D. F. Schmidt's Rear-Dumping Dragline Bucket

Applicant and Principal Investigator:
Dakota Coal Company
1600 East Interstate Avenue, Suite One
Bismarck, ND 58506-5540

Date:
September 30, 1997

Request Amount:
$400,000

TABLE OF CONTENTS

SECTION NUMBER	SECTION TITLE	PAGE
	TABLE OF CONTENTS	i
	ABSTRACT	ii
1.0	PROJECT SUMMARY	1
	1.1 Introduction	1
	1.2 Project Objectives	2
	1.3 Expected Results	2
	1.4 Duration of Project	3
	1.5 Total Project Cost	3
	1.6 Participants	3
2.0	PROJECT DESCRIPTION	4
	2.1 Current Dragline Bucket Technology	4
	2.2 D. F. Schmidt's Rear-dumping Bucket	5
	2.3 Anticipated Results of the Project	6
3.0	BACKGROUND	8
	3.1 D.F. Schmidt's Patented Rear-Dumping Bucket and Related Agreements	8
	3.2 Project Work Completed To Date	9
4.0	VALUE TO NORTH DAKOTA LIGNITE INDUSTRY	13
	4.1 Standard of Success	13
	4.2 Value to North Dakota	15
5.0	PROJECT MANAGEMENT	17
6.0	PROJECT COST	22
7.0	ATTACHMENTS	
	Attachment 1	24-31
	Attachment 2	32
	Attachment 3	33
8.0	EXHIBITS	
	Exhibit 1	34
	Exhibit 2	35
	Exhibit 3	36

ABSTRACT

Dakota Coal Company (Dakota Coal), as principal investigator, is requesting $400,000 of financial assistance from the lignite research program. These funds will be used to assist in development (Stage Two as defined below) of the rear-dumping dragline bucket, as designed by D. F. Schmidt and Dakota Coal. To date Dakota Coal has invested $228,000 to develop the rear-dump bucket. Dakota Coal's future development plan for the rear dumping bucket is as follows:

Stage One:

Successfully retrofit and test a 21 cubic yard class rear-dumping dragline bucket at the BNI Coal's (BNI) Center Mine beginning in late October 1997. This test will run over an extended period in all phases of the dragline's daily operations provided BNI's production standards are met.

Stage Two:

(1) Design, retrofit and test a 60-80 cubic yard class rear-dumping dragline bucket, and (2) design, construct, and operate a prototype 60-80 cubic yard class rear-dumping dragline bucket on a long term basis. The funds being requested in this application from the North Dakota Lignite Research, Development, and Marketing Program relate to this stage of Dakota Coal's development plan and are contingent upon the success of Stage One and the ability to test this bucket class in a North Dakota lignite mining operation.

Stage Three:

(1) Design, retrofit and test a 100 - 120 cubic yard class rear-dumping dragline bucket, and (2) design, construct, and operate a prototype 100 - 120 cubic yard class rear-dumping dragline bucket on a long term basis. Dependent on the successes of Stage One and Stage Two, Dakota

Coal may apply for further financial assistance for this stage in the future. Initial cost estimates for this stage are approximately 1.3 to 1.5 million dollars.

Dakota Coal has successfully retrofitted, modified and tested an 18-cubic yard rear-dumping bucket in a conventional dragline digging scenario at the Falkirk Mine. In November of this year, Dakota Coal will complete the retrofitting and begin the testing of a 21 cubic yard rear-dumping bucket at the BNI Center Mine in a multi-faceted dragline scenario on a full time production machine. Dakota Coal's cost to retrofit and test the 21 cubic yard rear-dumping bucket is estimated to be $150,000.

Dakota Coal, upon successful completion of the 21 cubic yard rear-dumping bucket's testing period, will proceed with Stage Two of the development plan and (1) retrofit a 60-80 cubic yard class bucket to that of a rear-dumping design and (2) construct a 60-80 cubic yard prototype rear-dumping bucket. Dakota Coal's cost to complete testing on these two 60-80 cubic yard rear-dumping buckets is estimated to be $1,000,000.

Anticipated goals of this rear-dumping dragline bucket project are:

(1) a 10-15% increase in dragline dumping radius; thus increasing spoil room,

(2) a cycle time advantage due to the ability to hoist the bucket from the cut earlier; thus improving dragline productivity,

(3) a 5% increase in dragline dumping height; thus increasing spoil room,

(4) a saving in power consumption due to the ability to load the bucket easier, and

(5) for the rear-dumping bucket to dig, hoist, swing, and dump smoothly and efficiently as compared to a front dumping bucket.

Dakota Coal is the fuel supplier to Dakota Gasification Company's Synfuels plant, Basin Electric Power Cooperative's Antelope Valley Station and Leland Olds Station, and United Power Association's Stanton Station. The primary purpose of this project is to improve the economic viability of these plants, as well as the other power plants in the state, by reducing the delivered cost of lignite. This will result from increased dragline productivity and thereby lower the cost of overburden moved. Secondarily, the project may create new jobs and business opportunities for North Dakota resulting from the construction and commercial sale of this new style bucket at a North Dakota facility.

Dakota Coal has kept the lignite mining operations in North Dakota abreast of this project either through actual on-site visits during operations of the rear-dumping dragline bucket at Falkirk, or through presentations, including video tape of the rear-dumping bucket in operation, and/or both of the above. Support for the continued development of this project can be found at each mining operation.

1.0 PROJECT SUMMARY

1.1 Introduction

In November 1995, the Board of Directors of Dakota Coal Company (Dakota Coal) passed a resolution authorizing the execution of a Field Test and Option Agreement and a License Agreement with the partnership of D. F. Schmidt and Modern Industrial, and a Dragline Bucket Field Testing Agreement with the Falkirk Mining Company (Falkirk). Falkirk is a subsidiary of The North American Coal Corporation and owns and operates the Falkirk Mine which is located near Underwood, North Dakota. The purpose of these three agreements was to provide the contractual framework needed to seek the commercialization of the rear-dumping dragline bucket concept as envisioned and patented by D. F. Schmidt.

An 18-cubic yard rear-dumping bucket was successfully retrofitted and tested at the Falkirk Mine. This bucket originated from a Page archless bucket purchased from BNI Coal (BNI), Center, North Dakota, and was tested on Falkirk Mine's Marion 195-M track mounted dragline. This particular dragline's mode of operation was single seam with no side-chopping or bench building required. Also the dragline was being utilized at Falkirk on a as-needed basis.

Dakota Coal has expended $228,000 to design, modify and test this bucket. With the successful conclusion of the 18-cubic yard rear-dumping bucket testing, Dakota Coal is retrofitting a 28-cubic yard conventional front-dumping bucket to that of a 21-cubic yard rear-dumping design to be operated at BNI Coal's Center Mine. Provided production standards are met, this will be a long term test on a primary stripping full-time production machine.

The successful demonstration of this new bucket design will provide the lignite mines in North Dakota with increased dragline productivity without physically altering the size or load capacity of the draglines. This will provide the North Dakota lignite suppliers with the capability to uncover more lignite and the increased productivity will reduce mining costs. Should in-state bucket fabrication become feasible, then commercial sales of this bucket would generate more jobs and tax revenue for the state of North Dakota. By providing Dakota Coal with the funding requested, the demonstration of this technology on multiple class buckets can begin; thereby, providing the North Dakota lignite mining industry with an additional tool to lower mining costs and subsequently keep North Dakota electrical generation competitive. Upon completion of the three stages of the development plan, we also expect to have the significant information necessary for the design and construction of buckets of any size ranges.

1.2 Project Objectives

The objective of this project is to provide the testing necessary to prove the technical and commercial viability of the rear-dumping dragline bucket concept as being superior to the front-dumping buckets currently operating on the draglines in North Dakota.

1.3 Expected Results

We anticipate that the rear-dumping bucket will increase the operating radius of a dragline; increase the dumping height; increase the bucket capacity (as compared to a conventional front dumping bucket) and improve the cycle times. These results will allow the lignite mines in North Dakota to lower the dragline overburden removal costs, thereby making lignite a more competitive fuel for North Dakota's electrical generation and Synfuels industries.

1.4 Duration of Project

Based upon the success of the 21 cubic yard rear-dumping dragline bucket at BNI's Center Mine in late fall and winter of 1997, design and planning will begin for the retrofitting of a 60-80 cubic yard class rear-dumping dragline bucket to be tested in late spring/early summer 1998. This would be followed with the construction of a new 60-80 cubic yard class rear-dumping bucket in fall 1998.

The construction duration will be minimized by incorporating the use of Nedloh, Ltd. of Wilton, North Dakota, and/or Dakota Gasification Company's shop/fabrication facilities, thereby minimizing the use of out-of-state facilities and manpower.

1.5 Total Project Cost

STAGE TWO:

Dakota Coal's total cost to design, retrofit, construct and test two 60-80 cubic yard class rear-dumping dragline buckets is estimated at $1,000,000. This includes estimates from Nedloh, Ltd., for both a retrofit and new construction, consulting services, and field maintenance.

1.6 Participants

All costs associated with this project, except those funds provided by the lignite research program, are being undertaken exclusively by Dakota Coal. Engineering design will be provided by Dakota Coal and Basin Electric Power Cooperative's Engineering Division, with structural consulting services being provided by D. F. Schmidt. Fabrication facilities will be provided by Nedloh, Ltd., Wilton, North Dakota, and/or Dakota Gasification Company, Beulah, North Dakota.

2.0 PROJECT DESCRIPTION

2.1 Current Dragline Bucket Technology

In today's surface mining operations, many companies utilize draglines for overburden removal. The buckets utilized on these machines are of a front-dumping design. Dragline bucket capacities can range from 10 cubic yards to as high as 220 cubic yards. In North Dakota, the lignite mining operations utilize draglines with bucket capacities ranging from 18 cubic yards to approximately 120 cubic yards.

Prior to 1990, most dragline buckets were very massive and were either arch or archless in design. These buckets utilize front mounted teeth for digging and are supported by hoist chains connected to trunnions located toward the rear and on the outside of the bucket sidewalls. Often times a spreader bar was needed to keep the hoist chains properly aligned. In July 1990, the High Production System (HPS) front-dumping bucket was introduced which was lighter in weight and utilized a lower rear wall than most standard dragline buckets. The HPS bucket also incorporated hoist chain trunnion mountings which were located inside the bucket thereby eliminating the spreader bar.

Front-dumping buckets are loaded utilizing a drag rope (or ropes) which pulls the bucket into the overburden and towards the dragline. Once the bucket is filled and hoisted to the dump area the material in the bucket is dumped over the front teeth using a dumping system consisting of a dump cable sheave (or sheaves), dump rigging cables and attachments. The dumping system also stabilizes the bucket during its swing cycle to the dump area. Because of the inherent design, dumping material out of the front of the bucket drops the material in a direction towards

the dragline thereby minimizing the available dump space in which the overburden can be piled. This space where the overburden is to be piled is further limited due to the fixed boom length and boom angle of the dragline.

2.2 D. F. Schmidt's Rear-Dumping Bucket

In 1995, D. F. Schmidt and Modern Industrial of Bismarck, North Dakota, asked Dakota Coal for financial and developmental assistance to design, construct and test a rear-dumping bucket dragline as patented by D. F. Schmidt (U.S. Patent No. 5,400,530) (See Attachment 1).

Through development, the rear-dumping bucket is presently rigged with an outboard mounted bail with hoist trunnions positioned near the front of the bucket and above the loaded bucket center-of-gravity. The bucket has a three-way tapered basket. The sidewalls taper outwardly in an upward direction from the floor and also diverge from the front to the rear of the basket. The rear wall slopes rearwardly and upwardly from the floor. The three-way taper allows overburden material to flow outwardly with less hindrance as it enters the basket and while it is being dumped out and over the rear basket wall.

The rear-dumping bucket also employs a rear tag rope and a rear gate. The rear tag rope (or ropes) is connected at the drag chains' "crows foot" and looped through a dump sheave (or sheaves), suspended above the hoist bail, and connected at the rear of the bucket to a cross-tube stiffener. The rear gate is top-hinged and is mounted off the cross-tube stiffener. During the digging cycle, the tag rope is slack until which time that the hoist line is tightened as the bucket is hoisted. The tag rope not only stabilizes the bucket during the swing cycle, it allows the bucket to tip rearwardly as the drag chain forces are lessened to move or "pay" the bucket

outwardly away from the dragline. As the bucket begins to tip, the tag rope assumes more of the tipping forces thereby allowing the bucket to be rear dumped in a controlled manner.

The rear-dumping bucket is loaded in a manner whereby the drag chains, which are attached to the cheek plates, pull the bucket into the overburden cut. As the bucket is hoisted out of the cut, the bucket will tend to tip rearwardly. The rearward tipping motion is controlled by maintaining tension on the drag chains (as opposed to slacking the drag chains in a front-dumping bucket) in combination with the tag rope which provides a force to resist the rearward pivoting motion and prevents premature dumping. As the dragline swings the loaded bucket from the cut, tension in the drag rope is maintained until the bucket reaches the dumping location at which time the drag rope is slackened and the bucket tilts rearwardly to discharge the material out of the rear of the bucket. The rear dumping motion will flow and stack the dumped material radially away from the dragline.

In this new design, the material flow during the loading of the rear-dumping bucket, is not impaired by hoist chains or trunnions which may, in HPS buckets, be located inside the bucket. In buckets of less than 100 cubic yard capacity, the rear-dump design may eliminate the need for the arch found on some front-dumping buckets. The bail system allows for hoist rope attachment, via an opposite plain link, directly above the rear-dumping bucket thereby eliminating upper hoist chains, spreader bar and other associated rigging.

2.3 Anticipated Results of the Project

The rear dumping action allows the overburden to be discharged away from the dragline thereby increasing the dumping radius of the dragline. The increased dumping radius creates more dump

space for overburden material. This can provide the dragline with the capability to either dig deeper without rehandle or excavate wider pits.

The use of a bail allows for hoist rope(s) attachment directly above the bucket thereby eliminating the need for a spreader bar, upper hoist chains and other associated rigging. This reduces overall bucket weight and allows for a greater maximum dumping height. An increased dumping height also provides the dragline with either greater digging depth or wider pit capabilities because of the additional dump space.

The rear-dumping bucket obtains its weight savings through the reduction of the sidewall thickness and the minimizing of structural reinforcing in areas not critical to bucket strength and wear. This can be done when the hoist trunnion location is placed in the forward part of the bucket. As detailed earlier, weight savings are also achieved by the elimination of various pieces of bucket attachment hardware. Together the total weight reduction over conventional buckets could exceed 10%.

Finally, cycle time reductions can be achieved by hoisting a loaded bucket farther away from the dragline fairleads. The rear-dumping bucket has the ability to be stabilized in a level position under the boom point as opposed to closer to the dragline fairleads as found with a front-dumping bucket. This allows for less pay-in and pay-out time in the loading cycle.

3.0 BACKGROUND

3.1 D. F. Schmidt's Patented Rear-Dumping Bucket and Related Agreements

In early 1995, D. F. Schmidt and Modern Industrial, Bismarck, North Dakota, requested Dakota Coal to provide financial and developmental assistance for the designing, construction and testing of a rear-dumping dragline bucket as patented by D. F. Schmidt (U.S. Patent No. 5,400,530). In November 1995, the Board of Directors of Dakota Coal passed a resolution authorizing the execution of a Field Test and Option Agreement and License Agreement with D. F. Schmidt and a Dragline Bucket Field Testing Agreement with the Falkirk Mining Company, Underwood, North Dakota. The purpose of these three agreements was to provide the contractual framework to provide for the designing, construction and testing of the rear-dumping dragline bucket as envisioned and patented by D. F. Schmidt.

To date, D. F. Schmidt has patents for this bucket in the United States (Patent No. 5,400,530) and the United Kingdom (Patent No. 2284194) (See Attachments 1 & 2). In addition, D. F. Schmidt has patent applications filed in Australia (Patent Application No. 50197193) and in Canada (Patent Application No. 2,141,856) (See Attachment 2). As the various rear-dumping bucket prototypes have been constructed and tested, further patent applications have been and will be applied for under D. F. Schmidt's name (See Attachment 3).

Essentially this patent is an improvement on previous older patents which cover not only rear-dumping buckets, but also tag line systems and bail systems. A listing of previous patents is provided in D. F. Schmidt's original patent listed as Attachment 1. The Field Test and Option Agreement between Dakota Coal and D. F. Schmidt allows Dakota Coal to design, construct and

test the rear-dumping bucket. If the bucket proves successful, Dakota Coal then has the exclusive right to enter into a License Agreement with the partnership of D. F. Schmidt and Modern Industrial.

The License Agreement between the partnership of D. F. Schmidt and Modern Industrial and Dakota Coal grants Dakota Coal the exclusive worldwide right and license to manufacture, modify and market the rear-dumping bucket as patented by D. F. Schmidt. In return, Dakota Coal will pay D. F. Schmidt and Modern Industrial a royalty based on the net selling price of the bucket for a term which will remain in effect to the end of the expiration of all worldwide patents, reissues, extensions or renewals of this rear-dumping bucket.

To accommodate further testing of the rear-dumping bucket, a Dragline Bucket Field Testing Agreement between Dakota Coal and the BNI will be executed. In this agreement, Dakota Coal has the right to test the rear-dumping bucket on the BNI's Page 736 dragline located near Center, North Dakota. In doing so, Dakota Coal will not, in its testing, exceed the operating limits of the Page 736 dragline. BNI, in turn, will keep all testing data confidential and can, should they decide to do so, keep the rear-dumping bucket after the testing is complete.

3.2 Project Work Completed To Date

After acquiring BNI's Page twenty-one (21) cubic yard bucket, design work was started to modify the front-dumping bucket into an eighteen (18) cubic yard rear-dumping bucket. The eighteen yard capacity was needed to match the rated suspended load capabilities of Falkirk's Marion 195-M track mounted dragline.

Modification work began on February 5, 1996, by Nedloh, Ltd., at their shop located in Wilton, North Dakota. After the modification to a rear-dumping bucket was complete, the rear-dumping bucket was moved to the Falkirk Mine on March 1, 1996. The first modified bucket had only 51 inches of floor and 138 inches of rear wall sloped at an angle of 35° (See Exhibit 1). To minimize the cost of the retrofitting, the decision was made not to cut down the height of the bucket sidewalls thus eliminating the expensive replacement of the bucket top rail. By not cutting the top rail most of the modification work was done on the floor and rear wall area.

The testing of the first modified bucket began on March 7, 1996, at the Falkirk Mine. A floor mounted sliding hoist trunnion was tested first which did not provide the bucket with the amount of control that was needed. The sliding trunnion was abandoned and various stationary hoist trunnion locations were tried. Also the tag arm and a rear-wall tag line configurations were tested to provide additional bucket control. By the end of the testing of the first rear-dumping bucket, the following items were established:

1. The rear-dumping bucket concept indeed works and can be optimized.
2. Hoist trunnion locations are best located above the loaded bucket center-of-gravity
3. A tag arm and tag chain system provides much smoother bucket control in the cut and during the swing and dump cycles.
4. A thirteen (13) percent gain in dumping radius was achieved with this rear-dumping bucket.
5. A struck-full capacity is achievable in the digging cycle.
6. During the loading cycle, the bucket achieved struck capacity in one to two times its length, thereby reducing the load cycle time.

Following the test of the first bucket, the decision was made to further modify this bucket. The second version was a scaled down version of the anticipated shape needed for a larger class bucket (See Exhibit 2). The second version also incorporated new innovations derived from the field test of the first version. The new ideas would include: a bail hoisting system, the option to locate the hoist trunnion on the top rail of the bucket, a longer floor and shorter back wall, and an improved tag arm/tag line system.

Nedloh, Ltd. was again used to make the modifications for the second version rear-dumping bucket which was completed on August 15, 1996, and was then moved to the Falkirk Mine. Operator training was started on August 22 and continued through September 20. During operator training, trunnion locations and tag arm/tag line adjustments were made. On September 26, 1996, a production test was started to compare the production capabilities of the second bucket versus the current front-dumping bucket utilized on the Marion 195-M dragline. Upon completion of this test, the following operational parameters were established for this rear-dumping bucket:

1. The dumping radius of the Marion 195-M was increased by fifteen (15%) percent.
2. Due to a leveling flaw in the rear-dumping bucket in the bottom 1/3 of the digging face, its actual hourly dragline productivity was sixty (60%) percent of the conventional front-dumping bucket.
3. Dragline bucket capacity: voided conclusion because of leveling flaw.
4. Cycle times: a longer extended test will be needed to draw any conclusions
5. Power consumption, based on limited data appeared to be essentially the same for both buckets.

During the winter of 1996/1997, Dakota Coal, D.F. Schmidt, and Modern Industrial built a scaled model of Falkirk's Marion 195-M dragline and performed extensive laboratory testing with regard to the rear-dumping dragline bucket's leveling flaw in the bottom 1/3 of the digging face cut. The conclusion of this testing was a rigging system that included tag ropes to the rear of the bucket, as well as a rear gate. These changes were reviewed with representatives of Falkirk and The Coteau Properties Company so as to obtain opinions from North Dakota mining professionals.

The rear-dumping bucket (See Exhibit 3) was modified again based on laboratory conclusions/design. This testing period was to prove that the flaw experienced in the production test had been successfully overcome. During a two week testing window of opportunity at the Falkirk in June of this year, the rear-dumping bucket modification proved that the leveling flaw had been overcome and corrected. This was further enhanced by matching the conventional front dumping bucket's hourly production, even though it was a very limited fifteen (15) hour study.

4.0 VALUE TO NORTH DAKOTA LIGNITE INDUSTRY

4.1 Standard of Success

The entire project will consist of three stages; however, this application only covers Stage Two. Stage One will cover the design, retrofitting and testing of a 21 cubic yard rear-dumping bucket; and Stage Two involves the design, retrofitting, fabrication, and testing of both a modified and a prototype 60-80 cubic yard class rear-dumping dragline bucket.

Stage One will involve the retrofitting of a 28 cubic yard front dump bucket to a 21 cubic yard rear-dump configuration. Once the retrofit is complete the bucket will be tested on BNI's Page 736 dragline. The test will compare the production capabilities of the rear-dump bucket versus the current front-dumping bucket now on the machine over an extended time period. Based on expected results of the this testing period and field observations, the following parameters will be tested and conclusions rendered:

1. The rear-dump bucket is expected to dig, hoist, swing and dump smoothly and efficiently as compared to the front-dump bucket.
2. Dump Radius - The rear-dump bucket is expected to achieve a dump radius increase.
3. Cycle Time - The rear-dump bucket is expected to achieve a reduction in the total cycle time.
4. Dump Height - The rear-dump bucket is expected to achieve an increase in the maximum dump height without jeopardizing the boom or point sheaves.
5. Increased dragline production

The primary objectives in the testing of this bucket are operator acceptance, increase in dump radius and increase in dump height. The BNI machine to be tested on operates in a multi-faceted

digging scenario, which will give excellent operating observations in both side-chopping and bench-building. In addition, because of the time of year this test will take place, frost conditions are expected.

Upon successful completion of the Phase One, Phase Two will proceed with the retrofitting of a existing front dumping bucket to that of a 60-80 cubic yard class rear-dumping dragline bucket. There are two (2) 60-80 cubic yard class draglines operating in North Dakota, one at BNI's Center Mine, a Page 757, and Knife River Coal Mining Company's Beulah Mine, a Bucyrus-Erie 1570. With completion of positive testing of the retrofitted rear-dumping bucket in this class, Dakota Coal would begin construction of a prototype bucket in the 60-80 cubic yard class bucket. The prototype bucket will be constructed from new materials. It will incorporate the modifications and improvements gained from the retrofitted 60-80 cubic yard class bucket. This new bucket will be constructed either at Nedloh, Ltd., Wilton, North Dakota, or at Dakota Gasification Company's (DGC) shop complex. Other than the lip and hardware castings, the bucket can be built by either of the aforementioned facilities. This prototype will incorporate all of the information gained from prior operating experiences. Therefore, this prototype bucket will be tested on a long term basis, approximately six (6) months or longer. Parameters tested over this period are as follows:

1. Confirmation of production gains found in previous tests.
2. Durability of bucket over varying digging, operator and climate conditions.
3. Long-term stress analysis of such areas including the bail, the lip/cheek area, tag arms and basket.

4. Dragline power consumption comparisons.
5. Optimization of bucket teeth, chain, wear facing, dumping hardware and attachment hardware.
6. Provide a long-term working environment to monitor maintenance requirements, to optimize digging techniques and to provide a proving ground for local mining operations to visit and study.

Once this prototype demonstrates that a commercially produced rear-dumping bucket can achieve the desired production goals over a long-term basis, Dakota Coal would initiate plans to implement Stage Three, which is development of a 100-cubic yard plus class rear-dumping dragline bucket.

4.2 Value to North Dakota

The value to North Dakota lignite producers and consumers can be summarized as follows:

1. The bucket can provide added productivity to existing draglines, thereby lowering production costs.
2. Pay back of replacement buckets may be less than one (1) year.
3. The bucket can make local lignite mining operation and lignite consumers more competitive.
4. If the commercial production of buckets in-state is feasible, then more local jobs and revenue can be added to North Dakota's economy.

With annual production of lignite mines in North Dakota ranging from 3.9 million to 15.4 million tons, the pay back for capital invested into a rear-dumping bucket may be achieved in less than one year.

Lower production costs in local lignite mines, means lower fuel and feedstock costs for in-state electrical generation plants and the Synfuels Plant. With upcoming utility deregulation and currently low natural gas prices, lignite prices must stay competitive or lignite may lose some of its market. The rear-dumping bucket can provide meaningful production savings coupled with fast capital pay back. By keeping local lignite producers competitive, local jobs can be maintained and valuable local and state revenues preserved.

Commercial in-state production of the rear-dumping bucket will provide valuable high-paying manufacturing jobs. The bucket manufacturing would provide more revenue to local vendors through their consumable supplies. If successful, sales of this bucket could eventually reach national and international proportions.

5.0 PROJECT MANAGEMENT

Project management will be accomplished utilizing an integrated team assembled from individuals of several North Dakota companies along with D. F Schmidt. Personnel from Dakota Coal Company, Nedloh, Ltd.(Wilton, North Dakota), Basin Electric Power Cooperative, Dakota Gasification Company, and Modern Industrial (Bismarck, North Dakota), will be the team. The team will be small and dynamic. Due to the staged approach to the project, not all team members will contribute throughout all stages. Together the team possesses an intimate knowledge of all aspects of dragline bucket design, construction and operation. In addition personnel from, Falkirk Mining Company, The Coteau Properties Company, and BNI Coal have been presented material at different periods of the development for their expertise and input.

Dean Bray, representing Dakota Coal, will be the project supervisor. He will coordinate all aspects of the project from bucket design, construction, and testing. D. F. Schmidt, the design patentee, will provide technical support throughout all stages of the project and will also be responsible for all new patents, updates and revisions. Dennis Holden of Nedloh, Ltd. will assist in the retro-fitting and/or construction of the buckets. These three individuals will provide the key supervision for the project.

Prior to and during construction, the structural engineering expertise needed for the design of these buckets will be provided by Dewayne Marthaller, a structural engineer in Basin Electric Power Cooperative's Engineering Division. Basin Electric and its subsidiaries possess a full range of design and engineering resources which can be utilized should it be required to do so.

Once the buckets have been designed and constructed, personnel representing mine engineering, dragline operations and dragline maintenance will be contacted at BNI, as appropriate. BNI has indicated support toward the needed manpower, machine time and materials to properly test the modified and prototype buckets. Bucket testing will be a coordinated effort between the mine staff and the project supervisors. At the end of the testing period, the test data will be shared with all participants involved at the respective mines.

Dean Bray - Mine Planning Engineer, Dakota Coal Company

Mr. Bray is currently the Mine Planning Engineer for Dakota Coal. He has extensive mining experience ranging from detailed mine planning to operations management as a front-line dragline supervisor.

Mr. Bray joined the Basin Electric family as a mining engineer at the Glenharold Mine located at Stanton, North Dakota, in May of 1989. During his time at the Glenharold Mine, he was involved in establishing and implementing the pit layout and dragline stripping plan.

Prior to working for the Basin Electric family, Mr. Bray had ten (10) years of varying mining experience with Consolidation Coal Company. He worked at three (3) different strip (surface) mines as well as one (1) underground coal mining operation. Related work experience includes surveying, time studies, short and long term mine planning as well as dragline and coal production supervision. His dragline exposure at the three (3) surface mines included a nine (9) cubic yard Marion 7400, a thirty-four (34) yard BE 1250, a sixty-two (62) yard Page 762, and a one hundred twenty (120) cubic yard BE 2570.

Mr. Bray has a degree in Mining Engineering from Montana College of Mineral Science and Technology in Butte, Montana.

D. F. Schmidt

Mr. Schmidt began his career with Marion Power Shovel Company in 1946. In his twenty (20) years with Marion, Mr. Schmidt was an electrical erector for the first eight (8) years and chief erector for the remaining twelve (12) years. He was charged with erecting excavator stripping shovels and draglines in the United States, Europe and Africa.

Mr. Schmidt worked for Peabody Coal Company as their chief electrician for three (3) mines in southern Indiana. His responsibilities included all electrical work on the draglines, shovels, overburden drills, tipple, preparation plant, locomotives, shop facilities and high voltage power lines. In 1969, Peabody transferred Mr. Schmidt to their Black Mesa Mine in Arizona and put him in charge of erecting their draglines, shovels and overburden drills.

Arch Minerals Mining Company then hired Mr. Schmidt to manage the erection of the draglines, shovels and overburden drills for their three (3) new mines in Wyoming. After the erection phase, he was the master mechanic for all three mines.

In 1976, Mr. Schmidt came to North Dakota with North American Coal and was in charge of erecting the draglines and shovels for the Falkirk Mine. Again, after the erection phase, he was assigned as maintenance manager and division master mechanic over the Falkirk Mine, the Coteau Mine and the Indian Head Mine.

Mr. Schmidt was responsible for the design and building of the HPS dragline bucket and rigging system; the first major dragline bucket design change in many years. Mr. Schmidt has extensive experience in creating new products, equipment designs and procedures to improve and enhance the maintenance departments at the operations where he was employed.

Since Mr. Schmidt's retirement from North American, he has been granted two (2) patents pertaining to the rear-dumping dragline bucket and he has submitted four (4) additional patents. The additional patents are at various stages of the patenting process.

DuWayne A. Marthaller - Senior Civil Engineer

Mr. Marthaller has been employed with Basin Electric Power Cooperative for sixteen (16) years and his present title is that of Senior Civil Engineer. His engineering experience includes power and process plant design, transmission line design, substation design and has worked as a project coordinator. His main responsibilities include design and project coordination for power plant and high voltage transmission systems and structure design analysis.

Mr. Marthaller's pertinent emphasis for this project include structural analysis, steel design, failure analysis and structural vibration analysis.

Mr. Marthaller received a Master of Science in Civil Engineering from Colorado State University and his Bachelor of Science in Civil Engineering from North Dakota State University. He is a registered professional engineer in the state of North Dakota.

Dennis Holden - General Manager of Nedloh, Ltd.

Mr. Holden has managed his own business, located at Wilton, North Dakota, for the past twelve (12) years. Nedloh, Ltd. has extensive experience in dragline maintenance, welding, field welding, fabrication (,includes new dragline bucket construction), build up, heavy equipment repair, and stress relieving. His company has done related work across the United State for a multitude of different companies.

Mr. Holden's work experience prior to this was with such companies as:

T.I.C. - Steamboat Springs, Colorado
C.D.K. - Farmington, New Mexico
Decker Coal Company - Decker, Montana
G.E. Hankins - Colstrip, Montana
F&F Welding & Repair - Waukomis, Oklahoma
F&E Erection - San Antonio, Texas
H&K Machine - Washburn, North Dakota
William Clairmont Construction - Bismarck, North Dakota
Butler Machinery - Bismarck, North Dakota

His work experience with these companies include: heavy equipment repair, field welding, machining fabrication, dragline erections and extensive types of dragline maintenance.

Mr. Holden was educated at Bismarck Junior College Area Technical & Vocational Center in welding and at Denver Automotive & Diesel College, Inc. as an automotive technician.

6.0 PROJECT COST

Project Costs Incurred To-Date By Dakota Coal

- 1st Modification (Exhibit 1)		
Bucket Purchase	$	7,000
Retrofitting (Nedloh)	$	64,200
Consulting	$	4,500
Mine Maintenance	$	5,400
Other	$	3,900
	$	85,000
- 2nd Modification (Exhibit 2)		
Bucket Modification (Nedloh)	$	53,300
Consulting	$	8,000
Mine Maintenance	$	24,600
Other	$	5,100
	$	91,000
- 3rd Modification (Exhibit 3)		
Bucket Modification (Nedloh)	$	42,300
Consulting	$	3,600
Mine Maintenance	$	3,100
Other	$	3,000
	$	52,000
Subtotal (Cost Incurred To-Date)	$	228,000

Future Project Costs Are Outlined As Follows:

STAGE ONE

Retrofit a 28-cubic yard front-dumping dragline bucket to that of a 21-cubic yard rear-dumping design.

Bucket Modification (Nedloh)	$	95,000
Consulting	$	15,000
Mine Maintenance	$	30,000
Other	$	10,000
	$	150,000
Subtotal of Dakota Coal's Costs Incurred Through Stage One	$	378,000

STAGE TWO

- Retrofitting of a sixty - eighty (60-80) cubic yard conventional front-dumping dragline bucket to that of a rear-dumping design configuration (based on Nedloh, Ltd. detailed estimate):

Bucket Purchase	$	20,000
Bucket Modification Nedloh (Materials)	$	137,000
Bucket Modification Nedloh (Supplies)	$	10,000
Bucket Modification Nedloh (Labor)	$	115,000
Bucket Modification Nedloh (Other)	$	68,000
Dragline Maintenance For Testing Period	$	50,000
Consulting services	$	50,000
	$	450,000

- Construction of a prototype sixty - eighty (60-80) cubic yard class rear-dumping dragline bucket (based on Nedloh, Ltd. detailed estimate):

Bucket Modification Nedloh (Materials)	$	231,000
Bucket Modification Nedloh (Supplies)	$	9,000
Bucket Modification Nedloh (Labor)	$	109,000
Bucket Modification Nedloh (Other)	$	101,000
Dragline Maintenance For Testing Period	$	50,000
Consulting Services	$	50,000
	$	550,000

Total For Stage Two	$	1,000,000

Dakota Coal's total actual and projected costs for the rear-dumping dragline project will be $1,378,000 through the completion of Stage Two. The $400,000 of financial assistance being requested represents 29% of that total.