

BENEFITING AGRICULTURE THROUGH COAL ASH USE

EERC Proposal No. 2004-0236

Submitted to:

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North Dakota Industrial Commission
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State Capitol, 10th Floor
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Amount Requested: \$16,000

Submitted by:

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April 2004

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BENEFITING AGRICULTURE THROUGH COAL ASH USE

ABSTRACT

The University of North Dakota (UND) Energy & Environmental Research Center (EERC) and Power Products Engineering (PPE) propose to work with North Dakota utilities, the North Dakota Industrial Commission (NDIC), and the U.S. Department of Energy National Energy Technology Laboratory to demonstrate the use of North Dakota lignite ash in applications specific to regional agriculture needs. These applications will involve the use of coal ash to stabilize soils in areas such as feedlot surfaces, feed storage, composting pads, containment systems, and cattle-working areas.

For the past 4 years, the EERC, North Dakota State University Carrington Research Extension Center, and PPE demonstrated the use of regional coal ashes in feedlot pens. With evidence presented in this study, the North Dakota Department of Health (NDDH) approved the use of four regional coal fly ashes, but limited the use to departmentally approved feedlot facilities. There are only 40 departmentally approved feedlot facilities in North Dakota.

The recently completed study and over 10 years of previous data have produced a preponderance of evidence that shows coal ash used as a soil stabilizer has no negative effect to runoff or the environment.¹ This body of data strongly suggests that coal ash is suitable for use in all feedlot settings, but NDDH needs convincing. This project will continue work with NDDH to develop a list of approved agriculture-related beneficial uses for coal ash.

The total cost for this 1-year project is \$49,230, of which \$16,000 is being requested from NDIC.

¹ Pflughoeft-Hassett, D.F.; Dockter, B.A.; Hassett, D.J.; Heebink, L.V.; Solc, J.; Buckley, T.D. *Demonstration of Coal Ash for Feedlot Surfaces*; Energy & Environmental Research Center Report 2004-EERC-02-10 to U.S. Department of Energy National Energy Technology Laboratory and Project Sponsors; Feb 2004; Sweeten, J.W. *Feedlot Surface Condition – Coal Ash Surfacing versus Control*; Texas Agricultural Extension Service Result Demonstration Report; 1996; Greenless, W.J.; Pitt, J.M.; Dawson; M.R.; Chriswell C.D.; Melvin, S.W. *Stabilizing Cattle Feedlot Soil with Fluidized Bed Combustor Ash*. *Trans ASAE*. **1998**, 41 (1), 203–211; Midwest Fly Ash and Materials. *Use of Class C Fly Ash for Livestock Feedlot Applications*; Bulletin No. 1; American Coal Ash Association. *Livestock Pads Made from CCPs. ACAA Ash at Work*; April 1999; p 21; Daines, M. *Lime-Enriched FGD Product for Feedlot and Hay Storage Base*. Handout at the 1997 EERC CCB Utilization Workshop, Minneapolis, MN, Sept 29–30, 1997.

BENEFITING AGRICULTURE THROUGH COAL ASH USE

PROJECT SUMMARY

For the past 4 years, the University of North Dakota (UND) Energy & Environmental Research Center (EERC), the North Dakota State University (NDSU) Carrington Research Extension Center (CREC), and Power Products Engineering (PPE) have demonstrated the environmental, engineering, and technical feasibility of utilizing fly ash to stabilize feedlot soils. The proposed effort will build on the success of the previous effort by demonstrating new applications and educating the regional agriculture community and the North Dakota Department of Health (NDDH) on the environmental and economic benefits of using coal ash to stabilize soils in various agriculture applications.

The primary objective of the proposed effort is to demonstrate the use of coal ash use in soil stabilization in various regional agriculture applications including feedlot surfaces, feed storage, compost pads, containment systems, and cattle-working areas. Supporting objectives are as follows:

- Identify appropriate soil–ash mixtures for various soil stabilization applications and soil types.
- Conduct up to ten demonstrations that showcase the various potential use applications with cooperation from the regional agriculture community.
- Evaluate real-world performance of the demonstration.
- Work with NDDH and the North Dakota Department of Agriculture (NDDA) to develop a list of approved agriculture-related beneficial uses for coal ash.

- Develop a protocol for approving coal ash applications in the state of North Dakota with cooperation from NDDH and NDDA.
- Train NDSU Extension Service staff, county extension agents, and livestock producers and farmers how to use coal ash to stabilize soils in the proposed applications through hands-on experience at demonstration sites.
- Promote project results to the North Dakota agriculture community.

This proposal is requesting \$16,000 in support from the North Dakota Industrial Commission (NDIC) through the Lignite Research Council to match industrial funds anticipated from Great River Energy and Otter Tail Power Company. Further funding will be requested from the U.S. Department of Energy (DOE) Jointly Sponsored Research Program (JSRP) at the EERC. The total cost of this project will be \$49,230. The State Board of Agriculture Research and Education has also agreed to contribute to a parallel effort to be conducted by NDSU CREC and PPE.

PROJECT DESCRIPTION

Introduction

The EERC, NDSU CREC, and PPE recently completed a 4-year study that analyzed the environmental and engineering performance of coal ash for use in feedlot soil stabilization and its technical and economical feasibility. The study resulted in the approval of four regional coal fly ashes for use in feedlots approved by NDDH. Although this determination is a significant milestone toward increasing coal ash utilization in the state, NDDH's determination is limited to about 40 departmentally approved feedlots (1).

The original project was successful in the completion of its goals, but more work remains in getting coal ash approved for other feedlot applications and to train area people on how to

properly place coal ash in their own feedlot settings. The proposed effort will address these issues by continuing its work with NDDH and conducting additional technology transfer activities. The EERC, NDSU, utilities, and agriculture community agree that promoting this and other agriculture-related uses has a great potential to benefit North Dakota agriculture.

Goals and Objectives

The primary objective of the proposed effort is to demonstrate the use of coal ash use in soil stabilization in various regional agriculture applications, including feedlot surfaces, feed storage, compost pads, containment systems, and cattle working areas. Supporting objectives are to:

- Identify appropriate soil–ash mixtures for various soil stabilization applications and soil types.
- Conduct up to ten demonstrations that showcase the various potential use applications with cooperation from the regional agriculture community in a select number of locations.
- Evaluate real-world performance of the demonstration.
- Work with NDDH and NDDA to develop a list of approved agriculture-related beneficial uses for coal ash.
- Develop a protocol for approving coal ash applications in the state of North Dakota with cooperation from NDDH and NDDA.
- Train NDSU Extension Service staff, county extension agents, livestock producers, and farmers how to use coal ash to stabilize soils in the proposed applications through hands-on experience at demonstration sites.
- Promote project results to the North Dakota agriculture community.

Methodology

The proposed effort will be performed over 1 year. Specific tasks are detailed below.

Task 1: Quality Assurance/Quality Control

Coal fly ash from Great River Energy's Stanton and Coal Creek Stations and Otter Tail Power Company's Coyote and Hoot Lake Stations were approved by the NDDH for use in feedlot soil stabilization. These four coal ashes are required to be reevaluated every year for this application.

The EERC proposes to perform bulk chemistry and leachate analysis on up to eight materials (fly ash and bottom ash) for presentation to NDDH in conjunction with previously assembled environmental characterization data. Standard procedures, already agreed upon by NDDH, will be used to determine chemical composition and leaching characteristics.

Task 2: Approving Beneficial Uses and Approval Protocol for Coal Combustion Byproducts

It became apparent by working with NDDH during the previous demonstration project that NDDH does not have a generic protocol for approving a material for use, nor does it have a listing of approved beneficial uses, as is common in many other states. In fact, the only guideline available from NDDH that refers to coal ash is designed for large-scale soil stabilization applications that need to be approved on a case-by-case basis. Since the case-by-case approvals require extensive documentation and potentially long time frames to obtain, this has been identified as a barrier to coal ash use in agriculture applications as well as other applications.

This task will be primarily an education task focused on NDDH. It is proposed to work extensively with NDDH at all levels in both the Solid Waste and Water Quality Divisions to educate them on typical protocols in other states for developing lists of beneficial coal ash uses, approval protocols, and written policies. Further, work to familiarize NDDH staff with regional

coal ash characteristics will continue. A 1-day seminar for NDDH staff will be included in this effort. Food will be served at the seminar, the cost of which may exceed institutional limits.

With over 25 years of experience in coal ash environmental issues, the EERC has the expertise and resources to develop a standard test matrix to approve power plant coal ashes (see Appendix A). The EERC will develop the proposed standard test matrix with sound scientific validity and will present the proposed test matrix to NDDH for approval. Additionally, other EERC work summarizing state regulations and use practices and developing a coal ash training course will lay solid groundwork for this task.

Task 3: Demonstration of Coal Ash Soil Stabilization for Livestock Enterprises

The project team proposes to demonstrate the use of soil–ash mixtures in various animal agriculture settings including runoff and manure containment liners, feed storage, compost pads, and cattle working areas. These demonstrations will take place on varying soil conditions and will demonstrate the durability and versatility of this material. Depending on site conditions, different placement techniques may be used.

A laboratory phase is proposed to further develop soil–ash mixtures that will meet the requirements for runoff and manure containment systems. Additionally, work to incorporate bottom ash in containment systems will be investigated in the laboratory to evaluate the potential for bottom ash to reduce the phosphorus content of any water that leaves the containment system. The laboratory findings and recommendations will be used in developing up to three demonstrations of this ash application. Laboratory work may also be required to develop appropriate ash addition figures for some soil types.

The project team will work with regional livestock and dairy operations to identify opportunities for demonstrating the use of coal ash in the identified applications. The project

team will work with NDDH to obtain required approvals, if needed. The project team will work with the cooperating feedlot operations to determine appropriate placement techniques using equipment available on-site. Up to ten demonstrations will be accomplished throughout the state in a select number of locations. It is anticipated that about three applications will be demonstrated at each site. To achieve a cross section of scenarios across the state, sites will be selected based on soil type and types of animals raised. NDSU Extension Service staff will be invited to participate in the training, as noted in Task 4.

Task 4: Train Livestock Producers and Farmers, NDSU Extension Service Staff, and County Extension Agents

Up to ten demonstration activities, similar to past CREC Field Days, will be conducted throughout North Dakota. Regional farmers and livestock producers will be afforded the opportunity to experience, firsthand, the use of coal ash in numerous soil stabilization applications, such as liners, feed storage, compost pads, and cattle-working areas, and learn how ash should be used with varying soil types.

At all training opportunities, research staff will be available to answer any specific questions and, in some instances, will provide assistance during a user-application process. NDDH highly recommends that either EERC, CREC, or Extension Service staff be present at the initial ash placement projects to help determine whether changes or clarifications are needed to the manual developed during the previous demonstration project.

Training county extension agents will be a major priority for this effort. Agents will be invited to attend training demonstrations and will receive training materials. Once this project closes, it is anticipated that county extension agents and the NDSU Extension Service will assume the responsibility of training users for these applications.

Task 5: Promotion

The use of coal ash in agriculture applications will be promoted through news releases, agriculture-based trade shows, and distribution of the “how-to” brochure developed with NDDH during the previous study. A news release announcing the NDDH-approved use of coal ash in feedlot stabilization will be sent to local media outlets as well as national agriculture and scientific media outlets. This news release will provide a follow-up to a 2001 news release announcing the preliminary results of the CREC demonstration project. News releases will also be used to announce upcoming demonstration activities. In addition, the project team will attend at least one major agriculture-based trade show in North Dakota. This forum provides one-on-one interaction with target users of coal ash. The how-to brochure developed with NDDH during the CREC demonstration project will be distributed with the news release, at the trade show events, and during demonstration activities.

Anticipated Results

The project team anticipates that the proposed project will result in the following outcomes:

- A large number of broad animal agriculture-related coal ash applications will be demonstrated including the following:
 - The use of fly ash in feed storage areas to reduce spoiled and wasted feed and increase diet purity.
 - Soil stabilization with an ash–soil mixture in animal-handling areas to improve the working environment for both animals and people.

- Composting pads constructed with a fly ash–soil mixture to improve the composting process and reduce leaching into the soil profile plus provide a firm surface for machine operations.
- Runoff containment and solids-settling areas require the placement of clay with specific aggregate traits. A fly ash–soil mixture to provide a better solution for more durability and longevity in regions where clay is not available.
- NDSU Extension Service staff to be trained in these applications and prepared to aid the North Dakota agriculture community in use of coal ash in appropriate applications.
- A list of beneficial animal agriculture-related coal ash applications will be developed and submitted to NDDH.
- An appropriate protocol for approval of coal ash use will be developed and submitted to NDDH.
- Coal ash use in agriculture-related applications will be better understood by NDDH staff, and a request to approve the recommended list of beneficial uses and approval protocols will submitted and discussed with NDDH.

STANDARDS OF SUCCESS

The standards of success for this effort include:

- Continued reevaluation of the four regional coal fly ashes approved by NDDH for use in NDDH-permitted feedlots.
- Successful work with NDDH to develop an approval protocol and written policies for future coal ash use in the state.

- Demonstration of the use of coal ash in various feedlot applications with cooperation from area livestock producers and NDDH.
- Train livestock producers and farmers, NDSU extension service staff, and county extension agents on how to properly place coal ash in feedlot settings.
- Dissemination of project results to potential users (feedlot operators).

BACKGROUND

Livestock producers are in need of economical options to improve feedlot conditions through soil stabilization. The majority of the state's 12,000 beef and 800 dairy producers has at least some areas subject to concentrated traffic by livestock. Earthen pens do not withstand this pressure—particularly when wet for any length of time such as during spring thaw. As the integrity of the pen surface breaks down, deep mud and poor drainage reduce animal performance and health (as indicated by poor weight gain), increase odor emissions, and prevent regular maintenance operations such as manure removal. Commonly, the soil–manure interface layer is damaged, resulting in deeper leaching of nutrients and an increased risk of groundwater pollution.

Coal ash use for agriculture soil stabilization out of loafing (in-pen) areas has been documented in the past, although the majority of studies have focused on in-pen stabilization (2–6). In all previous studies, coal ash has proved to be physically effective in stabilizing soils without causing harmful effects to the environment (2–6). Several other areas where livestock producers struggle with less than desirable soil conditions could benefit from the use of fly ash–soil mixtures as well.

The EERC, NDSU CREC, and PPE recently completed a 4-year study to analyze the environmental and engineering performance of coal fly ash use in feedlot soil stabilization.

Surfaces treated with coal ash were more durable and easier to clean than the control pens, resulting in a reduced need to resurface pens. In addition, animals raised on the treated pens exhibited improved weight gain compared to animals raised on the control pens.

The recently completed study (1) and over 10 years of previous data (2–6) have produced a preponderance of evidence that shows coal ash used as a soil stabilizer has no negative effect to runoff or the environment and has a positive effect on animal performance. This body of data strongly suggests coal ash is suitable for use in all feedlot settings. In addition, coal fly ash is allowed for use in cement and concrete products in North Dakota and has been allowed for use in soil stabilization projects related to road building.

QUALIFICATIONS

Ms. Debra Pflughoeft-Hassett, EERC, will act as Project Manager for this effort. Ms. Pflughoeft-Hassett has several years' experience in management of technical research projects with an emphasis on investigation of the utilization of coal combustion by-products (CCBs) including lignite ash. She also has experience in the environmental and engineering aspects of CCB utilization projects and has participated in project teams evaluating the economic aspects of CCB utilization. Ms. Pflughoeft-Hassett is familiar with North Dakota lignite ash producers and users and served as the Project Manager for the previous EERC, NDSU, and PPE study. She is also familiar with the national and international CCB industry. Lead EERC researchers will be Mr. David Hassett and Ms. Loreal Heebink, leading the environmental evaluations and monitoring; Mr. Bruce Dockter, leading the engineering evaluations and placement activities; and Ms. Tera Buckley, leading technology-transfer activities. Resumes of all lead EERC researchers are included in Appendix A.

Mr. Andrew Stewart, PPE, will work with the area NSDU Extension Service staff, county extension agents, and regional livestock producers and farmers to demonstrate how to properly place coal ash in feedlot settings. Mr. Stewart has a wide range of experience in utilization of lignite ash, including directing previous placement activities at the CREC site. Mr. Stewart's resume is also included in Appendix A.

VALUE TO NORTH DAKOTA

At present, only large-scale feedlot facilities permitted by NDDH can use coal fly ash to stabilize feedlot pens. Greater potential exists to utilize valuable by-products from the state's lignite-fired utilities. From environmental, engineering, and economic standpoints, feedlot operators can benefit from the use of coal fly ash to stabilize feedlot surfaces. In the 1997 Census of Agriculture, North Dakota had 920,600 beef and 54,000 dairy cows (7). The majority of these producers has facilities that would benefit from the use of fly ash in various applications including feed storage, composting pads, containment systems, and cattle-working areas.

As noted in the previous study (1), there are several economic advantages for feedlot operators using coal fly ash to stabilize soils. Soils stabilized with coal fly ash or cement are expected to have a surface life of 5 years. If coal fly ash was used to stabilize feedlot pens, the yearly expense for this placement is about \$140 a 75- × 100-ft pen; whereas, a cement-treated feedlot would cost \$525 a 75- × 100-ft pen a year. These costs include raw material and transportation costs. It is assumed that both treatments would be placed using conventional farm equipment. A significant feed efficiency was also noted in the previous study. During the spring thaw and early summer (April, May, June), bison in the pens treated with coal fly ash gain an average of 0.35 pounds a day more than bison in the untreated pens, resulting in a feed savings of \$0.13 per pound gained.

The realized economic advantage of stabilizing feedlots with coal fly ash will depend on several factors, including maintenance savings, improved manure quality, improved animal health, and other as yet unidentified market advantages. Potential returns from increased animal performance appear to outweigh the costs of stabilizing feedlots with coal ash.

As more use applications are approved by NDDH, feedlot operators will be able to realize these economic advantages and utilities will be able to beneficially reuse their by-products and reduce disposal costs.

MANAGEMENT

The project will be managed by Ms. Debra Pflughoeft-Hassett. Ms. Pflughoeft-Hassett will be assisted in project management duties by EERC staff whose duties include contract, budget, accounting, procurement, and office services. The EERC infrastructure has a long history of supporting effective project management. Ms. Pflughoeft-Hassett has experience as a Project Manager and has successfully managed previous projects funded by NDIC. She also manages the coal combustion by-products program at the EERC. Ms. Pflughoeft-Hassett's resume is included in Appendix A of this proposal.

TIMETABLE

The project duration is 1 year. The target start date for this project is June 1, 2004. Table 1 indicates the proposed project schedule detailing task initiation and completion. Project reporting is also included in the timetable. Project reports are expected to include brief quarterly letter reports and a final report.

BUDGET

The total cost of this project is \$49,230. A detailed budget is included with budget notes for reference. The projects costs will be provided from multiple sources. Initial cash

Table 1. Time Line for Feed Lot Project

Task	Task Description	Work Schedule by Quarters			
		1	2	3	4
Task1	Quality Assurance/Quality Control	■	■		
Task 2	Approving Uses and Approved Protocols for CCBs	■	■	■	■
Task 3	Demonstration of Coal Ash Soil Stabilization	■	■	■	
Task 4	Training	■	■	■	■
Task 5	Promotion	■	■	■	■

contributions will be provided by a consortium of industry partners. The EERC is in the process of securing industrial funding from Great River Energy and Otter Tail Power Company.

Mr. Andrew Stewart will consult on the project, and his costs will be \$8000. Included in Appendix B is a letter outlining a subcontract with Mr. Stewart, PPE.

The EERC is requesting \$16,000 from NDIC. These funds will match the cash contributions noted.

The EERC will request \$17,230 from the EERC-DOE JSRP to provide the remaining amount needed to perform the project as proposed. The total project cost, on a cost-reimbursable basis, is \$49,230. Of this cost, the EERC requests that NDIC provide \$16,000.

Three items are required from NDIC for inclusion in the EERC proposal to DOE:

- A formal commitment to the project. This can be a letter of commitment, a purchase order, or a signed contract.
- A biographical sketch or resume for NDIC’s Project Manager or key technical contributor.
- A short overview of NDIC.

The EERC will submit a proposal to DOE for its approval upon receipt of NDIC’s commitment and the information above.

A detailed budget and accompanying budget notes are enclosed.

MATCHING FUNDS

This proposal is requesting \$16,000 in support from NDIC through the Lignite Research Council to match \$16,000 in industrial funds anticipated from Great River Energy and Otter Tail Power Company. Further funding will be requested from the EERC–DOE JSRP. The total cost of this project will be \$49,230. The State Board of Agriculture Research and Education has also agreed to contribute to a parallel effort conducted by NDSU CREC and PPE. When appropriate, the two projects will work together to achieve the common goals.

TAX LIABILITY

The EERC is part of UND, a tax-exempt entity.

CONFIDENTIAL INFORMATION

There is no confidential information contained in this proposal.

REFERENCES

1. Pflughoeft-Hassett, D.F.; Dockter, B.A.; Hassett, D.J.; Heebink, L.V.; Solc, J.; Buckley, T.D. *Demonstration of Coal Ash for Feedlot Surfaces*; Energy & Environmental Research Center Report 2004-EERC-02-10 to U.S. Department of Energy National Energy Technology Laboratory and Project Sponsors; Feb 2004.
2. Sweeten, J.W. *Feedlot Surface Condition – Coal Ash Surfacing versus Control*; Texas Agricultural Extension Service Result Demonstration Report; 1996.
3. Greenless, W.J.; Pitt, J.M.; Dawson; M.R.; Chriswell C.D.; Melvin, S.W. Stabilizing Cattle Feedlot Soil with Fluidized Bed Combustor Ash. *Trans ASAE*. **1998**, *41* (1), 203–211.
4. Midwest Fly Ash and Materials. *Use of Class C Fly Ash for Livestock Feedlot Applications*; Bulletin No. 1.

5. American Coal Ash Association. Livestock Pads Made from CCPs. *ACAA Ash at Work*; April 1999; p 21.
6. Daines, M. *Lime-Enriched FGD Product for Feedlot and Hay Storage Base*. Handout at the 1997 EERC CCB Utilization Workshop, Minneapolis, MN, Sept 29–30, 1997.
7. U.S. Department of Agriculture. 1997 Census of Agriculture.
<http://www.nass.usda.gov/census/> (accessed March 22, 2004).

SUMMARY BUDGET

BENEFITING AGRICULTURE THROUGH COAL ASH USE
 UTILITIES / NDIC / DOE
 PROPOSED START DATE: JUNE 1, 2004
 EERC PROPOSAL #2004-0236

CATEGORY	TOTAL		UTILITIES SHARE		NDIC SHARE		EERC JSRP SHARE	
	HRS	\$COST	HRS	\$COST	HRS	\$COST	HRS	\$COST
TOTAL DIRECT LABOR	402	\$ 12,857	176	\$ 5,571	204	\$ 6,575	22	\$ 711
FRINGE BENEFITS - % OF DIRECT LABOR	53%	\$ 6,814		\$ 2,953		\$ 3,485		\$ 376
TOTAL LABOR		<u>\$ 19,671</u>		<u>\$ 8,524</u>		<u>\$ 10,060</u>		<u>\$ 1,087</u>
OTHER DIRECT COSTS								
TRAVEL		\$ 1,458		\$ 1,458		\$ -		\$ -
COMMUNICATION - PHONES & POSTAGE		\$ 77		\$ 19		\$ 19		\$ 39
OFFICE (PROJECT SPECIFIC SUPPLIES)		\$ 150		\$ 95		\$ 47		\$ 8
SUPPLIES		\$ 30		\$ 30		\$ -		\$ -
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)		\$ 260		\$ 130		\$ 130		\$ -
FEES		\$ 10,531		\$ -		\$ -		\$ 10,531
TOTAL OTHER DIRECT COST		<u>\$ 12,506</u>		<u>\$ 1,732</u>		<u>\$ 196</u>		<u>\$ 10,578</u>
TOTAL DIRECT COST		\$ 32,177		\$ 10,256		\$ 10,256		\$ 11,665
FACILITIES & ADMIN. RATE - % OF MTDC	VAR	\$ 17,053	56%	\$ 5,744	56%	\$ 5,744	47.7%	\$ 5,565
TOTAL ESTIMATED COST		<u>\$ 49,230</u>		<u>\$ 16,000</u>		<u>\$ 16,000</u>		<u>\$ 17,230</u>

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 expenses. The Detailed Budget is presented to assist in the evaluation of the proposal.

DETAILED BUDGET

BENEFITING AGRICULTURE THROUGH COAL ASH USE
 UTILITIES / NDIC / DOE
 PROPOSED START DATE: JUNE 1, 2004
 EERC PROPOSAL #2004-0236

LABOR	LABOR CATEGORY	HOURLY RATE	TOTAL		UTILITIES SHARE		NDIC SHARE		EERC JSRP SHARE	
			HRS	\$ COST	HRS	\$ COST	HRS	\$ COST	HRS	\$ COST
PFLUGHOEFT-HASSETT, D.	PROJECT MANAGER	\$ 36.74	120	\$ 4,409	60	\$ 2,204	44	\$ 1,617	16	\$ 588
HASSETT, D.	PRINCIPAL INVESTIGATOR	\$ 38.62	50	\$ 1,931	16	\$ 618	34	\$ 1,313	-	\$ -
HEEBINK, L.	RESEARCH SCIENTIST/ENGINEER	\$ 22.68	20	\$ 454	10	\$ 227	10	\$ 227	-	\$ -
DOCKTER, B.	RESEARCH SCIENTIST/ENGINEER	\$ 28.91	100	\$ 2,891	55	\$ 1,590	45	\$ 1,301	-	\$ -
BUCKLEY, T.	RESEARCH SCIENTIST/ENGINEER	\$ 20.70	60	\$ 1,242	25	\$ 518	35	\$ 724	-	\$ -
-----	SENIOR MANAGEMENT	\$ 50.49	13	\$ 656	-	\$ -	13	\$ 656	-	\$ -
-----	RESEARCH TECHNICIAN	\$ 19.15	19	\$ 364	-	\$ -	19	\$ 364	-	\$ -
-----	TECHNICAL SUPPORT SERVICES	\$ 14.90	20	\$ 298	10	\$ 149	4	\$ 60	6	\$ 89
			402	\$ 12,245	176	\$ 5,306	204	\$ 6,262	22	\$ 677
ESCALATION ABOVE CURRENT BASE		5%		\$ 612		\$ 265		\$ 313		\$ 34
TOTAL DIRECT LABOR				\$ 12,857		\$ 5,571		\$ 6,575		\$ 711
FRINGE BENEFITS - % OF DIRECT LABOR		53%		\$ 6,814		\$ 2,953		\$ 3,485		\$ 376
TOTAL LABOR				\$ 19,671		\$ 8,524		\$ 10,060		\$ 1,087
<u>OTHER DIRECT COSTS</u>										
TRAVEL				\$ 1,458		\$ 1,458		\$ -		\$ -
COMMUNICATION - PHONES & POSTAGE				\$ 77		\$ 19		\$ 19		\$ 39
OFFICE (PROJECT SPECIFIC SUPPLIES)				\$ 150		\$ 95		\$ 47		\$ 8
SUPPLIES				\$ 30		\$ 30		\$ -		\$ -
GENERAL (FREIGHT, FOOD, MEMBERSHIPS, ETC.)				\$ 260		\$ 130		\$ 130		\$ -
FUELS & MATERIALS RESEARCH LAB.				\$ 1,449		\$ -		\$ -		\$ 1,449
ANALYTICAL RESEARCH LAB.				\$ 817		\$ -		\$ -		\$ 817
GRAPHICS SUPPORT				\$ 265		\$ -		\$ -		\$ 265
SUBCONTRACT - POWER PRODUCTS ENGINEERING				\$ 8,000		\$ -		\$ -		\$ 8,000
TOTAL OTHER DIRECT COST				\$ 12,506		\$ 1,732		\$ 196		\$ 10,578
TOTAL DIRECT COST				\$ 32,177		\$ 10,256		\$ 10,256		\$ 11,665
FACILITIES & ADMIN. RATE - % OF MTDC			VAR	\$ 17,053	56%	\$ 5,744	56%	\$ 5,744	47.7%	\$ 5,565
TOTAL ESTIMATED COST				\$ 49,230		\$ 16,000		\$ 16,000		\$ 17,230

BENEFITING AGRICULTURE THROUGH COAL ASH USE
 EERC PROPOSAL #2004-0236

DETAILED BUDGET - FEES

FUELS & MATERIALS RESEARCH LAB.	RATE	#	\$COST
MISCELLANEOUS	\$69	20	\$ 1,380
SUBTOTAL			\$ 1,380
ESCALATION		5%	\$ 69
TOTAL FUELS & MATERIALS RESEARCH LAB.			\$ 1,449

ANALYTICAL RESEARCH LAB.	RATE	#	\$COST
LEACHING	\$67	4	\$ 268
MISCELLANEOUS (SAMPLE)	\$34	15	\$ 510
SUBTOTAL			\$ 778
ESCALATION		5%	\$ 39
TOTAL ANALYTICAL RESEARCH LAB.			\$ 817

GRAPHICS SUPPORT	RATE	#	\$COST
GRAPHICS (HOURLY)	\$42	6	\$ 252
SUBTOTAL			\$ 252
ESCALATION		5%	\$ 13
TOTAL GRAPHICS SUPPORT			\$ 265

DETAILED BUDGET - TRAVEL

BENEFITING AGRICULTURE THROUGH COAL ASH USE
 EERC PROPOSAL #2004-0236

RATES USED TO CALCULATE ESTIMATED TRAVEL EXPENSES		
DESTINATION	PER MILE	PER DIEM
Bismarck, ND	\$ 0.31	\$ 20

PURPOSE/DESTINATION	NUMBER OF				MILEAGE	PER DIEM	MISC.	TOTAL
	TRIPS	PEOPLE	MILES	DAYS				
Meetings/ND Region	7	1	575	1	\$ 1,248	\$ 140	\$ 70	\$ 1,458
TOTAL ESTIMATED TRAVEL								<u>\$ 1,458</u>

BUDGET NOTES

ENERGY & ENVIRONMENTAL RESEARCH CENTER (EERC)

Background

The EERC is an independently organized multidisciplinary research center within the University of North Dakota (UND). 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, depending 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 prepared for this proposal is based on a specific start date; this start date is indicated at the top of the EERC 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.

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 salary estimates are based on the scope of work and prior experience on projects of similar scope. Technical and administrative salary charges are based on direct hourly effort on the project. The labor rate used for specifically identified personnel is the

current hourly rate for that individual. The labor category rate is the current average rate of a personnel group with a similar job description. For faculty, if the effort occurs during the academic year and crosses departmental lines, the salary will be in addition to the normal base salary. University policy allows faculty who perform work in addition to their academic contract to receive no more than 20% over the base salary. Costs for general support services such as grants and contracts administration, accounting, personnel, and purchasing and receiving, as well as clerical support of these functions, are included in the EERC facilities and administrative cost rate.

Fringe benefits are estimated on the basis of 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 for 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 on the basis of UND travel policies which can be found at: <http://www.und.edu/dept/accounts/employeetravel.html>. Estimates include General Services Administration (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 generally included in the facilities and administrative cost. Direct project cost includes line charges at remote locations, 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; this includes duplicating and printing.

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, glassware, and/or other project items such as nuts, bolts, and piping necessary for pilot plant operations. Other items also included are supplies such as computer disks, computer paper, memory chips, toner cartridges, maps, and other organizational materials required to complete the project.

Instructional/Research

This category includes subscriptions, books, and reference materials necessary to the project.

Fees

Laboratory, analytical, graphics, and shop/operation fees are established and approved at the beginning of the university's fiscal year.

Laboratory and analytical fees are charged on a per sample, hourly, or daily rate, depending on the analytical services performed. Additionally, laboratory analyses may be

performed outside the University when necessary.

Graphics fees are based on an established per hour rate for overall graphics production such as report figures, posters for 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

Freight expenditures generally occur for outgoing items and field sample shipments.

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 project meetings, workshops, and conferences where the primary purpose is dissemination of technical information may include costs of food (some of which may exceed the institutional limit), transportation, rental of facilities, and other items incidental to such meetings or conferences.

Facilities and Administrative Cost

The facilities and administrative rate (indirect cost rate) included in this proposal is the rate that became effective July 1, 2002. Facilities and administrative cost is calculated on modified total direct costs (MTDC). MTDC is defined as total direct costs less individual items of equipment in excess of \$5000 and subcontracts/subgrants in excess of the first \$25,000 for each award.

APPENDIX A
RESUMES OF KEY PERSONNEL

DEBRA F. PFLUGHOEFT-HASSETT

Research Manager

Energy & Environmental Research Center (EERC)

University of North Dakota (UND)

PO Box 9018, Grand Forks, North Dakota 58202-9018 USA

Phone (701) 777-5000 Fax (701) 777-5181

E-Mail: dphassett@undeerc.org

Principal Areas of Expertise

Ms. Pflughoeft-Hassett's principal areas of interest and expertise include utilization and characterization of coal combustion by-products (CCBs), waste management, and environmental impacts of CCB use and disposal. She has worked on the development of databases containing characterization information on CCBs and on the development of chemical characterization protocols. Ms. Pflughoeft-Hassett also has expertise in applying analytical chemistry, mineralogical and geological data, and engineering testing to demonstrations and field projects utilizing CCBs. Ms. Pflughoeft-Hassett has participated extensively as an investigator on research investigations of CCB characterization, groundwater contamination, sediment attenuation, leaching characterization, and chemical fixation of trace elements. She also participates as a principal researcher and project manager on several investigations of the characterization, utilization, and disposal of CCBs and currently manages the research effort of the Coal Ash Resources Research Consortium (CARRC) and other CCB research at the EERC.

Qualifications

B.S., Chemistry, University of North Dakota, 1982.

Professional Experience

1994 – Research Manager, EERC, UND. Ms. Pflughoeft-Hassett's responsibilities include serving as project manager and principal researcher for numerous projects on coal by-product management focusing on utilization and industrial waste minimization and resource recycling. Ms. Pflughoeft-Hassett coordinates research with other EERC research staff and industrial and governmental clients. She is also responsible for technical and fund management of these projects.

1978 – 1994 Research Associate, EERC, UND. Ms. Pflughoeft-Hassett participated extensively as a principal researcher and project manager on investigations of the utilization and disposal of coal combustion by-products and characterization of coal by-products and coordinated the research efforts of the Coal Ash Resources Research Consortium. She has worked on the development of databases containing characterization information on coal by-products and on the development of chemical characterization protocols. She also participated in research investigations of groundwater contamination, sediment attenuation, coal conversion by-product characterization, leaching characterization, and chemical fixation of trace elements, and developed and applied numerous analytical techniques for these tasks.

1975 – 1978 Laboratory Analyst, Human Nutrition Laboratory, Grand Forks, North Dakota.

Professional Memberships

- American Coal Ash Association
- American Society of Testing and Materials
- North Dakota Academy of Science
- North Dakota Solid Waste Management Association

Publications and Presentations

- Has coauthored over 70 publications

DAVID J. HASSETT
Senior Research Advisor
Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
PO Box 9018, Grand Forks, North Dakota 58202-9018 USA
Phone (701) 777-5000 Fax (701) 777-5181
E-Mail: dhassett@undeerc.org

Principal Areas of Expertise

Mr. Hassett's principal areas of interest and expertise include the application of analytical chemistry toward the solution of environmental problems associated with trace element occurrence, transport, and fate. The most recent research focus has been on trace element transformations during coal conversion processes and interaction between groundwater and coal conversion solids as related to the leachability of trace elements. Additional areas of expertise include hydration reactions of coal conversion solid residues as well as organic synthesis, radiochemistry, x-ray spectrometry, analytical chemistry, and vegetable oil diesel fuels.

In 1985, Mr. Hassett presented his research on vegetable oil diesel fuels as a member of a People to People Biomass Utilization Delegation to the People's Republic of China and, in 1998, was an invited keynote speaker at the 15th Conference on Clay Mineralogy and Petrology held in Brno in the Czech Republic. He has laboratory experience with infrared spectroscopy, gas chromatography, neutron activation analysis, atomic spectroscopy (atomic absorption and inductively coupled argon plasma), thin-layer chromatography, ultraviolet and fluorescence analysis, x-ray fluorescence spectroscopy, nuclear magnetic resonance spectroscopy, ion chromatography, laser spectroscopy, and capillary electrophoresis.

Mr. Hassett has expertise with numerous types of analytical instrumentation gained over 30 years of diverse research experience.

Qualifications

Graduate Studies in Chemistry (part-time), Winona State University, 1970–1975.
B.S., Chemistry and Mathematics, Winona State University, 1966.

Professional Experience

1994 –	Senior Research Advisor, EERC, UND.
1975 – 1994	Director, Applied Chemistry and Analytical Research, EERC, UND.
1972 – 1975	Graduate Teaching Assistant, Department of Chemistry, Winona State University.
1970 – 1972	Research Chemist, Watkins Products, Inc., Winona, Minnesota.
1968 – 1970	Military Service, Walter Reed Army Medical Center, Walter Reed Army Institute of Research, Washington, D.C. Engaged in neutron activation analysis and related gamma ray spectroscopy.

1966 – 1968

Chemist, R&D Pharmaceutical and Household Consumer Products
Laboratory, Watkins Products, Inc.

Professional Memberships

- Society for Applied Spectroscopy
- North Dakota Academy of Science
- Sigma Xi
- American Institute of Chemists (Fellow)

Patent

- Hassett, D.J.; Thompson, J.S. Enhanced Ettringite Formation for the Treatment of Hazardous Liquid Waste. U.S. Patent 5,547,588, Aug 20, 1996.

Publications and Presentations

- Has authored or coauthored over 200 publications

BRUCE A. DOCKTER
Research Engineer
Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
PO Box 9018, Grand Forks, North Dakota 58202-9018 USA
Phone (701) 777-5000 Fax (701) 777-5181
E-Mail: bdockter@undeerc.org

Principal Areas of Expertise

Mr. Dockter's principal areas of interest and expertise include physical and chemical analysis of fly ash and examination of coal ash for utilization in high- and low-volume applications. In addition, he has also worked extensively in the field of high-temperature research on the physical and chemical properties of coal ashes and slags.

Qualifications

Registered Professional Engineer, 1993.
M.E., Civil Engineering, University of North Dakota, 1991.
B.S., Civil Engineering, University of North Dakota, 1983.

Professional Experience

- 1991 – Research Engineer/Manager, Fuels and Materials Research Laboratory, EERC, UND. Mr. Dockter's responsibilities include supervisory management of laboratory projects and testing procedures and coordination of research efforts between laboratory facilities and EERC project managers for evaluating coal by-products for utilization options. Tasks also include methodology evaluations, proposal writing, and paper publications and presentations.
- 1985 – 1991 Chemist II/Manager, Coal By-Products Utilization Laboratory, EERC, UND. Mr. Dockter's responsibilities included daily operation of laboratory emphasizing setting daily work objectives, supervision of full-time and student employees, and general lab maintenance. He was also responsible for training new employees, conducting seminars, keeping test result books, and writing final report papers.
- 1984 – 1985 Chemist I, Fine Coal Cleaning Project, Grand Forks Energy Research Center. Mr. Dockter's responsibilities included data interpretation for methods including oil agglomeration and froth flotation.
- 1983 – 1984 Engineering Technician III, Fine Coal Cleaning Project, Grand Forks Energy Research Center. Mr. Dockter's responsibilities included performing washability and other beneficiation tests for the physical separation of mineral-rich materials from coal samples.

Professional Memberships

- American Society for Testing and Materials
- National Society of Professional Engineers
- Transportation Research Board

Publications and Presentations

- Has authored or coauthored over 70 publications

LOREAL V. HEEBINK

Chemist

Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
PO Box 9018, Grand Forks, North Dakota 58202-9018 USA
Phone (701) 777-5000 Fax (701) 777-5181
E-Mail: lheebink@undeerc.org

Principal Areas of Expertise

Ms. Heebink's principal areas of interest and expertise include ash chemistry, leaching procedures, ultratrace mercury analysis with a double gold amalgamation atomic fluorescence apparatus, and environmental impacts of coal combustion byproduct (CCB) use and disposal. Ms. Heebink has laboratory experience with fuel component analysis with innovative Fourier transform infrared (FT-IR) techniques, organic synthesis, nuclear magnetic resonance spectroscopy, FT-IR spectroscopy, atomic absorption and inductively coupled argon plasma spectroscopy, ultraviolet and fluorescence analysis, thin layer chromatography, gas chromatography, and ion chromatography.

Qualifications

B.S., Chemistry, Magna Cum Laude, University of North Dakota, 2000.

A.S., Chemistry, Summa Cum Laude, Minot State University-Bottineau, Bottineau, North Dakota, 1997.

Professional Experience

2000 – Chemist, EERC, UND.

Ms. Heebink's responsibilities include research focused primarily on the environmental impacts of CCB use and disposal, ultratrace mercury analysis, and data interpretation and management.

1997 – 1999 Stockroom Assistant, Department of Chemistry, UND.

Ms. Heebink's responsibilities included preparing solutions weekly for classroom laboratories, assisting students and instructors with chemicals, and organization of the stockroom.

Professional Membership

- American Chemical Society
- North Dakota Academy of Science
- Sigma Xi

Publications and Presentations

- Has coauthored several publications.

TERA D. BUCKLEY
Marketing Research Specialist
Energy & Environmental Research Center (EERC)
University of North Dakota (UND)
PO Box 9018, Grand Forks, North Dakota 58202-9018 USA
Phone (701) 777-5000 Fax (701) 777-5181
E-Mail: tbuckley@undeerc.org

Principal Areas of Expertise

Ms. Buckley's principal areas of interest and expertise include developing and conducting research studies, promoting CCB utilization, and producing CCB-related marketing materials.

Qualifications

B.B.A., Marketing, University of North Dakota, 2001.

Professional Experience

- 2002 – Marketing Research Specialist, EERC, UND. Ms. Buckley's responsibilities include serving on a team of scientists and engineers involved in industrial waste management research, including planning, designing, and carrying out technical and marketing research and technology transfer related to coal combustion by-products (CCBs). Project management duties include ensuring are performed in a timely and quality manner; assigning tasks and/or working with project team to accomplish projects; and ensuring projects are completed within budget.
- Aug – Dec 2002 Interim Communication Manager, EERC, UND. Ms. Buckley's responsibilities included planning, developing, directing, and marketing all public relations activities, including written promotional materials, press releases, conferences and other exhibitions, Web site content, and tours of the Center.
- 2001 – 2002 Research Specialist, EERC, UND. Ms. Buckley's responsibilities included preparing quarterly, semiannual, annual, and final reports; assisting researchers in generating, assembling, interpreting, and presenting technical data; presenting project results at project review meetings and conferences; ensuring quality and timely Web content; and planning and preparing promotional materials.
- 2000 – 2001 Research Assistant, EERC, UND. Ms. Buckley's responsibilities included publishing the Buyer's Guide to Coal Ash-Containing Products, developing the Coal Ash Resource Center Web site, developing ways to promote coal by-product utilization, and assisting in the preparation of reports and proposals.

Ms. Buckley also performed marketing activities for independent clients, including the American Coal Ash Association, the UND Athletic Department, Tabula Coffeehouse, Westlie Motor Company, Norsk Host Fest, Marketplace '97, and Deli at the Fair. Activities included reviewing current market strategy, developing and conducting research studies, creating new promotional strategies, and presenting findings to management.

Publications and Presentations

- Has coauthored several publications

Andrew W. Stewart, P.E.

Education Bachelor of Science - Civil Engineering, 1979, University of North Dakota
Bachelor of Science – Chemistry, 1978, University of North Dakota

Affiliations Registered Professional Engineer - North Dakota and Minnesota
American Coal Ash Association, Chairman of the Board (1994-1997)
European Association for Use of the By-Products of Coal-Fired Power Stations, Honorary Life Member
American Society of Civil Engineers, Member

Experience

2001–Present **Power Products Engineering, Inc.** **Eden Prairie, MN**
Owner and President

Professional engineer with over 20 years of experience in energy/power generation and civil engineering environments. Customer-focused and attuned to markets and business objectives. Outstanding technical abilities enhanced by proven skills as a project manager, negotiator and team leader. Grounded in plant operations and construction, with special expertise in the development of energy projects.

1998 – 2000 **En-Rock, Inc.** **Eden Prairie, MN**
President

Responsible for the development, coordination and monitoring of the by-product programs from coal fired power plants. Other areas of responsibility include providing engineering services in the use of by-products as well as management consulting in the area of disposal of unused by-products.

1981 – 1998 **Cooperative Power Association** **Eden Prairie, MN**
Manager of Engineering Services

Responsible for the development, coordination and monitoring of the by-product program for Coal Creek Station. Program consists of sales of flyash and bottom ash with a net benefit of over \$2 million annually. New product development includes the addition of bottom ash sales in 1997 and the upcoming gypsum conversion facility outlined below.

1975 – 1981 **Richmond Engineering, Inc.** **Grand Forks, ND**
Engineer

A privately held provider of design and construction management services for municipal, state and federal civil works projects.

PROJECT RELATED EXPERIENCE

Carrington Research Center

Provided engineering support for the design and construction of a bison feedlot at the Carrington North Dakota Research Facility. Principal responsibilities included the field application of coal fly ash to stabilize the feedlot soil matrix. (2000)

The Falkirk Mining Company

Provided engineering support for the design and construction of a fly ash stabilized base for haulroad construction. Principal responsibilities included the field application of coal fly ash to stabilize the subgrade. (1999)

APPENDIX B
SUBCONTRACT INFORMATION



14300 Charing Cross
Eden Prairie, MN 55346
Ph. (952) 974-3954 Fax (952) 974-395

March 29, 2004

EERC
P.O. Box 9018
Grand Forks, ND 58202-9018
Attn: Debra Pflughoeft-Hassett

RE: SCOPE FOR FEEDLOT ENGINEERING SERVICES

Dear Debbie:

As we discussed, Power Products Engineering, Inc. (PPE) is pleased to provide you with a scope for providing technical services for continuing the process of agricultural and feedlot applications utilizing CCB's.

Background

Based on the interest of the Energy and Environmental Research Center (EERC) and the North Dakota State University Extension Service to continue the construction of animal feedlots and other agricultural applications using coal combustion by-products (CCB's), PPE, has been requested to provide a proposal to provide technical services for this Project. This request is based on PPE's involvement in the feedlot project recently completed in Carrington as well as several demonstration projects. It is felt that with the renewed emphasis on farming costs that the time is right for pursuing this objective. PPE's involvement in the Project will help in moving forward with design and field investigation into construction techniques and the use of CCB technology.

The project has to date consisted of the design and field-testing of a variety of CCB's in the construction of several feedlots at the NDSU facility in Carrington, ND and development of basic construction methods. Further work will be done in the construction of feedlot surfaces at demonstration sites. The Tasks from the EERC proposal to the NDIC that PPE will participate in are found below.

Task 1: Demonstration of Ash and Soil Mixtures on Feedlot Surfaces

Sufficient evidence exists to suggest that using coal ash, and especially ash stabilized soils, can lead to significant improvements in various animal agriculture settings in addition to feeding and loafing areas at a low cost. The project team proposes to demonstrate the use of soil-ash mixtures in various animal agriculture settings including runoff and manure containment liners, feed storage, compost pads, and cattle working areas. These demonstrations will take place on varying soil conditions and will demonstrate the durability and versatility of this material. Depending on site conditions, different placement techniques may be used. PPE will be an integral part of this task.

A laboratory phase is proposed to further develop soil-ash mixtures that will meet the requirements for runoff and manure containment systems. Additionally, work to incorporate bottom ash in containment systems will be investigated in the laboratory to evaluate the potential

March 29, 2004

for bottom ash to reduce the phosphorus content of any water that leaves the containment system. The laboratory findings and recommendations will be used in developing at least one demonstration of this ash application. Laboratory work may also be required to develop appropriate ash addition figures for some soil types. PPE will assist the EERC in these laboratory investigations.

As part of the project team PPE will work with regional livestock and dairy operations to identify opportunities for demonstrating the use of coal ash in the identified applications. The project team will work with the NDDH to obtain required approvals if needed. The project team will work with the cooperating operations to determine appropriate placement techniques using equipment available on site. PPE will be on site at up to 10 demonstrations to be accomplished throughout the state. NDSU Extension Service Staff will be invited to participate as part of the training task noted later to get hands on experience from PPE.

Task 2: Training and Promotion

In an October 3, 2003 letter to the EERC, the NDDH stated, "education is paramount to the success of this endeavor." To meet NDDH requests and promote the beneficial use of coal ash in agriculture applications, the project team proposes to conduct various training and promotional activities.

Training

PPE will participate in up to ten demonstration activities, similar to past CREC Field Days, which will be conducted throughout North Dakota. Regional farmers and livestock producers will be afforded the opportunity to experience, first hand, the use of coal ash in numerous soil stabilization applications such as liners, feed storage, laneways, compost pads, cattle working areas, and on several feedlots with varying soil types.

At all training opportunities, PPE will be available to answer any specific questions and in some instances, will provide assistance during a users application process. The NDDH highly recommends that either PPE, EERC, CREC, or Extension Service staff be present at the initial ash placement projects to help determine whether changes or clarifications are need to the manual developed during the previous demonstration project.

Training county extension agents will be a major priority for this effort. Agents will be invited to attend training demonstrations and will receive training materials. Once this project closes, it is anticipated that county extension agents and the NDSU Extension Service will assume the responsibility of training users for these applications.

Promotion

The use of coal ash in agriculture applications will be promoted through news releases, attending agriculture based trade shows, and by distributing the "how-to" brochure developed with the NDDH. A news release announcing the NDDH approved use of coal ash in feedlot stabilization will be sent to local media outlets as well as national agriculture and scientific media outlets. This news release will provide a follow-up to a news release that was sent in 2001 announcing the preliminary results of the CREC demonstration project. In addition, the project team including PPE will attend at least one major trade show in North Dakota. This forum provides one-on-one interaction with target users of coal ash. The "how-to" brochure developed with the NDDH during the CREC demonstration project will be distributed with the news release and at the trade show events.

Compensation

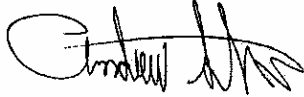
Compensation for the above work is proposed to be on a time and material basis at a rate of \$75/hour plus expenses billed at actual cost. Based on the tasks outlined above, a not to exceed

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value of \$8,000 is anticipated to cover all of the costs for this project. Detailed hourly billings for each of the tasks will be provided as well as detailed records of all expenses incurred.

If you should have any questions, please contact us at (952) 974-3954.

Sincerely,

A handwritten signature in black ink, appearing to read "Andrew W. Stewart". The signature is fluid and cursive, with a large initial "A" and "S".

Andrew W. Stewart, P.E.
President