Energy & Environmental Research Center

FISH CONSUMPTION SURVEY: MINNESOTA AND NORTH DAKOTA

EERC Proposal No. 98-0123-R1

Submitted to:

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ABSTRACT

The goal of this Energy & Environmental Research Center project is to determine the fish-eating tendencies of people in North Dakota and Minnesota. This project will focus on the general public and will also target specific subpopulations such as women of child-bearing age (18–44 years), children, and American Indians. This project is the first step in determining the health impacts of mercury on the general public in North Dakota and Minnesota. The survey will provide information that can be used to develop estimates on population exposure to mercury through consumption of fish. The primary components of the project include development of a survey questionnaire, implementation of the survey, analysis of hair from selected respondents for mercury levels, and statistical analysis and reporting.

The proposed project will be coordinated with a project proposed and funded by the Industrial Commission of North Dakota and other groups is entitled "Mercury Formation and Fate." The project is focused on the measurement of mercury species emitted from coal-fired power plants in North Dakota.

Respondents will be targeted through a random selection of Minnesota and North Dakota residents, Women with Infant Children (WIC) Clinics, and through contact with American Indian communities. The primary survey method used will be a mailing, followed by phone interviews. The methodologies used will be consistent with those suggested by the U.S. Environmental Protection Agency. The data will be analyzed using three basic methods: univariate, bivariate, and multivariate analysis. Consumption estimates will be given as single-point estimates and distributions. Distribution data will be presented to allow for maximum flexibility in the use of the data.

FISH CONSUMPTION SURVEY: MINNESOTA AND NORTH DAKOTA

PROJECT SUMMARY

The goal of this Energy & Environmental Research Center (EERC) project is to determine the fish-eating tendencies of people in North Dakota and Minnesota. The survey will provide information that will be used to assess the potential impact that mercury emissions from coal-fired utilities will have on health. In order to meet the goal of the project, the primary objectives include the following: selection of an advisory board; development of a survey questionnaire; implementation of the survey; analysis of hair for mercury levels; and data analysis, interpretation, and reporting. The tasks for the project include the following.

- Task 1 – Selection of an Advisory Board

An advisory board for the project will be selected to review the overall work plan and to provide guidance and direction for the overall project.

- Task 2 – Development of a Survey Questionnaire

The questions in the summary will seek to provide information on the sociodemographic characteristics of fish consumers, types of fish consumed, quantity of fish, characteristics of fishing activities, preparation and consumption patterns, and awareness of the angler with respect to fish consumption advisories. The questionnaire format will be developed through consultation with state and federal agencies and industry participants.

- Task 3 – Implementation of the Survey

This task will involve selecting the population for the survey, developing mailing lists, mailing the survey, phoning respondents, implementing quality assurance and quality control (QA/QC) procedures, and collecting and entering the data into the computer system.

- Task 4 – Analysis of Hair for Mercury Levels

The task will involve the selection of 60 respondents from questionnaires for sampling and analysis of mercury in hair. The selection of prospects for hair sampling will be based on the fish consumption rates of the respondents. A representative distribution of low to high consumption rates will be selected, and consideration will be made for sensitive populations. Appropriate QA/QC procedures will be in place prior to data collection and will be implemented during the sampling and analyses.

- Task 5 – Data Analysis, Interpretation, Reporting, and Deliverables

The data will be analyzed using three basic methods: univariate, bivariate, and multivariate analysis (a Statistical Analysis System [SAS] computer program will be used for analysis of the data). Fish consumption data will be presented in several ways. Consumption estimates will be given as single-point estimates and distributions. Distribution data will be presented to allow for maximum flexibility in the use of the data. The demographic data collected will permit analysis of fish consumption data as a function of ethnic groups, susceptible subpopulations (women of child-bearing age [18–44 years], children, and American Indians. A report will be provided that includes all data, interpretations, and conclusions. A database of information on consumption rates will also be provided.

PROJECT DESCRIPTION

Goal

The goal of this project is to determine fish consumption patterns in Minnesota and North Dakota that can be used to develop estimates on population exposure to mercury. This project will focus on the general public and will target specific subpopulations such as women of child-bearing age, children, and American Indians. This project is the first step in determining the health impacts of mercury on the general public.

Objectives

In order to meet the goal of the project, the primary objectives include the following: selection of an advisory board; development of a survey questionnaire, implementation of the survey, analysis of hair for mercury levels, and data analysis, interpretation, and reporting.

Work Plan

Task 1 – Selection of an Advisory Board

An advisory board for the project has been selected and includes representatives from the state health departments of North Dakota and Minnesota, the U.S. Department of Energy (DOE), game and fish departments, national organizations (EPRI and National Fisheries Institute), and industry partners.

The responsibilities of the advisory board will be to review the overall work plan and provide guidance and direction for the overall project. The board will meet at the initiation of project personnel to review and approve the work plan; at the completion of Task 2, Development of a Survey Questionnaire, to review the questionnaire; upon completion of the survey to assist in selecting questionnaire respondents for hair sampling and analysis; review data and analysis methods; and to review the final report.

Task 2 – Development of a Survey Questionnaire

The most significant pathway for human exposure to mercury is through the consumption of fish that have high mercury levels resulting from bioaccumulation. In order to characterize the potential for human exposure, it is necessary to identify the exposed population, determine the quantity of fish consumed, and determine the level of mercury in the fish consumed. This task will develop a survey to identify the exposed populations and determine the quantity of fish consumed. The questionnaire will be designed based on U.S. Environmental Protection Agency (EPA)

guidelines (1) and input from the advisory board. Examples of questionnaires that will be considered for use in this project are attached as Appendix A.

Task 3 – Implementation of Survey

Implementation will involve several steps, including: 1) selection of population, 2) development of a mailing list and subsequent mailing to target respondents, 3) phone interviews with selected respondents, 4) ensuring that all quality assurance and quality control procedures are in place, and 5) entering data into a database program.

Subtask 3.1 Selection of a Population

The population selected to be surveyed will include people from the general population as well as sensitive populations of North Dakota and Minnesota, including American Indians, women of child-bearing age, and children. The specific populations to be included in the survey will be determined based on input from the project advisory board. The total number of surveys that will be sent will be approximately 7000. This will include surveys conducted through Women with Infant Children (WIC) clinics and American Indian tribes.

Subtask 3.2 Development of Mailing List and Mailing of Survey Questionnaires

The mailing will include a cover letter describing the project and the importance of respondent input and a copy of the questionnaire. The questionnaire will also ask for a phone number to allow for follow-up contact on questionnaire responses. Contact with potential respondents will be conducted in a manner consistent with University of North Dakota Institutional Review Board (IRB) policy. A copy of the UND IRB Human Subjects Review Form as approved for this project is attached as Appendix A.

Subtask 3.3 Telephone Interviews

Telephone interviews will be conducted as a follow-up for returned surveys that require more information or clarification. In addition, phone interviews will be conducted with respondents selected for hair sampling as described in Task 4.

Subtask 3.4 Quality Assurance/Quality Control

The EERC has an established quality assurance program. David Brekke of the EERC is the Quality Assurance Manager and reports to Dr. Michael Jones, who is the Associate Director for Industrial Relations and Technology Commercialization and does not have responsibility for conducting or managing research or development projects at the EERC.

The EERC is committed to delivering consistent and high-quality research that meets our clients' needs and expectations. In order to ensure that the goals of this project are realized, an organization-wide quality management system (QMS), authorized and supported by EERC managers, is in effect and governs all programs within the organization. The EERC established and formalized a QMS and quality control procedures in August 1988. The *Quality Manual* (2) defines the requirements and the organizational responsibilities for each major element of the QMS and references the supporting documents needed to provide a comprehensive program. Compliance with this manual and its supporting documents assures that the EERC adequately fulfills governmental and private clients' requirements relating to quality and compliance with applicable regulations, codes, and protocols. This project is required to follow the *Quality Manual*, project-specific quality assurance procedures, and all revisions. The EERC quality assurance manager implements and oversees all aspects of QA/QC for all research, development, and demonstration projects and will review the QA/QC components of this project. The project manager is responsible for ensuring that project specific QA/QC protocols are followed.

The EERC maintains a wide range of laboratories and equipment for solid, liquid, and gaseous characterization of the physical, chemical, mineralogical, biological, hydrological, and geological properties of natural and synthetic materials and processes. Laboratory procedures and instrument calibrations follow nationally recognized or approved standards and methods put forth by EPA, American Society for Testing and Materials (ASTM), National Institute of Standards and Technology (NIST), and other agencies. Each laboratory manager is responsible for ensuring that the applicable QA/QC procedures in this project are implemented. The following QA/QC requirements are specific to this project.

Subtask 3.5 Database Development

All data obtained will be entered into a database program that is compatible with the SAS program used in Task 5 to statistically analyze the data.

Task 4 – Analysis of Hair for Mercury Levels

This task involves the selection of respondents and the sampling and analysis of hair. A total of 60 hair samples will be analyzed. Respondents will be selected based on survey results and input from the advisory board. The sampling procedures will be consistent with those conducted by D. Airey (3) and Gerstenberger et al. (4). Samples of hair will be taken from respondents from as close to the scalp as possible at the center near the back of the head. A pencil-width section of hair is optimum for collection. Smaller quantities will be obtained from respondents with short hair, thin hair, or personal concerns. Samples will be sealed in a freezer bag and labeled. The total mercury content will be determined through the use of cold-vapor atomic absorption (CVAA) (5).

Task 5 – Data Analysis, Interpretation, and Reporting

Fish consumption rates will be determined based on survey data. Efforts will be made to determine the fish consumption rates for the general population, women (18 to 44 years), children, and American Indians. In addition, efforts will be made to determine the consumption rates of

various types of fish/seafood. The first step is to analyze the data using standard statistical methods. The second step is to calculate the mean consumption rates for the populations and fish types of interest. The final step, where data are available, is to develop the relationship between the mercury level in respondents' hair to fish consumption rates when the level of mercury in the fish consumed can be estimated. The procedures, data, results of analyses, interpretations and conclusions will be summarized in a report.

Subtask 5.1 Statistical Analysis

The data will be analyzed using three basic methods: univariate, bivariate, and multivariate analysis (SAS will be used for analysis of the data).

- Univariate analysis will examine one variable at a time for purposes of describing the survey sample and will be presented in frequency distributions, measures of central tendency (mean, median, or mode), and measures of dispersion (range, standard deviation). Measures of central tendency and dispersion are applicable only to interval and ratio data.
- Bivariate and multivariate analyses are used to examine associations among variables. In bivariate analyses, one variable is used to explain the distribution of another variable. In multivariate analysis, two or more variables are used in combination to explain the distribution of another variable.
- Fish consumption data will be presented in several ways. Consumption estimates will be given as single-point and interval estimates of the mean, 50th, 75th, and 90th percentiles of the distribution.

Subtask 5.2 Calculation of Consumption Rates

Fish consumption rates will be calculated based on the demographic information available. The estimates of the consumption rates will be based on the weight of fish consumed on an "as-

consumed basis." Information in a recipe file available from the U.S. Department of Agriculture will be used to calculate the amount of fish used in recipes if necessary (6).

Subtask 5.3 Relationship Between Fish Consumption and Mercury Levels in Hair

The results obtained from the mercury analysis of the hair will be compared to the fish consumption rate information. In addition, if data are available on the average level of mercury in fish species consumed, the mercury consumption rate can be estimated and compared to reference dosage for adults, women (18–44 years), and children.

Subtask 5.4 Final Report

A report will be prepared that summarizes all procedures, results, discussion, and conclusions.

DELIVERABLES

A report will be provided that includes all data, interpretations, and conclusions. A database of information on consumption rates will also be provided.

STANDARDS OF SUCCESS

QA/QC procedures will be implemented at the onset of the project to ensure that the quality objectives of the project are met. The QA/QC procedures will be independently reviewed by the EERC's Quality Assurance Manager (see discussion in Subtask 3.4 of the work plan).

BACKGROUND

The quantity of mercury mobilized and released into the environment has increased since the beginning of the industrial age. Much of the contamination to the aquatic environment has been attributed to atmospheric mercury sources (7). The atmospheric sources are largely due to anthropogenic activities. Mercury—specifically methylmercury—has been identified to be a neurotoxin and has the

highest potential health effects on the developing fetus and children (8). Fish consumption is the dominant pathway for human and wildlife exposure to mercury. In December 1997, the *Mercury Study Report to Congress* (9) provided an assessment of the magnitude of U.S. mercury emissions by source, the health and environmental implications of those emissions, and the availability and cost of control technologies. The report did not quantify the risk from mercury exposure because of uncertainties in a number of areas, with one being the actual human fish consumption patterns. In addition, Stern and others (10) indicate that "Despite scientific attention placed on the toxicology of methylmercury, little is known about the population exposure to this compound."

Natural and anthropogenic processes have an impact on the overall mercury cycle. There are several forms of mercury in the environment, including elemental mercury (gas), ionic mercury (gas), inorganic mercury salts (solids), and organic mercury (i.e., methylmercury). Mercury in the atmosphere is mostly in the elemental form; however, some is present in the ionic form. The elemental form can remain in the atmosphere for as long as a year and can be transported thousands of miles from its source prior to deposition. The primary method of mercury deposition is through wet deposition (8) from the atmosphere to surface water and land. Dry deposition can also occur. The ionic and particulate form of atmospheric mercury is less likely to be transported long distances and will be deposited close to the source through wet and dry deposition. After deposition, there is also evidence for mercury cycling between the atmosphere, land, and water, which is not completely understood. Upon deposition, mercury is methylated, which is considered the key step in the entrance of mercury into the food chain (11). The methylation process from inorganic mercury is a biotransformation process that occurs in the sediments and the water (9). Once in the form of methylmercury, it is transferred to planktivorous and piscivorous fish through their diets (9). Methylmercury in smaller fish are passed up the food chain and accumulated in the fish muscle tissue.

Concern over potential human health risks associated with chemically contaminated fish and shellfish has led many states to issue consumption advisories and bans in an effort to limit exposures to certain organic compounds and metals that may become concentrated in the tissues of these fish. The consumption of fish is highly variable across the U.S. population. The most recent compilation of information regarding fish consumption among the general U.S. population is compiled in Volume IV of the *Mercury Study Report to Congress* (9). The inclusion of fish in diets varies with geographic location, seasons of the year, ethnicity, and personal food preferences. Jacobs and others (12) in a recent analysis of the U.S. Department of Agriculture (USDA) *Continuing Survey of Food Intake by Individuals* (CSFII) (13–15) estimated food consumption rates for three fish habitats: freshwater/estuarine fish, marine, and all fish. The estimated fish consumption rates for all fish for the U.S. population was 15.65 grams/person/day, with 4.71 grams/person/day from freshwater/estuarine sources and 10.94 grams/person/day from marine sources. The average consumption rate for women aged 18–44 years from all sources was found to be 14.25 grams/person/day. The results were reported on an as-consumed basis with consideration given for weight loss or weight gain during cooking.

Another recent study of 1000 randomly selected New Jersey residents (11) found the consumption rates (mean) for all adults to be 50.2 grams/day and for women aged 18–40 years to be 41 grams/day. They also estimated the mean methylmercury intake of 7.5 μg/day for all adults and 6.3 μg/day for women (18–40 years).

Ebert and others (16) reviewed fish consumption surveys and found the mean rates of fish consumption ranged from 2 to 31 grams/day on the basis of surveys of anglers from selected states and river systems and the general U.S. population. Ebert and others (16) surveyed 2500 licensed resident anglers in Maine; that survey indicated an annual average consumption rate of freshwater river fish of 3.7 grams/day.

Fish consumption data are essential in developing advisories and bans, and they also play an integral role in developing water quality criteria. For humans, a technique that has often been used to obtain consumption data is to conduct a survey in which respondents are asked to estimate the species of fish consumed, how much fish tissue they consume, and the frequency at which it is consumed or to record actual consumption on a daily basis. The methodology for conducting the survey will be consistent with the "Guidance for Conducting Fish and Wildlife Consumption Surveys" (1). Examples of surveys are attached in Appendix A.

Ebert and others (17) have reviewed fish consumption rate estimates for use in regulatory processes. They suggest three critical factors to be considered when using fish consumption rates for assessment of risks:

1. Identification of specific populations most likely to be affected.
2. Selection of fish consumption rates for a specific geographical area. Differences in climate, target fish species, length of fishing season, and cultural/ethnic backgrounds can significantly influence consumption rates.
3. Consideration of the type of water body or fishery.

Fish consumption rate estimates can be used in conjunction with the U.S. Food and Drug Administration (FDA) criteria on mercury exposure to estimate safe levels of fish consumption. The FDA has established estimates for oral exposure to methylmercury. The tolerable daily intake (TDI) for mercury is 0.3 mg/person/week, of which no more than 0.2 mg/person/week should be present as methylmercury. The tolerable amount is 230 μg/week for a 70-kg person (18). The tolerable levels of methylmercury intake are based upon mercury contents in blood and hair at which toxic effects were observed.

Sampling and analysis of head hair for mercury levels are used to indicate a person's exposure to mercury (3, 4, 19–20). The levels of mercury in hair have been shown to increase with increased

frequency of fish consumption. Analyses for mercury content of hair and blood samples from fish-eating subjects from New Guinea (19) concluded that a strong relationship exists between fish consumption and the mercury content of hair.

QUALIFICATIONS

The EERC was established in 1951 and is located in Grand Forks, North Dakota. A former DOE facility, the EERC was successfully defederalized in 1983 and became part of the University of North Dakota. The EERC is recognized internationally for developing, field-testing, and demonstrating technologies in energy conversion, pollution prevention, environmental control, and waste remediation and utilization. The EERC has a rapidly growing customer base worldwide, specializing in multiclient consortia and serving as a broker in government–industry partnerships. Approximately 70% of its contracts are with industrial clients. The EERC offers comprehensive technical support with its highly experienced specialists, state-of-the-art facilities for chemical and physical testing, and advanced analytical capabilities and can provide a variety of field demonstration sites and systems analysis to identify technologies with the greatest potential for deployment and commercialization.

Project Manager

Dr. Steven A. Benson will act as overall project manager and will be involved in all tasks of the program. Dr. Benson is an Associate Director for Research at the EERC of the University of North Dakota and the Director of the EERC's EPA-funded Center for Air Toxic Metals (CATM). He received his Ph.D. in Fuel Science from the Pennsylvania State University in 1987 and his B.S. in Chemistry from Moorhead State University in 1977. Dr. Benson's principal areas of interest and expertise include behavior and fate of trace elements in the environment, including mercury, in process systems; transformations of inorganic components in combustion and gasification; associations of major, minor, and trace

elements in fuels; ash slagging and fouling in utility boilers; and scanning electron microscopy/ microprobe analysis.

Principal Investigators

Dr. John Erjavec will be involved in the development of the survey and statistical methods of data interpretation. Dr. Erjavec received his Ph.D. and M.S.E. in Chemical Engineering from the University of Wisconsin in 1972 and 1966, respectively, and his B.S.E. in Chemical Engineering from Princeton University in 1965. He also completed a minor in Statistics from the University of Wisconsin in 1972. Dr. Erjavec has significant expertise in statistics and statistical analysis of large databases. He has used statistical methods for experimental design. Dr. Erjavec also teaches classes on statistics at the University of North Dakota. Dr. Erjavec's principal areas of expertise include chemical process modeling, engineering economics, engineering statistics, process dynamics and control, including the use of advanced techniques (e.g., A/I), and mass-transfer operations. Dr. Erjavec is an Associate Professor in the Department of Chemical Engineering at the University of North Dakota.

Ms. Constance Wixo will be involved in the development of the survey questionnaire and implementation of the survey. Ms Wixo is an Administrative Manager at the EERC and received a B.B.A. in Management and a minor in Psychology from the University of North Dakota in 1992. Ms. Wixo has 25 years of experience in communications, scheduling, document production, and other related activities. She also coordinates the publication of books, technical journals, and peer-reviewed articles and functions as editor of the *CATM Newsletter*. Ms. Wixo has been integrally involved in various survey projects through her academic training and through involvement in projects performed at the EERC. One of these projects, performed under contract to DOE, included a survey, workshop, and report that resulted in DOE's *Report to Congress: Barriers to the Increased Utilization of Coal Combustion/Desulfurization Byproducts by Governmental and Commercial Sectors*, published in July 1994.

Ms. Carolyn Lillemoen will be involved in the analyses of hair samples to determine mercury levels. Ms. Lillemoen is a Research Chemist and the Manager of the Analytical Research Laboratory at the EERC. She received her B.S. in Biology with a Chemistry minor from the University of North Dakota in 1984 and her B.S.Ed. in Science from the same institution in 1986. Ms. Lillemoen's principal areas of interest and expertise include atomic absorption spectroscopy (flame, graphite furnace, cold-vapor, and hydride generation), inductively coupled argon plasma spectroscopy, and analytical quality control. She has coauthored numerous publications. Ms. Lillemoen has worked extensively with microwave digestion methods of solid materials for the determination of mercury and other trace metals and has considerable experience with leaching characterization of waste materials for environmental impact. Prior to her position at the EERC, she worked with professors in the University of North Dakota Biology Department using immunoassays.

VALUE TO NORTH DAKOTA

Information on the potential impact of mercury on human health through the consumption of fish is important for the health of North Dakotans as well as the assessment of the impact of power production from North Dakota lignite on mercury in fish.

MANAGEMENT

The direction of the project will be coordinated through an advisory committee that consists of industry participants, representatives from the state health organizations, the Industrial Commission of North Dakota's technical representative, and federal government representatives from DOE and EPA. Letters of support and commitment to participate in the project are attached as Appendix C. The overall project management structure is illustrated in Figure 1. The project manager will be Dr. Steve Benson, who will be responsible for the coordination of the EERC effort. The overall questionnaire will be

developed by the project team, which includes the advisory committee, project manager, and principal investigators. Dr. John Erjavec will be responsible for developing the implementation plan for the questionnaire to ensure proper statistical analysis of the data and will perform statistical analysis on the data. Ms. Constance Wixo will be responsible for the implementation of the survey, collecting data, and data entry. Ms. Carolyn Lillemoen will be responsible for collection and analysis of hair samples.

TIMETABLE

The duration of the project will be approximately 1 year. The time line for the project is shown in Table 1.

BUDGET

The overall budget for the project is attached. A laptop computer will be purchased for the project that will be used for data entry during visits to respondents off-site.

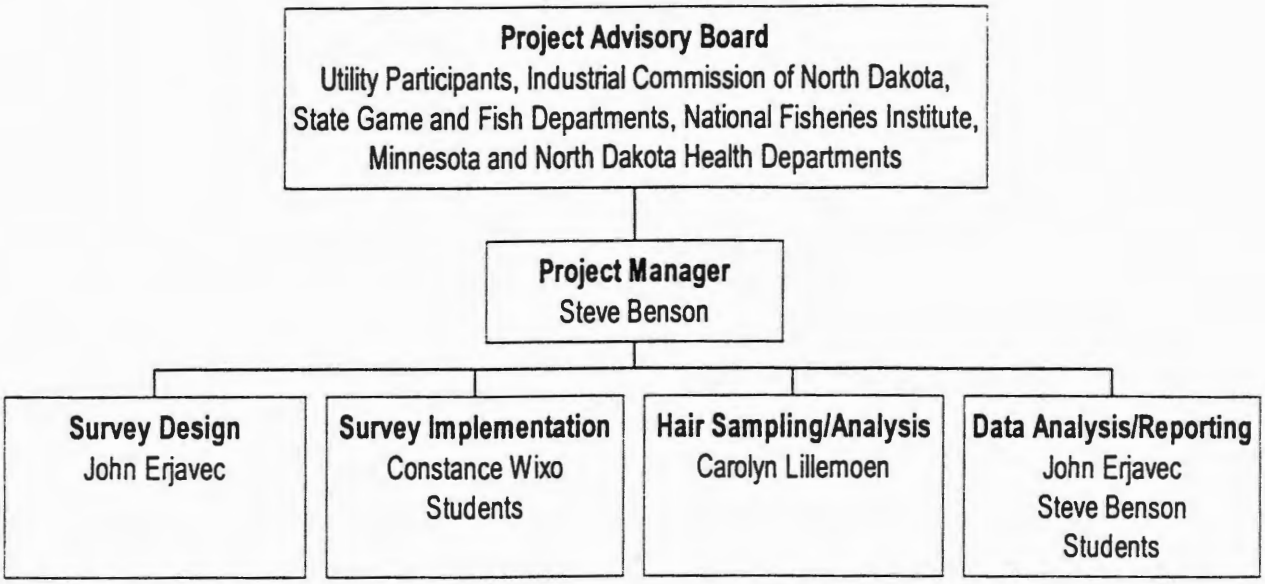

Figure 1. Project management structure for fish consumption survey project.

TABLE 1

Project Schedule in Project Months

Task	1	2	3	4	5	6	7	8	9	10	11	12
Task 1 – Selection of Advisory Board	■	■										
Task 2 – Survey Development		■	■									
Task 3 – Survey Implementation			■	■	■	■	■	■	■	■		
Task 4 – Hair Sampling/Analysis							■	■	■	■		
Task 5 – Data Analysis/Reporting									■	■	■	■

MATCHING FUNDS

Several utility participants have expressed an interest in possibly funding the program. These include Northern States Power Company, Cooperative Power Association, and Minnesota Power. The industry participants will contribute $13,000 each for a total of $39,000. These funds will be matched with $39,000 from the Industrial Commission of North Dakota; funding is also being sought from the State of Minnesota through the Department of Health and the Minnesota Pollution Control Agency for $40,000. These funds will be matched with DOE Jointly Sponsored Research Program funds of $78,700 available through the EERC, for a total project funding level of $196,700.

TAX LIABILITY

Not applicable.

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SUMMARY BUDGET

FISH CONSERVATION SURVEY: MINNESOTA & ND
MULTI SPONSORS/DOE
PROPOSED START DATE: 11/1/98
EERC PROPOSAL #98-0123-R1 11-Sep-98

		TOTAL		COMMERCIAL SHARE		MINNESOTA STATE AGENCIES		NDIC SHARE		EERC JSRP SHARE	
		HOURS	$ COST	HOURS	$ COST	HOURS	$ COST	HOURS	$ COST	HOURS	$ COST
TOTAL DIRECT LABOR		3232	$68,368	672	$13,933	512	$12,950	632	$13,331	1416	$28,154
FRINGE BENEFITS - % OF DIRECT LABOR	52%		$35,551		$7,245		$6,734		$6,932		$14,640
TOTAL LABOR			$103,919		$21,178		$19,684		$20,263		$42,794
OTHER DIRECT COSTS											
TRAVEL			$10,529		$800		$2,275		$2,850		$4,604
SUPPLIES			$500		$100		$100		$100		$200
EQUIPMENT > $750			$4,000		$0		$0		$0		$4,000
COMMUNICATIONS - PHONES & POSTAGE			$866		$103		$211		$104		$448
OFFICE (PROJECT SPECIFIC SUPPLIES)			$662		$213		$25		$217		$207
FEES (AND SUBCONTRACTS)			$11,292		$2,930		$3,679		$1,790		$2,893
TOTAL OTHER DIRECT COST			$27,849		$4,146		$6,290		$5,061		$12,352
TOTAL DIRECT COST			$131,768		$25,324		$25,974		$25,324		$55,146
INDIRECT COST - % OF MTDC		VAR	$64,906	54%	$13,676		$14,026	54%	$13,676	46%	$23,528
TOTAL ESTIMATED COST			$196,674		$39,000		$40,000		$39,000		$78,674

NOTE: Due to limitations within the university's accounting system, the system does not provide for accumulating and reporting expenses at the Detailed Budget level. The Summary Budget is presented for the purpose of how we propose, account, and report the expenses. The Detailed Budget is presented to assist in the evaluation of the proposal.

DETAILED BUDGET

FISH CONSU[illegible]ION SURVEY: MINNESOTA & ND
MULTI SPONSORS/DOE
PROPOSED START DATE: 11/1/98
EERC PROPOSAL #98-0123-R1 11-Sep-98

LABOR	LABOR CATEGORY	HOURLY RATE	TOTAL HOURS	TOTAL $ COST	COMMERCIAL SHARE HOURS	COMMERCIAL SHARE $ COST	MINNESOTA STATE AGENCIES HOURS	MINNESOTA STATE AGENCIES $ COST	NDIC HOURS	NDIC $ COST	DOE SHARE HOURS	DOE SHARE $ COST
S. BENSON	PROJECT MANAGER	$41.27	450	$18,571	110	$4,540	90	$3,714	100	$4,127	150	$6,190
C. LILLEMOEN	PRINCIPAL INVESTIGATOR	$20.54	320	$6,573	0	$0	80	$1,643	20	$411	220	$4,519
J. ERJAVEC	RESEARCH SCIENTIST/ENGINEER	$34.23	375	$12,836	50	$1,712	80	$2,738	50	$1,712	195	$6,674
C. WIXO	RESEARCH TECHNICIAN	$18.18	895	$16,271	263	$4,781	142	$2,582	252	$4,581	238	$4,327
----------	SENIOR MANAGEMENT	$41.16	80	$3,292	18	$741	25	$1,029	14	$576	23	$946
----------	QUALITY CONTROL MANAGER	$21.85	20	$436	2	$44	5	$109	3	$66	10	$217
----------	RESEARCH TECHNICIAN	$14.78	140	$2,068	25	$370	20	$296	25	$370	70	$1,032
----------	STUDENT ASSISTANTS	$6.78	832	$5,641	184	$1,248	45	$305	148	$1,003	455	$3,085
----------	TECHNICAL SUPPORT SERVICES	$11.18	120	$1,340	20	$224	25	$280	20	$224	55	$612
			3232	$67,028	672	$13,660	512	$12,696	632	$13,070	1416	$27,602
ESCALATION ABOVE CURRENT BASE		2%		$1,340		$273		$254		$261		$552
TOTAL DIRECT LABOR				$68,368		$13,933		$12,950		$13,331		$28,154
FRINGE BENEFITS - % OF DIRECT LABOR		52%		$35,551		$7,245		$6,734		$6,932		$14,640
TOTAL LABOR				$103,919		$21,178		$19,684		$20,263		$42,794
OTHER DIRECT COSTS												
TRAVEL				$10,529		$800		$2,275		$2,850		$4,604
SUPPLIES				$500		$100		$100		$100		$200
EQUIPMENT > $750				$4,000		$0		$0		$0		$4,000
COMMUNICATIONS - PHONES & POSTAGE				$866		$103		$211		$104		$448
OFFICE (PROJECT SPECIFIC SUPPLIES)				$662		$213		$25		$217		$207
GRAPHICS				$1,010		$58		$700		$58		$194
ANALYTICAL RESEARCH LAB.				$10,282		$2,872		$2,979		$1,732		$2,699
TOTAL OTHER DIRECT COST				$27,849		$4,146		$6,290		$5,061		$12,352
TOTAL DIRECT COST				$131,768		$25,324		$25,974		$25,324		$55,146
INDIRECT COST - % OF MTDC			VAR	$64,906	54%	$13,676	54%	$14,026	54%	$13,676	46%	$23,528
TOTAL ESTIMATED COST				$196,674		$39,000		$40,000		$39,000		$78,674

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

Background

The EERC is an independently organized multidisciplinary research center within the University of North Dakota. The EERC receives no appropriated funding from the state of North Dakota and is funded through federal and nonfederal grants, contracts, or other agreements. Although the EERC is not affiliated with any one academic department, university academic faculty may participate in a project based on the scope of work and expertise required to perform the project.

The proposed work will be done on a cost-reimbursable basis. The distribution of costs between budget categories (labor, travel, supplies, equipment, subcontracts) is for planning purposes only. The principal investigator may, as dictated by the needs of the work, reallocate the budget among approved items or use the funds for other items directly related to the project, subject only to staying within the total dollars authorized for the overall program. The budget for this proposal has been prepared based on a specific start date; this start date is indicated at the top of the EERC detail budget or identified in the body of the proposal. Please be aware that any delay in the start of this project may result in an increase in the budget. Financial reporting will be at the total project level.

Salaries and Fringe Benefits

As an interdisciplinary, multiprogram, and multiproject research center, the EERC employs an administrative staff to provide required services for various direct and indirect support functions. Direct project salaries are estimated based on the scope of work and prior experience on projects of similar scope. Technical and administrative salaries are charged based on direct hourly effort on the project. Costs for general support services, such as grants and contracts administration, accounting, personnel, purchasing and receiving, as well as clerical support of these functions, are included in the indirect cost of the EERC.

Fringe benefits are estimated based on historical data. The fringe benefits actually charged consist of two components. The first component covers average vacation, holiday, and sick leave (VSL) for the EERC. This component is approved by the UND cognizant audit agency and charged as a percentage of direct labor on permanent staff employees eligible for VSL benefits. The second component covers actual expenses for items such as health, life, and unemployment insurance; social security matching; worker's compensation; and UND retirement contributions.

Travel

Travel is estimated based on UND travel policies, which include estimated GSA daily meal rates. Travel includes scheduled meetings and conference participation as indicated in the scope of work.

Communications (Phones and Postage)

Monthly telephone services and fax telephone lines are included in indirect cost. Direct project cost includes long-distance telephone including fax-related long-distance calls; postage for regular, air, and express mail; and other data or document transportation costs.

Office (Project Specific Supplies)

General purpose office supplies (pencils, pens, paper clips, staples, Post-it notes, etc.) are provided through a central storeroom at no cost to individual projects. Budgeted project office supplies include items specifically related to the project: special research notebooks, binders, and other project organizational

materials; duplicating, printing, special covers or paper, and binding of reports; project data forms, transparencies or other presentation materials; literature searches and technical information procurement, including subscriptions; manuals, computer diskettes, memory chips, laser printer paper, and toner cartridges; and other miscellaneous supplies required to complete the project.

Data Processing

Data processing includes items such as site licenses and computer software.

Supplies

Supplies in this category include scientific supply items such as chemicals, gases, and glassware and/or other project items such as: nuts, bolts, and piping necessary for pilot plant operations.

Fees

Laboratory and analytical fees are established and approved at the beginning of each fiscal year and are charged based on a per sample or hourly charge depending on the analytical services performed. Additionally, laboratory analyses may be performed outside the University when necessary.

Engineering support fees are based on an established per hour rate for drafting services related to the production of drawings as part of EERC's quality assurance/quality control program for complying with piping and pressure vessel codes.

Graphic services fees are based on an established per hour rate for overall graphics production such as report figures, poster sessions, standard word or table slides, simple maps, schematic slides, desktop publishing, photographs, and printing or copying.

Shop and operation fees are for expenses directly associated with the operation of the pilot plant facility. These fees cover such items as training, safety (protective eye glasses, boots, gloves), and physicals for pilot plant and shop personnel.

General

Membership fees (if included) are for memberships in technical areas directly related to work on this project. Technical journals and newsletters received as a result of a membership are used throughout development and execution of the project as well as by the research team directly involved in project activity.

General expenditures for workshops and conferences may include such items as food (some of which may exceed the institutional established limits), room amenities (e.g., place cards, music, banners, floral arrangements), speaker gifts, security, interpreters, technical tour transportation, and room and equipment rental necessary to conduct workshops and conferences.

Indirect Cost

The indirect cost rate included in this proposal is the rate which became effective July 1, 1995. Indirect cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of $750 and subcontracts/subgrants in excess of the first $25,000 of each award.