"Fossil-Fuel Power -- Status and Prospects" Mr. Paul Keshishian, Director of Power Production, Wisconsin Power and Light Company; fossil-fuel power production techniques, advantages, disadvantages, present-day problems, near-term outlook, sources of fuel.

"Operation of Nuclear Reactors" Mr. R. J. Cashwell, Reactor Supervisor, Nuclear Engineering Department, UW; personnel, personnel licensing, control, time-dependent behavior, AEC regulations.

"Nuclear Reactor Safety" Dr. Jan van Erp, Nuclear Engineer, Argonne National Laboratories; what is the problem -- why are some people concerned? (radioactivity; delayed heat generation), postulated accident, back-up safety, normal effluents, safety record.

"Nuclear Reactor Design and Licensing Requirements" Dr. Jan van Erp, Nuclear Engineer, Argonne National Laboratories; licenses and inspections, safety committees and reviews, specifications, quality control.

"Nuclear Power in Our Society", Professor George Dixon, Sociology and Anthropology Departments, UW-Stevens Point; Member of Executive Committee and Professional Coordinator -- League Against Nuclear Dangers (LAND); spoke mainly about the purpose and makeup of LAND.

"Thermal Effluents from Power Plants," Professor Theodore Green, Civil Engineering and Meteorology Departments, UW; amount and characteristics of thermal discharges from power plants, the factors to consider and effects of these discharges.

"Uses of Thermal Effluents ", Mr. Sam Nelson, Institute for Environmental Studies, Graduate Student, UW; discussed several waste heat uses in depth.

"The Biological Effects of Fossil Plant Effluents", Dr. John Rankin Professor of Medicine and Preventive Medicine; effluents from fossil plants biological effects.

"Current Research on Coal Utilizations", Dr. Raymond Vener, Chief Development Branch, Division of Research and Development, Office of Coal Research, US Department of Interior; coal gasification and liquidification, current fossil fuel related research and future expectations.

"The Nuclear Fuel Cycle -- Mining Through Fabrication", Professor P. J. Fulford Nuclear Engineering Department, Purdue University; mining, fabrication, reprocessing, waste disposal -- problems, status, R & D, future.

"Nuclear Fuel Waste Disposal", Dr. John Blomeke, Assistant Director, Salt Mine Repository Project, Oak Ridge National Laboratories; current and future waste disposal practices.

"The Biological Effects of Radiation", Professor Seymour Abrahamson, Zoology and Genetics Departments, UW; effects of radiation on people, effects of typical reactor discharges.

"New Developments in Nuclear Power" Professor P. J. Fulford, Purdue University; breeder reactors, types, advantages, time schedules, development costs.

"Prospects for Solar Energy", Professor John Duffie, Director, Solar Energy Laboratory and Associate Dean, Graduate School; current uses of solar power.

"Controlled Thermonuclear Fusion", Professor Gilbert Emmert, Nuclear Engineering Department, UW; definitions, prospects, promises, UW Fusion Reactor Design.

"Domestic Energy Resources", Professor Eugene Cameron, Geology Department, UW; Coal, oil, gas, uranium domestic recoverable resource picture.

"Industrial Experience with Nuclear Power", Mr. Wade Larkin, Group Vice President-Power Supply, Northern States Power Company; general experience, future expectations with reasons.

"Energy Policy Formulation", Dr. Richard Timm, Environmental Analyst, Wisconsin Public Service Commission; how is energy policy formulated? Roles of federal and state governments and public; present and future policies, need for public understanding.

"Panel Session", Mr. Cashwell, Mr. Timm, Mr. Larkin, Professor Carbon, Professor Neess; opportunity for audience to ask final questions.

One three-hour laboratory session was given. It was held in the UW Reactor Laboratory and was supervised by Richard Cashwell, our Reactor Supervisor. Topics demonstrated included reactor criticality and control, exponential behavior with positive and negative reactivity insertions, self shutdown characteristics, superprompt criticality with associated self shutdown, and a discussion about delayed neutrons. The object of the lab was to explain how a reactor operates and behaves with various perturbations; direct comparisons were made with PWR's.

The workshop also included bus trips to the Wisconsin-Michigan Power Company Point Beach Generating Station near Two Rivers, Wisconsin and the Blount Street Fossil generating station in Madison. Both trips concluded with a lively question and answer session involving a plant supervisor.

Participants

Information concerning this workshop was sent to the alternate candidates

of last year's program (approximately 80). Forty-seven applications for participation were received; 37 of these applicants attended the workshop (See Appendix B). Two were from Illinois, the remainder were from Wisconsin. One woman applied and attended.

The group was very enthusiastic about the program and actively participated throughout the week. All participants were present each day. Lecturers were in every case held after their talks for questions. Often there was not enough time for a given speaker to answer all the questions people had.

Workshop Evaluation

Two rather extensive questionnaires were given to each participant at the beginning of the workshop. The purpose of these was to evaluate the program and thus help develop future workshops. Thirty-six participants completed the UW questionnaire; 34 completed the AEC evaluation sheet. The results indicate that the program was quite successful and that similar programs should be offered in the future. Please refer to the questionnaire summaries attached for concurrence with this judgment.

The results of UW questions 3,4, and 7 and AEC questions 3 and 4 are worth noting and are summarized below. Also presented are the results of similar questions asked to the participants of last year's program. Refer to Appendix G for the total 1972 workshop questionnaire response summary.

Questions

- UW 3) "The extent to which I achieved my objective(s) was:"
- UW 4) "Do you feel both sides of controversial issues were covered?"
- UW 7) "Was there enough opportunity for interaction with staff? With other participants?"

AEC 3) "Were your expectations (in coming to this workshop) fulfilled?"

AEC 4) "Do you feel that the workshop enables you to make an objective value judgment of the various forms of electrical power generation and their environmental effects?"

<u>TALLIED ANSWERS</u>	<u>1973 RESPONSE</u>	<u>1972 RESPONSE</u>
<u>UW 3)</u>		
no achievement	0	(not a choice)
part achievement:	8	3
full achievement:	25	36
(no comment) :	3	0
<u>UW 4)</u>		
Yes	20	17
Somewhat	15	7
No	1	15
<u>UW 7)</u>		
Yes	29	30
No	7	9
<u>AEC 3)</u>		
Yes	31	
Partial	2	
No	0	
(no comment)	1	
<u>AEC 4)</u>		
Yes	30	29
Somewhat	0	6
No	3	3
(no comment)	1	1

The results of UW questions 5 and 8 will help to improve future workshops. The summaries (in no special order) here include:
Question

UW 5) Did any topics receive too much or too little emphasis?

Response

Too Much

Talks by and discussions with
federal and state officials

Too Little

The people problems involved
Breeders
Fuel cells
Related terminology
Alternate sources other than fossil,
nuclear, and fusion

Question

UW 8) Any suggestions for future conferences on this or related topics?

Response

(High Incidence)

A schedule not quite so full
Participant interaction groups (1-2 hours)
More time for each presentation
Tour of UW laboratories
End workshop by Friday noon
The Point Beach Trip was too long for what was seen (Blount Street was enough).

IDEAS FOR IMPROVEMENT

Program improvement and information use were discussed several times throughout the week. Ideas presented on this topic do not differ significantly from those reported previously (Report C00-2260-2, pp. 4-8). This section of Report C00-2260-2 has been attached as Appendix H.

Contract Adherence and Personnel Involvement

All contract requirements have been followed, none have been knowingly violated.

The approximate amounts of time devoted to the project by UW Department of Nuclear Engineering Staff during the 1973 Summer Workshop phase are listed below.

<u>Individual</u>	<u>Title</u>	<u>Contribution (man-days)</u> 1973 Summer Workshop Phase
M. W. Carbon	Principal Investigator Professor and Chairman Nuclear Engineering Dept.	12
R. J. Cashwell	Reactor Supervisor	1
G. A. Emmert	Professor of Nuclear Engineering	1
K. T. Hartwig	Specialist	25
Clerical Support		10

APPENDIX A

WORKSHOP ON ELECTRICAL POWER GENERATION

Madison, Wisconsin

6 - 10 August 1973

Monday, August 6

- 8:30 "Welcome Breakfast", Dean W. R. Marshall, College of Engineering*
- 9:30 "Registration", Mr. K. T. Hartwig, Assistant to the Chairman,
Nuclear Engineering Department
- 10:40 "Power Uses by Our Society", William A. Buehring, Graduate Student,
Nuclear Engineering Department, and Former Employee at Argonne
National Laboratory
- 1:00 "A Biologist's View of Power Generation and Usage", Professor John
C. Neess, Zoology Department
- 2:00 "History of Nuclear Power", Professor Max W. Carbon, Chairman,
Nuclear Engineering Department
- 3:20 "Alternate Sources of Energy", Professor John S. Steinhart, Geophysics
and Institute for Environmental Studies; Associate Director of
Marine Studies Center
- 6:30 Picnic

Tuesday, August 7

- 8:30 "Fossil-Fuel Power--Status and Prospects", Mr. Paul Keshishian, Vice
President, Wisconsin Power and Light Company
- 9:30 "Operation of Nuclear Reactors", Mr. R. J. Cashwell, Reactor Supervisor,
Nuclear Engineering Department
- 10:40 "Nuclear Reactor Safety", Dr. Jan van Erp, Nuclear Engineer, Argonne
National Laboratory
- 11:40 "Nuclear Reactor Design and Licensing Requirements", Dr. Jan van Erp,
Argonne National Laboratory
- 2:00 Group A: Laboratory Session on Reactor Operation
Group B: Trip to Fossil Power Plant (Blount Street Plant, Madison, Wis.)
- 7:00 "Nuclear Power in Our Society", Professor George Dixon, Sociology
and Anthropology Departments, University of Wisconsin - Stevens
Point; Member of Executive Committee and Professional Coordinator,
League Against Nuclear Dangers

* All locations are University of Wisconsin-Madison except where otherwise indicated

Wednesday, August 8

- 8:30 "Thermal Effluents from Power Plants", Professor Theodore Green, Civil Engineering and Meteorology Departments
- 9:30 "Uses of Thermal Effluents", Mr. Sam Nelson, Graduate Student Institute for Environmental Studies
- 10:40 "The Biological Effects of Fossil Plant Effluents", Dr. John Rankin, Professor of Medicine and Preventive Medicine
- 1:00 Group A: Trip to Fossil Power Plant (Blount Street Plant, Madison, Wis.)
Group B: Laboratory Session on Reactor Operation
- 7:00 "Current Research on Coal Utilization", Dr. Raymond Vener, Chief, Development Branch, Division of Research and Development, Office of Coal Research, Department of Interior

Thursday, August 9

- 8:30 "Nuclear Fuel Cycle: Mining Through Fabrication", Professor P. J. Fulford, Nuclear Engineering Department, Purdue University
- 9:30 "Nuclear Fuel Waste Disposal", Dr. John O. Blomeke, Assistant Director, Salt Mine Repository Project, Oak Ridge National Laboratory
- 10:40 "The Biological Effects of Radiation", Professor Seymour Abrahamson, Zoology and Genetics Departments
- 11:40 "New Developments in Nuclear Power", Professor P. J. Fulford, Nuclear Engineering Department, Purdue University
- 12:10 "Prospects for Solar Energy", Prof. J. A. Duffie, Director, Solar Energy Laboratory and Associate Dean, Graduate School
- 12:30-10:00 "Trip to Point Beach Nuclear Power Plant"

Friday, August 10

- 8:30 "Controlled Thermonuclear Fusion", Professor G. A. Emmert, Nuclear Engineering Department
- 9:10 "Domestic Energy Resources", Professor Eugene Cameron, Geology Department
- 9:40 "Industrial Experience With Nuclear Power", Mr. Wade Larkin, Group Vice President, Northern States Power Company
- 10:40 "Energy Policy Formulation", Mr. Richard Timm, Environmental Analyst, Engineering Division, Public Service Commission of Wisconsin
- 1:00 "Panel Session", Messrs. Cashwell, Carbon, Timm, Larkin, and Neess
- 3:00 "Knowledge Exam"
- 3:30 "Evaluation"
- 4:30 "Closing Remarks"

PARTICIPANT LIST

HIGH SCHOOL SCIENCE TEACHERS WORKSHOP

"Electrical Power Generation -- Comparative Risks & Benefits"

Aug. 6-10, 1973 Madison, Wisconsin

APPENDIX B

<u>Name</u> <u>Home Address</u> <u>Telephone #</u>	<u>School Affiliation</u> <u>Name/Town/State</u>	<u>Name</u> <u>Home Address</u> <u>Telephone#</u>	<u>School Affiliation</u> <u>Name/Town/State</u>
Richard M. Alfors 1605 Larkspur Dr. Rockford Ill. 61107 -398-9714	West Rockford Sr. High Rockford, Illinois	F. E. Gellerup Route 3 Box 59 Wautoma, Wis. 54982 414-787-2625	Wautoma High School Wautoma, Wisconsin
John Bauman 434 North Main St. Oregon, Wis. 53575 -835-5861	Oregon Sr. High Oregon, Wisconsin	Richard Guenther 7320 Pershing Blvd. Kenosha, Wis. 53140 -694-7026	Bradford High School Kenosha, Wisconsin
Gerald Bjerke Route 1 Black River Falls Wisconsin 54615 715-284-4294	Senior High School Black River Falls Wisconsin	David Hackbarth 111 N. Peters Ave. Fond du Lac, Wis. 54935 414-921-6160	Oshkosh North Oshkosh, Wisconsin
David Braunschweig 505 Woodside Tr. Madison, 53711 608-233-3482	Madison West Madison, Wisconsin	John Hafeman Pembine, Wis. 54156	Pembine High School Pembine, Wisconsin
Edward F. Cina 936 Morgan Rd. River Falls, Wis. 54022 -425-5725	River Falls Sr. High River Falls, Wis.	Gerald Hansel 2524 S. East St. Appleton, Wis. 54911 414-733-6152	Appleton East High Appleton, Wis.
C. P. Frigo St. Norbert Abbey De Pere, Wis. 414-336-3121	Premontre High Green Bay, Wisconsin	Gerald Hesselberg Box 121 La Farge, Wis. 54639	La Farge High School La Farge, Wisconsin
		Lyman Humphrey 1410 Lyndale Rd.# Madison, Wisconsin 608-271-5948	Oconomowoc Sr. High Oconomowoc, Wis.

Name
Home Address
Telephone #

School Affiliation
Name/Town/State

Carl R. Moede
Route 2 Box 14
Suring, Wis.
54174
414-842-2966

Pulaski High School
Pulaski, Wis.

Robert Moehring
2533 S. Howell Ave.
Milwaukee, Wis.
53207
414-744-0146

Riverside High School
Milwaukee Wisconsin

Archie Nicolette
P.O. Box 427
Woodruff, Wisconsin
54568
715-356-3809

Lakeland High School
Minocqua, Wisconsin

Albert Pesko
Route 2
Wis. Rapids, Wis.
715-325-5825

Lincoln High School
Wisconsin Rapids, Wis.

Steve Potter
381 N. Carron
Berlin, Wis.

East High School
Madison, Wis.

David Schlichting
705 Pinchot Ave.
Madison, Wis.
53716
608-222-0306

Edgerton High School
Edgerton, Wis.

Neal Schulz
3140 W. Layton Ave.
Greenfield, Wis.
414-282-8593

Greenfield High School
Greenfield, Wisconsin

Name
Home Address
Telephone #

School Affiliation
Name/Town/State

John Ihde
824 Kent St.
Wausau, Wis.
54401
715-845-3306

West High School
Wausau, Wisconsin

Lee Ihlenfeldt
105 Lathrop St.
Madison, Wisconsin
53705
608-238-1663

Memorial High School
Madison, Wisconsin

Wayne Jenson
333 Wainwright Ave.
Burlington, Wisconsin
53105
414-763-6983

Burlington High School
Burlington, Wisconsin

Sylvester Karis
Rt. 5
Menomonie, Wis.
54751
715-235-2068

Menomonie Sr. High School

Ludwig Kroner
36766 Cherokee Rd.
Oconomowoc, Wis.
53066

Oconomowoc High School
Oconomowoc, Wisconsin

Thomas Leuthner
1100 Bellevue St.
Green Bay, Wis.
54302
-435-0658

East High School
Green Bay, Wisconsin

Name Home Address Telephone #	School Affiliation Name/Town/State
Allan E. Schwahn 133 Imperial Dr. R. R. # 2, Box 149 Waunakee, Wis. 53597 846-5460	LaFollette High School Madison, Wisconsin
Stephen Skinner 522 College Milton, Wisconsin 53563 -868-7429	Milton High School Milton Wisconsin
Douglas Smith 4668 Moody Rd. Rockton, Ill. 61072 -624-7089	Auburn High School Rockton, Ill.
William Stammerman P.O. Box 147 Phelps, Wis. 54554 715-545-2391	Phelps High School Phelps, Wisconsin
James Thomas 6807 S. 19th St. Milwaukee, Wis. 53221 414-761-2399	Boy's Tech Milwaukee, Wis.
Robert Thorson Cadott, Wisconsin 735-289-4917	Cadott High School Cadott, Wisconsin

Name Home Address Telephone #	School Affiliation Name/Town/State
Dennis Tietge 930 Washington St Wausau, Wis. 54401 715-845-3230	Wausau West High School Wausau, Wisconsin
Edward Tobias 554 Carter St. Genoa City, Wis. 53128 414-279-6466	Badger High School Lake Geneva, Wis.
John Urness 830 N. 2nd St. Platteville, Wis. 53818 -348-6392	Platteville High School Platteville, Wisconsin
Dorothea von Trott 232 N. 3rd Ave. Cedarburg, Wis. 53012 414-377-0928	Salem Central High School Salem, Wisconsin
John Woeckner P. O. Box 436 Green Lake, Wis. 54941	Green Lake High School

APPENDIX C

SOURCE INFORMATION DISTRIBUTED
TO
PARTICIPANTS OF 1973 SUMMER WORKSHOP
ON
"ELECTRICAL POWER GENERATION --- COMPARATIVE RISKS & BENEFITS"
AUGUST 6-10 MADISON, WISCONSIN

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- F. BIOLOGICAL/ENVIRONMENTAL EFFECTS
- G. QUESTION AND ANSWER SUMMARIES
- H. MINICOURSE

A. SOURCE INFORMATION

- (1) Science Information Available from the Atomic Energy Commission, TID-4550, January 1971.
- (2) A Bibliography of Basic Books on Atomic Energy (Annotated), A World of the Atom Series Booklet, IB-002.
- (3) USAEC Combined Film Catalog, 1972.
- (4) "Order Form for Information Booklet on Atomic Energy", USAEC publication.
- (5) "Resource Letter ERPEE-1 on Energy: Resources, Production, and Environmental Effects", June 1972, prepared for American Association of Physics Teachers.
Only the first 3 pages of this excellent annotated bibliography are copied; see the first page for availability.
- (6) Consulting Engineer, March 1973 reprint.
The reprint contains 15 excellent articles on various subjects related to the energy crisis. These articles are referenced throughout this handout summary.
- (7) Aware Index, October 1970 - July 1973.
This is an organized compilation of all articles that have appeared in Aware magazine; the environmental magazine about the electric industry.
- (8) Aware magazine, June and July 1973 issues.
Seven articles of interest appear that are referenced throughout this handout summary. Each participant may receive a courtesy subscription (contact the publisher, Mr. Fenton Kelsey, for further details).

B. POWER AND ENERGY USE, RESOURCES, OVERVIEW ARTICLES

- (1) "Energy Conservation," Lincoln, G. A., Science, Vol. 180, pp. 155-162, 13 April 1973.
- (2) "Energy and the Environment in Perspective," G. D. Braden and D. H. Brown, General Electric reprint 7360.
- (3) "Resources: Are we Running Short," R. C. B. Morton, Consulting Engineer, March 1973.
- (4) "Outlook for the Future," S. D. Freeman, Consulting Engineer, March 1973.
- (5) "The Engineer's Role: Industry Faces New Challenge," G. C. Gambs, Consulting Engineer, March 1973.
Excellent article on energy use and resource picture with projections.
- (6) "The Role of Government: Managing Existing Resources," A. Kaufman, Consulting Engineer, March 1973.
- (7) "The Role of Government: Senate Seeks Unified Policy to Meet the Crisis," H. M. Jackson, Consulting Engineer, March 1973.
- (8) "Energy's Impact on Foreign Policy," J. Darmstadter, Consulting Engineer, March 1973.
- (9) "New Sources and Methods: Total Energy, A Key to Conservation," S. E. Beall, Consulting Engineer, March 1973.
- (10) "The Engineer's Role: Engineers Seek to Stretch Resources," L. Jenkins, Consulting Engineer, March 1973.
- (11) "The Engineer's Role: A-E Team Can Short-Circuit Major Crisis," R. G. Stein, Consulting Engineer, March 1973.
- (12) "The Engineer's Role: Systems Integrity -- Beating the Blackout," R. B. Squires, Consulting Engineer, March 1973.

C. FOSSIL POWER

- (1) Selected articles from Bituminous Coal Facts 1972, National Coal Association:
 - (a) "Coal and Energy," p.6-10.
 - (b) "Coal Reserve Areas in the United States," Map, p. 21.
 - (c) "Environment," p. 22-29.
 - (d) "US Consumption of Energy Fuels and Electricity from Water and Nuclear Power, 1920-1971," Table, p. 57.
 - (e) "Estimated Remaining Coal Reserves of the World," Table, p. 72.
 - (f) "Coal Reserves of the United States," Table, p. 74.
- (2) "Coals Comeback," reprint from Business Week, Nov. 4, 1972, p. 50.
- (3) "The Role of Government: FPC Sets Limits on Natural Gas," Consulting Engineer, March 1973.

D. NUCLEAR POWER

- (1) Nuclear Reactors, An Understanding The Atom Series Booklet, IB-507.
- (2) Nuclear Power Plants, A World of the Atom Series Booklet, IB-505.
- (3) Worlds Within Worlds: The Story of Nuclear Energy, Volume 3 (Nuclear Fission, Nuclear Fusion, Beyond Fusion), USAEC publication, IB-016.
- (4) "The Regulations of the Environmental Effects of Nuclear Power Plants," J. P. Davis, Nuclear Safety, Vol. 14, No. 1. Jan-Feb. 1973. pp6-13.

- (5) "Standards for Protection Against Radiation," Lauriston Taylor, Proceeding of the Conference on Nuclear Power and the Environment, Madison, Wisconsin, April 3-4, 1970.
- (6) "Electricity From Nuclear Power," MAP, Atomic Industrial Forum, Inc., March 31, 1973.
- (7) "New Sources and Methods: Nuclear Energy; How Soon? How Safe?" R. E. Lapp, Consulting Engineer, March 1973.
- (8) "The Maturing Atom," J. G. Conner, A. A. Bauer, H. M. Epstein, P. J. Mallozzi, Aware, June 1973.

E. ALTERNATE SOURCES OF ENERGY

- (1) "New Sources and Methods: Fusion and Other Long-Range Strategies," D. J. Rose, Consulting Engineer, March 1973.
- (2) "New Sources and Methods: Solar Energy, An Endless Supply," M. Wolf, Consulting Engineer, March 1973.
- (3) "Energy Options For The Future," W. R. Gould, April 2, 1973, 2-507.
- (4) "Thermal Conversion Offers Potential in Solar Energy Production," A. B. Meinel, M. P. Meinel, Aware, June 1973.
- (5) "Three Major Types of Geothermal Systems," T. O. Friz, Aware, July 1973.
- (6) "Hydrogen -- A New Form of Energy Transmission," D. Gregory, Aware, July, 1973. This article appears in depth in Scientific American, January 1973.

F. BIOLOGICAL/ENVIRONMENTAL EFFECTS

- (1) Atoms, Nature, and Man, A World of the Atom Series Booklet, IB-202.
- (2) Your Body and Radiation, A World of the Atom Series Booklet, IB-109.
- (3) "Health Hazards from Radio active Emissions," M. Eisenbud, Sc.D., April 29, 1973 (This also appeared in the July 1973 issue of Aware).
- (4) "Environmental Effects of Electric Power Generation," M. I. Goldman, Sc.D., April 2, 1973.
- (5) "The Engineer's Role: Power Plants -- Picking the Sites," C. A. Brown, Consulting Engineer, March 1973.
- (6) "Environmental Aspects of Nuclear Geothermal Heat Stimulation," G. M. Sundquist, G. A. Whan, Aware, June, 1973.
- (7) "Environmental Impact of Transportation of Fuel and Waste," Table from Health Physics Society Newsletter, March 1973.

G. QUESTION AND ANSWER SUMMARIES

- (1) Nuclear Power and the Environment?! Questions and Answers, American Nuclear Society, 1973.
- (2) Nuclear Power and the Environment, A Series of Fact Sheets Presented by the Delaware Valley Section of the American Nuclear Society, (1971-1973).

H. MINICOURSE

- (1) The Environmental Impact of Electrical Power Generation: Nuclear and Fossil, 1973, Division of Science and Technology, Bureau of Curriculum Services, Pennsylvania Department of Education, Box 911, Harrisburg, Pa. 17126. —

*S.P.O. student manual
WASH. 1261 1.25
WASH #1262 1.70*

APPENDIX D

Speaker Related Information Distributed To 1973 Summer Workshop Participants

<u>Day/Time</u>	<u>Speaker/Talk</u>	<u>Information Distributed</u>
Monday, August 6		
10:40 AM	Buehring "Power Uses by Our Society"	Slides
1:00 PM	Neess "A Biologist's View of Power Generation and Usage"	Paper
2:00	Carbon "History of Nuclear Power"	Notes
Tuesday, August 7		
8:30 AM	Keshkshian "Fossil-Fuel Power--Status and Prospects"	Slides
9:30	Cashwell, "Operation of Nuclear Reactors"	Notes
10:40	van Erp "Nuclear Reactor Safety"	Slides
11:40	"Nuclear Reactor Design and Licensing Requirements"	
7:00 PM	Dixon "Nuclear Power in Our Society"	Misc. Information
Wednesday, August 8		
8:30 AM	Green "Thermal Effluents from Power Plants"	Notes
9:30	Nelson "Uses of Thermal Effluents"	Paper
7:00 PM	Vener "Current Research on Coal Utilization"	Misc. Information
Thursday, August 9		
9:30 AM	Blomeke "Nuclear Fuel Waste Disposal"	Slides

<u>Day/Time</u>	<u>Speaker/Talk</u>	<u>Information Distributed</u>
Thursday, August 9		
10:40 AM	Abrahamson "The Biological Effects of Radiation"	Table
12:10 PM	Duffie "Prospects for Solar Energy"	Bibliography
Friday, August 10		
8:30 AM	Emmert "Controlled Thermonuclear Fusion"	Paper
9:40	Larkin "Industrial Experience With Nuclear Power"	Paper

Aug. 6-10, 1973

Nuclear Engineering Department, College of Engineering

University of Wisconsin at Madison

This questionnaire is part of an attempt to evaluate the program in which you are participating. Your responses will be helpful in planning future workshops. Additional comments or remarks may be made on the back of this form. Please fill out the form as the Workshop proceeds; it will be collected Friday afternoon. Thank you for your cooperation.

1.	In general, the <u>program content was</u>	(circle one):	Excellent
27 | Good
9 | Fair
0 | Poor
0 | NC* |
|----|--|---------------|-----------------|-----------|-----------|-----------|-----|
2.	In general, the quality of presentations was:	Excellent
14 | Good
20 | Fair
1 | Poor
0 | 1 |
|----|---|-----------------|------------|-----------|-----------|---|
3.	The extent to which I achieved my objective(s) was:	no achievement <u>0</u>					
	part achievement	<u>8</u>	full achievement	<u>25</u>	NC	<u>3</u>	
4.	Do you feel both sides of controversial issues were covered?	Yes:	<u>20</u>
		Somewhat:	<u>15</u>
		No:	<u>1</u>
5.	Did any topics receive too much emphasis? too little?
6.	Was there enough discussion?	Yes:	<u>29</u>
		No:	<u>7</u>
7.	Was there enough opportunity for interaction with staff? with other participants?	Yes:	<u>33</u>
		No:	<u>3</u>
8.	Any suggestions for future conferences on this or related topics?
9.	Would you attend such a conference in the future?	Yes:	<u>36</u>	No:	<u>0</u>
10.	Any additional comments?

*NC = no comment

12. Referring to particular parts of the program, please rate speakers, laboratories, etc., as excellent, good, fair, or poor, adding your own comments where pertinent.

Day	Event	Exc.	Good	Fair	Poor	No Rating	Comments
Mon.	"Welcome" -- Dean Marshall	5	16	5	0	10	
	"Power Uses By Our Society" William Buehring	6	24	4	1	1	
	"A Botanist's View of Power Generation and Usage" Professor J. Neese	10	18	6	1	1	
	"History of Nuclear Power" Professor M. Carbon	11	19	5		1	
	"Alternate Sources of Energy" Professor J. Steinhart	24	8	3	1		
Tues.	"Fossil-Fuel Power--Status and Prospects" Mr. P. Keshishian	13	20	2		1	
	"Operation of Nuclear Reactors" Mr. R. J. Cashwell	14	18	4			
	"Nuclear Reactor Safety" Mr. J. Van Erp	1	3	16	16		
	"Nuclear Reactor Design and Licensing Requirements" Mr. J. Van Erp	1	3	17	15		
Wed.	"Thermal Effluents from Power Plants" Professor T. Green	9	23	4			
	"Uses of Thermal Pollution" Mr. S. Nelson	5	5	22	4		

Day	Event	Exc.	Good	Fair	Poor	No Rating	Comments
Wed.	"The Biological Effects of Fossil Plant Effluents" Professor J. Rankin	30	5	1			
	Mr. Ray Vener, Office of Coal Research, Dept. of Interior	8	21	7			
Thurs.	"Nuclear Fuel Cycle: Mining Through Fabrication" Professor P. J. Fulford	18	15	2		1	
	"Nuclear Fuel Waste Disposal" Dr. J. O. Blomeke	10	19	5		2	
	"The Biological Effects of Radiation" Professor S. Abrahamson	28	7			1	
	"New Developments in Nuclear Power" Professor P. J. Fulford	4	10	9	1	12	Many "No Ratings" probably due to speaker switch shortly before talk
Fri.	"Controlled Thermonuclear Fusion" Professor G. Emmert	24	9	2		1	
	"Industrial Experience With Nuclear Power" Mr. W. Larkin	4	21	6	3	2	
	"Energy Policy Formulation" Mr. R. Timm	14	14	6	1	1	
	Laboratory (Reactor Operation)	22	11	2		1	
	Trip to Point Beach Nuclear Plant	6	17	11	2		
	Trip to Blount Street Plant	15	19	2			
	Panel	12	13	3		8	
	Picnic	13	16	2		5	

Day	Event	Exc.	Good	Fair	Poor	No Rating	Comments
Tues. 7:00 p.m.	"Nuclear Power in Our Society" Professor George Dixon		2	10	19	5	
Thurs. 12:10	"Prospects for Solar Energy" Professor J. S. Duffie	7	20	2		7	
Fri. 9:10	"Domestic Energy Sources" Professor Eugene Cameron	12	15	2		7	

WORKSHOP EVALUATION SHEET

APPENDIX F

Attendees 37

Completed Questionnaires 34

Name of Workshop:

"Electrical Power Generation -- Comparative Risks and Benefits"

Location: University of Wisconsin, Madison, Wisconsin

Dates: August 6 - 10, 1973

1. How did you hear about this workshop?
2. What did you expect to obtain from the workshop?

3. (a) Were your expectations fulfilled?

(b) If not, what was the deficiency?

Yes	Part	No	No Comment
31	2	0	1

4. Do you feel that the workshop enables you to make an objective value judgment of the various forms of electrical power generation and their environmental effects?

Yes 30 No 3 No comment 1

5. (a) Have your own personal views about the growing use of nuclear power to meet the increasing demands for electricity been affected by your attendance at the workshop?

(b) If so, in what way?

6. How do you plan to use the knowledge you gained:

(a) In your teaching?

(b) In your community activities?

Signature (Optional)

(Reverse side may be used if more space is needed. Please identify item number being continued.)

APPENDIX G
Program Evaluation

"Electrical Power Generation -- Comparative Costs and Benefits"

Aug. 7-11, 1972

Nuclear Engineering Department, College of Engineering

University of Wisconsin at Madison

This questionnaire is part of an attempt to evaluate the program in which you are participating. Your responses will be helpful in planning future workshops as well as the feedback (evaluation) conference. Additional comments or remarks may be made on the back of this form. Please fill out the form as the Workshop proceeds; it will be collected Friday afternoon. Thank you for your cooperation.

1. In general, the program content was (circle one):

Excellent	Good	Fair	Poor
30	8	0	0
2. In general, the quality of presentations was:

Excellent	Good	Fair	Poor
19	19	0	0
3. My objective(s) in attending this conference was (were):
4. The extent to which I achieved my objective(s) was: part achievement: 3
achievement: 36
5. Briefly define your objectives for your students or community in enrolling in this conference:
6. What did you learn that you did not expect to learn?
7. Do you feel both sides of controversial issues were covered?

Yes: 17
Somewhat: 7
No: 15
8. What topics were not covered that you wished were?
9. Did any topics receive too much emphasis? too little?

10. Was there enough discussion? Yes: 31
No: 8
11. Was there enough opportunity for interaction with staff? with other participants?
Yes: 30
No: 9
12. The strong and weak points of the conference were:
13. Do you feel that the workshop enables you to make an objective value judgement of the various forms of electrical power generation and their environmental effects?
Yes: 29
Somewhat: 6
No: 3
14. Have your own personal views about the growing use of nuclear power to meet the increasing demands for electricity been affected by your attendance at the workshop? If so, in what way?
15. Any suggestions for future conferences on this or related topics?
16. Would you attend such a conference in the future? Yes: 39 No: 0
17. Would you recommend attendance to a person in your organization? Yes: 39 No: 0
18. What topics do you think ought to be covered at the feedback conference?
19. What activities should take place at the feedback conference?
20. Any additional comments?

21. Referring to particular parts of the program, please rate speakers, laboratories, etc., as excellent, good, fair, or poor, adding your own comments where pertinent.

Day	Event	Exc.	Good	Fair	Poor	Comments
Mon.	"Welcome" -- Dean Marshall	16	17	4		
	"Power Uses by our Society" Prof. Carbon	10	25	4	1	
	"History of Nuclear Power" Prof. Maynard	12	25	3		
	"New Developments in Nuclear Power" -- Prof. Maynard	12	20	6		
	"Fossil-Fuel Power -- Status and Prospects" -- Mr. Keshishian	26	11	3		
	"Power Plant Components and Design" -- Mr. Luken	15	17	8		
Tues.	"Operation of Nuclear Reactors" Mr. Cashwell	27	11	2		
	"Nuclear Reactor Safety" Mr. Jordan (AEC)	10	21	8	1	
	"Nuclear Reactor Design and Licensing Requirements" Mr. Fiorelli (AEC)	4	11	16	9	
Wed.	"Thermal Effluents from Power Plants" -- Prof. Lee	32	8			
	"Minimization of Thermal Pollution" -- Prof. Carbon	12	25	3		

Day	Event	Exc.	Good	Fair	Poor	Comments
Wed.	"A Botanist's View of Power Generation and Usage" -- Prof. Loucks	19	11	8	1	
Thurs.	"The Nuclear Fuel Cycle -- Mining to Waste Disposal" -- Prof. Worzala	20	18	2		
	"Controlled Thermonuclear Fusion" Prof. Forsen	24	13	3		
	"The Biological Effects of Radiation" -- Prof. Clifton	17	20	3		
	"The Biological Effects of Fossil Plant Effluents" -- Prof. Clayton	9	24	7		
Fri.	"Alternate Sources of Energy" Prof. Beckman	15	19	5		
	"Industrial Experience with Nuclear Power" -- Mr. Wade Larkin	23	15	1		
	"Energy Policy Formulation" Mr. Eich	4	28	6		
	Laboratory (Reactor Operation)	26	12	1		
	Laboratory (Radiation Measurements)	10	16	9	3	
	Trip	19	16	2	2	
	Panel	24	8			
	Picnic	14	11			

APPENDIX H

WORKSHOP EVALUATION IDEAS FOR IMPROVEMENT

SECTION BLOCKED OUT

Below are listed strong points about the UW program as well as points that should not be overlooked in the development of a future program. Effective use of information is discussed in the next section.

UW-Program Strong Points:

- 1) Financial allowance for participants
- 2) Method used for choosing participants (maximize geographical coverage with particular attention paid to areas surrounding electrical power plants)
- 3) Laboratory on reactor operation and characteristics
- 4) Trip to nuclear generating station
- 5) Informal gathering - picnic
- 6) Length of daily program (approx. 8 hr./day)
- 7) Breadth of topics covered and caliber of speakers

- 8) Handout material and material sent to participants
- 9) Detailed evaluation questionnaire filled out during workshop
- 10) Notification of attendance sent to local newspapers and school officials
- 11) The importance of a feedback conference for maximizing ideas for information use and for the dissemination of additional material of particular interest. Participation in this was enthusiastic and greater than expected.
- 12) Continued contact with participants after conclusion of programs to disseminate updated information and to continue cross-fertilization of participant ideas by distributing to other participants a given participant's related material on information use techniques

OTHER POINTS TO BE CONSIDERED IN THE DEVELOPMENT OF FUTURE WORKSHOPS

- 1) Send out pre-workshop background information packet
- 2) A two week workshop (one week for the development of information use techniques)
- 3) Credit for the (1-2 credits) workshop
- 4) Speakers at night, lunch, and breakfast
(A schedule that varies from day to day)
- 5) Adequate environmentally oriented anti-power viewpoint coverage
- 6) Trip to conventional coal, gas or oil power plant
- 7) Large amounts of time for discussion
- 8) Talks on effective use of information and the use of related material in high school.
- 9) Attitude and knowledge examinations before and after the workshop
- 10) Additional handout material i.e., a package of generally related information to be given to all participants the day the workshop begins; notes on all lectures; copies of slides presented; detailed information bibliography; list of people willing to supply information from his or her field of expertise (within the state)
- 11) Solicit local utilities, large nuclear power companies such as General Electric, Westinghouse, Babcock and Wilcox, Combustion Engineering, etc., The American Nuclear Society, Atomic Energy

Commission, Atomic Industrial Forum, Businessmen for the Public Interest, The Sierra Club, etc., in advance for relevant handout material.

- 12) List of related films available for use from American Nuclear Society, Atomic Energy Commission, Utilities, Sierra Club etc.
- 13) A plan for continued relevant information flow to participants after workshop conclusion

FEEDBACK CONFERENCE EVALUATION THE EFFECTIVE USE OF INFORMATION

SECTION BLOCKED OUT

The conference's purpose was to update information provided the previous summer, re-evaluate the program with constructive suggestions and to discuss the effective use of information. In regard to the latter point, the following summary was prepared.

Method of Information

Use Discussed

Written handout material on specific subjects

Bibliographies of pertinent books and current articles and a list of local people willing to discuss the issues.

Films and Slides

University organized seminars around the state on the topic of ecology and power.

Important Points of

Discussion

The participants indicated that this form of information was the most attractive and easily used. It could be readily modified and integrated into their particular (teaching) approach. They requested as much handout material as possible and that the workshop director continue to send information for as long as possible.

These topics were brought up several times - This information would undoubtedly be helpful and used.

These forms of teaching aids rate highly with students and should be made available to the high school science teachers.

This received some support. However, it was felt that a program of more depth was needed - one that would reach more students over a longer period of time.

Tour programs coordinated with a nearby large power generating station.

The utilities are usually very willing to take part in a program of this sort. A trip like this puts some of the current power related problems into perspective for the high school student and is very worthwhile.

A generalized minicourse^{*†} available for use by all

At the conclusion to the summer workshop the response to this was positive and enthusiastic. In fact, several of the participants actually developed such courses. One of these (enclosed) was distributed to

all the participants prior to the feedback conference and discussed at some length at the conference. The interest was to generalize the minicourse. It was concluded by practically all that generalized minicourses are rarely used even if available. This is because it is difficult to adopt a general technique for material presentation; people like to integrate information into a program they themselves have developed. Therefore, a wealth of subject material and teaching aids such as slides or films would be more beneficial to a diverse group of high school science teachers than a generalized minicourse. The idea would be to integrate whatever information a teacher thought was particularly relevant with his own information and approach to a general subject.

Open communication channels between participants.

The feedback conference was effective in doing this. Lists of attendees and their addresses were made available to all participants. The Dept. of N.E. is temporarily acting as a collection and dissemination station for information any participant feels would be of value to others. This appears to have much support.

* A recent article entitled "NSTA Conducts Nuclear Energy Survey for AIF" appearing in The Science Teacher, Volume 39, Number 9, December 1972 and available from the Atomic Industrial Forum, Inc. substantiates these comments.

†The minicourses distributed to the 1976 Workshop participants were well received. Many thought a minicourse on the subject was a must.